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### Discogenic low back pain

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## OUTCOME OF INTERBODY FUSION IN SELECTED PATIENTS WITH DEGENERATIVE CHRONIC LOW BACK PAIN

### 5.1 INTRODUCTION

When dealing with patients with chronic low back pain, nonoperative methods are to be considered firstly. Treatments recommended include exercise, traction, acupuncture, transcutaneous electrical nerve stimulation, bracing, biofeedback, drug therapy, facet denervation, manipulation, and group education in back schools.<sup>1,3,5,6,8,9,10,23,25,29,30,31,38,42</sup> However, a part of patients experiencing chronic low back pain is not helped by any of these means. Lumbar spinal fusion can, in some of the patients who are severely disabled by the chronic low back pain and in whom no other treatment has been effective, result in (at least some) pain relief.<sup>39,41,43,46,54,55</sup> There is hardly any debate on the indication of spinal arthrodesis in low back pain resulting from serious congenital or acquired deformities, such as progressive spondylolisthesis, unstable fractures, inflammatory processes or neoplastic destruction.<sup>4,11,13,14,21,22,32,50</sup> However, much controversy exists whether to use spinal fusion in an attempt to control chronic low back pain in so-called benign segmental degeneration.<sup>20,26,35,37,49,51,61</sup> Dependent on clinical, radiographic or biomechanical criteria, in the literature this condition has been referred to by various circumscriptions such as “chronic low back pain”, “chronic lumbosacral sprain/strain”, “chronic degenerative disc disease”, “discogenic low back pain”, and “segmental instability”.<sup>61</sup> Unfortunately, the correlation between radiographic, biomechanical, and clinical findings is not clear and specific symptoms of motion segment instability have yet to be defined. Uncertainty about the diagnosis of this condition in combination with disappointing outcomes of various non-specific treatments has frustrated patients as well as physicians. As a result of this, with respect to the indication to perform spinal fusion in these patients, controversy persists.

Although the concept that degeneration of the spinal motion segment may give rise to pain is commonly accepted, it is not clear to which of the constituent elements (facet joints, ligaments, muscle, discs or bone) the pain is to be attributed. Any structure in the lumbar spine that contains sensory nerve supply may become a source of nonremittant pain when affected by pain producing tissue damage. Local innervation has been demonstrated in most tissues of the motion segment and more recent reports indicate an innervation of the degenerated lumbar disc (Ch 3). These findings support the concept of discogenic pain in which pathologic conditions of the disc, such as internal annular disruption and disc resorption, can cause low back pain.

In the group of chronic low back pain patients we have tried to select a group of patients in which the degenerated disc seemed to play a central role in pain production and in which arthrodesis of the painful lumbar segment might result in pain relief. The patients were prospectively selected using strict in- and exclusion criteria, the painful disc

was localised by discography and arthrodesis was either by anterior- or posterior lumbar interbody fusion.

## **5.2 MATERIALS AND METHODS**

Between 1980 and 1990 in the Leiden University Medical Center, 157 patients with severely disabling chronic low back pain were selected for lumbar interbody fusion. Patient selection involved the inclusion criteria: 1) the pain is localised in the lower back either or not radiating into one or both legs following a non-radicular pathway. The limb pain must be essentially different from the limb pain in patients with disc ex/protrusion; the pain has developed gradually, is not contained to a well defined radicular area, and may be present in both limbs; 2) complaints last more than 1 year; 3) congenital or acquired anomalies of the lumbar spine have been excluded; 4) no benefit from various non-surgical types of treatment; 5) no obvious psychosocial distress; 6) pain related disability to economic and/or social activities; 7) no neurological deficits related to the actual condition; 8) clinical and radiological absence of nerve root compression; 9) marked reduction or total disappearance of symptoms while wearing a lumbar brace; 10) discographically proven disc degeneration (table 5.1) and temporary pain provocation at discography.

### ***History taking***

The intake interview included information on patient's demographic characteristics, family history of pain, current family relationships, work and career adjustments, nature and onset of pain, reactions to pain, reactions to treatment, history of other medical problems, history of psychiatric status, reported pain and limitations, coping methods in relation to low back pain and self-assessment of treatment effects so far. These factors were evaluated in multiple personal communications.

### ***Physical examination***

On physical examination, all the patients had some degree of low back dysfunction. During flexion of the lumbar spine the movements were nonfluent and there was a limited mobility. The typical fixation of the involved lumbar segments as often seen in the presence of radicular involvement was absent. A neurological examination was performed.

### ***Radiological investigation***

Plain radiographs invariably showed degenerative changes of the lower lumbar spine. Patients with congenital or acquired anomalies of the lumbar spine were excluded. Caudography was performed in all cases to ascertain absence of nerve root compression.

### ***Discography***

If an interbody fusion operation remained optional after the foregoing selection methods, investigation was continued by discography at L3-L4, L4-L5, and the L5-S1 levels consecutively. The pain experienced at the injection of the radio-opaque dye (Iopamiro®) into the nucleus pulposus was recorded as to nature and intensity. Under fluoroscopic guidance, 0.5-1.5 cc of the dye was injected transdurally into the discs. The discographic patterns were classified in 4 stages of disc degeneration (see table 5.1). Pain reproduction was recorded as absent, atypical, or typical (when injection reproduced and intensified the

patient's usual back symptoms). Only evidently degenerated discs, i.e. stage II and III, in combination with a positive typical pain provocation remained candidates for an interbody fusion operation. Patients with an intervertebral disc that appeared to be degenerated but did not cause pain during discography were excluded. This test excluded 20 patients who had notably degenerated discs but without pain reproduction at any of the injected discs.

**Table 5.1** Discographic patterns according to Courzal.

Discographic Degeneration stage	
0	normal disc; roundish or bilobulated of the nucleus; unfissured anulus.
I	well outlined nucleus fissures in the inner anulus fibrosus.
II	degenerated disc with fissures leading to the outer edge of the anulus.
III	complete radial fissure with leakage of contrast into the epidural space.

### ***External immobilisation***

After discography the patients were asked to wear a plaster spica (Baycast®) from the trunk to one knee for 4 weeks. In this period the pain had to resolve slowly, and the pain had to return shortly after removing the cast. The (almost) complete disappearance of complaints during immobilisation in the spica was a consecutive selection criterion. Oral anticoagulants were prescribed during this period.

### ***Surgical technique***

The choice between anterior or posterior interbody fusion was made at random and depended mainly on the attending surgeon's preference at the time of the operation. Tricortical grafts (auto- or allografts) derived from the iliac crest were used for the interbody fusions. Homologous bone grafts were used sporadically.

The administration of low dosage of heparin was started one day before the operation. Antibiotic prophylactics (cloxacillin or erytromycin) were given intravenously at induction of anaesthesia and for one day postoperatively.

### ***Postoperative treatment***

During the first postoperative week, the regime consisted of immobilisation on a "Stryker frame". Patients were then mobilised in a thoraco-lumbar plaster spica (Baycast®) including one upper leg for 3 months. A detachable plastic spica enclosing only the trunk was prescribed during the fourth month. Anticoagulants were continued for three months.

### ***Evaluation of fusion status***

The fusion results were evaluated after at least 1 year by an independent radiologist. Criteria for evaluating the fusion status were the following:

- A. Definite fusion: Definitive bony trabecular bridging across the graft/host interface, no detectable motion on flexion-extension radiographs, and no gap at the interface.
- B. Probable fusion: No definitive bony trabecular crossing, but no detectable motion and no identifiable gap at the interface.
- C. Possible pseudarthrosis: No bony trabecular crossing, no motion, but an identifiable gap at the interface.

D. Definite pseudarthrosis: No traversing trabecular bone, definitive gap at the interface, and motion on flexion-extension radiographs.  
 A and B were considered as successful fusions, while C and D were considered as failed fusions.

**Clinical outcome**

All 157 patients were postoperatively evaluated after 1 and 3 years. The clinical outcome was scored using the Macnab classification<sup>27</sup>: excellent, good, fair, and poor (table 5.2). These grades of success could be condensed in two outcomes: satisfactory and unsatisfactory. Assessment of the results with respect to the back pain was fully based upon the patient’s own description.

**Table 5.2** Explanation of Macnab classification.

Classification	Explanation
Excellent recovery	(almost) complete relief of back/leg pain.
Good recovery	occasional pain in back/leg but obvious improvement; would have surgery again
Fair recovery	little or no change in back/leg pain; would not have surgery again
Poor recovery	pain worse than before surgery

**Statistical analysis**

Statistical analysis was performed using Confidence Interval Analysis (Gardner & BMJ 1989).

**5.3 RESULTS**

**5.3.1 Demographic data and procedures**

All 157 patients (77 men, mean age 42, range 24-61; 80 women, mean age 38, range 22-58; figure 5.1) with long-term severely disabling low back pain preoperatively (mean 7.4 years, range 1- >10 years; table 5.3) were postoperatively evaluated after 1- and 3 years. In about one-half of the patients, pseudoradicular pain co-existed. Hundred-and-one patients (64%) already underwent prior low back surgery (156 operations).

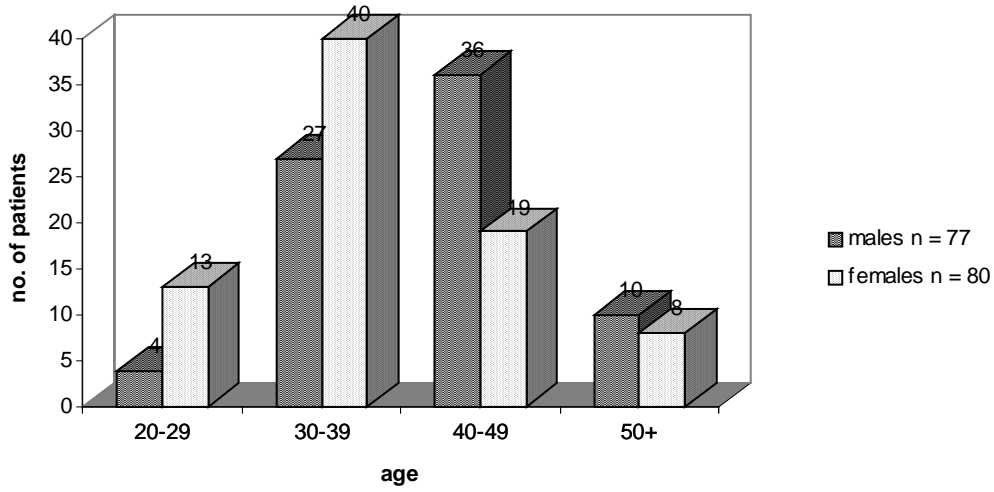
Of the 157 interbody fusion operations performed, 85 were by a PLIF-procedure and 72 by an ALIF-procedure (figure 5.2). Fifty-one patients had a one-level fusion, most commonly affecting the lumbosacral level L5-S1 (n=32), followed by L4-L5 (n=18) and L3-L4 (n=1). Hundred-and-two patients had two levels of involvement most commonly L4-L5 and L5-S1 (n=94), followed by L3-L4 and L4-L5 (n=6) and by L3-L4 and L5-S1 (n=2). A three level fusion was performed in 4 patients. Tricortical grafts derived from the iliac crest were used to interbody fusion. It is obvious that the harvesting site - anterior or posterior part of the iliac crest - depended on the choice for PLIF or ALIF. Autografts were used in the majority of patients (94% of the total of 267 fusion levels were autogenous). Eight patients received allografts and 9 patients, who underwent a multilevel fusion, received a combination of both auto- and allografts.

**Table 5.3.** Duration of symptoms preoperative.

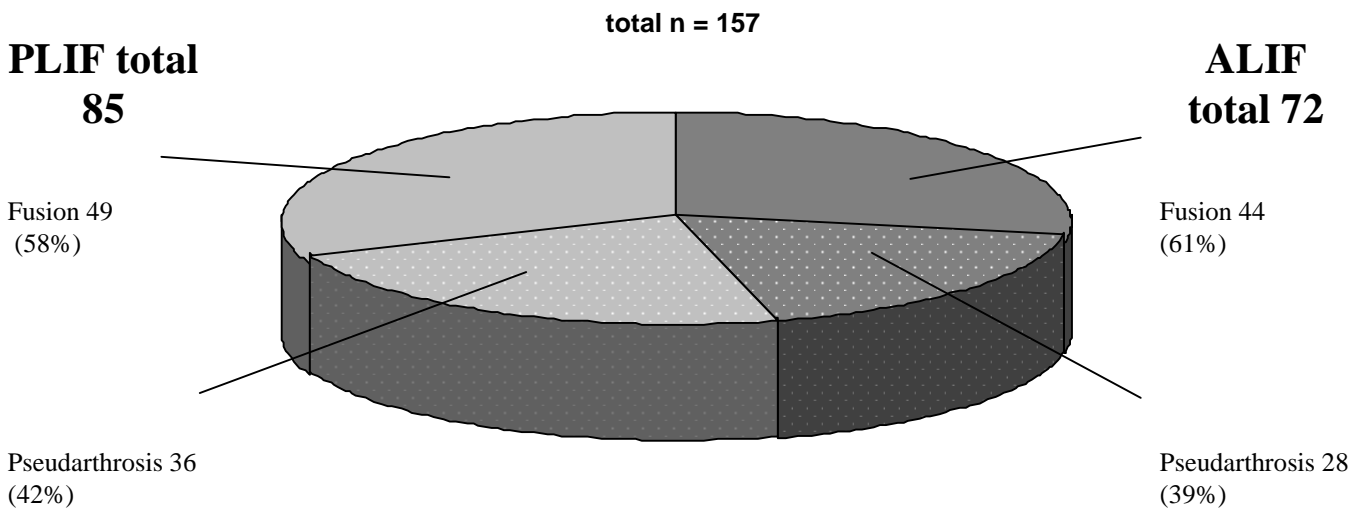
	years	number of patients (n=157)
duration	1-5	64

5-10	49
> 10	44

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**Figure 5.1** Patient sex and age distributions.



**Figure 5.2** Fusion results and type of approach.

## **5.3.2 Outcome**

### **5.3.2.1 Outcome: clinical**

An overall patient satisfaction was achieved in 67% of the total number of patients after 1 year. This percentage remained unchanged at 3 years follow-up. Clinical outcome was not related to sex, age or type of surgical approach. Better clinical results are seen in the one level operated than in the multi-level operated group (76% vs. 63%), but the difference was not significant. Patient satisfaction was strongly correlated with fusion status (95%CI (0.17-0.46)), indicating that patient satisfaction was higher in the group that showed bony union on radiographs at all operated levels. In the one-level group an overall satisfaction of 76% was reported, but of the patients in this group who showed bony union, 89% was satisfied. In the two level fusion group, the overall patient satisfaction was 63% compared to 74% of the patients who had bony union at both levels (figure 5.3).

### **5.3.2.2 Outcome: fusion**

Ninety-one (60%) of the patients were judged to have “solid bony union” (fusion status A and B) of all operated levels. Fusion failed to occur in 66 patients (40%) (fusion status C and D). Fusion results were best in the one-level operation group (71%) (figure 5.3). No significant difference was noted between different age groups, gender and the type of surgical approach. Of the 267 interspaces grafted in 157 patients, 190 levels (71%) obtained bony fusion and 77 levels (29%) did not. The lumbosacral interspace was grafted 132 times and 100 (76%) were judged solid. Bony union was achieved in 66% of the 122 operated L4-L5 interspaces; at L3-L4, 77% of the 13 operated levels achieved bony union. There was no difference in fusion results between the autogenous and homologous graft groups.

## **5.3.3 Complications**

The complications are shown in table 5.4. We subdivided this in three categories: pre-, intra-, and postoperative sequels.

### *Preoperative*

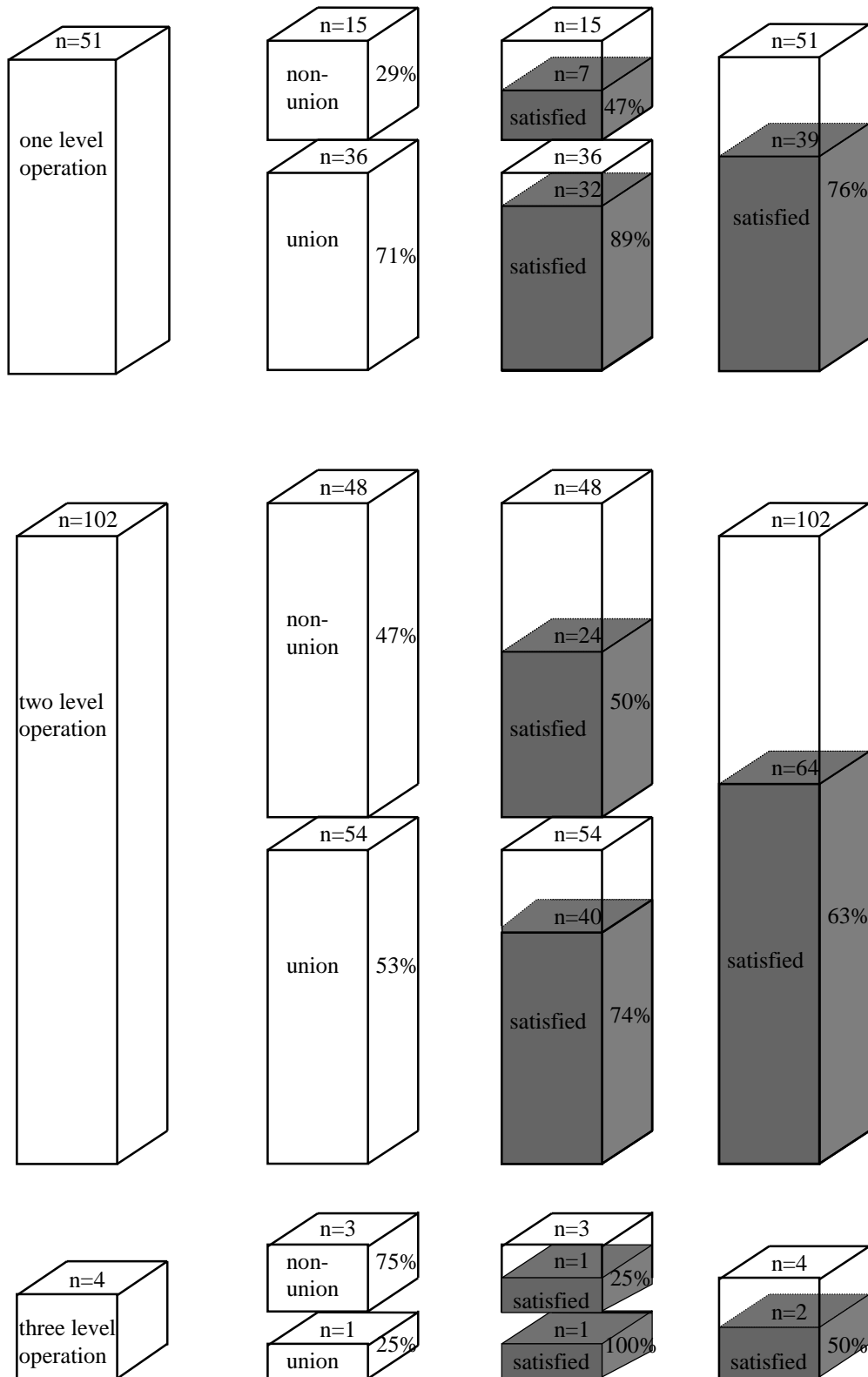
Discography resulted in discitis in two patients. After identification of the responsible microorganism, the patients were treated with bed rest (2-3 weeks) and antibiotics (6 weeks).

### *Intra-operative*

One patient suffered a transient extensor paresis of one foot. Ulnaropathy as a result of nerve compression at the sulcus ulnaris was found in two patients after an ALIF procedure. In both patients the symptoms disappeared spontaneously within 6 months postoperatively.

Donorsite-related peripheral nerve injury occurred in 4 patients. The lateral femoral cutaneous nerve was involved 3 times and a combination of the ilioinguinal nerve with the genitofemoral nerve once. These donorsite nerve injuries recovered spontaneously within days to weeks (range 3 days-6 weeks) except for the latter. A 36-years old diabetic

patient had persisting complaints of injury of his left ilioinguinal- and genitofemoral nerves.





**Figure 5.3.** Relation between levels of fusion, fusion status and patient satisfaction with a follow-up of 3 years.

*Postoperative*

There were 9 wound-related complications. Four superficial wound hematomas (2 in the abdominal wall and 2 in the iliac crest area) resorbed spontaneously. One patient developed an abdominal cicatricial hernia, necessitating repair. Four bacterial wound infections were treated by drainage (2 superficial abdominal wounds) or by drainage and antibiotic medication (2 donor site wounds).

In addition, transient urinary retention was relatively common during the first two days postoperatively. Intermittent catheterisation was started when spontaneous miction failed to occur. After two days of catheterisation, 3 patients needed a temporal urine catheter for one week. One patient developed a pyelonephritis that could successfully be treated with antibiotic medication. There was no thrombosis or thrombo-embolism in this series.

Graft donorsite pain was a common complaint, particularly in the early postoperative phase (table 5.5). In nearly one quarter of the patients this pain persisted for 3 months. At one year after surgery less than 10% of the patients identified donorsite pain. This percentage decreased after 3 years to 1%.

**Table 5.4. Complications of spinal fusion.**

Complication	number of cases	%
preoperative		
discitis (discography)	2	1,2%
peroperative		
transient paresis (foot extensors)	1	0,6%
transient ulnaropathy	2	1,2%
nerve injury secondary to donorsite	4	2,5%
postoperative		
wound hematoma	4	2,5%
incisional hernias	1	0,6%
wound infection	4	2,5%
urine retention	12	7,7%
requiring urine catheter	3	1,9%
pyelonephritis	1	0,6%
ileus requiring NG tube	5	3,3%

**Table 5.5. Donorsite pain.**

duration of iliac crest pain	anterior iliac crest (n=65)	posterior iliac crest (n=48)	total (n=149)
< 3 months	16 (24%)	18 (21%)	34 (23%)
1 year	7 (11%)	5 (6%)	12 (8%)
3 years	1 (1,5%)	1 (1%)	2 (1,3%)

## 5.4 DISCUSSION AND CONCLUSIONS

Discussing the results of this study presents a challenge to scientific warranted assessment because the included patients had no definite diagnosis. All the patients suffered from chronic low back pain in combination with degenerative changes in the lower spine and had exhausted all modalities of non-operative treatment. A term frequently used for these degenerative conditions of the lower spine causing low back pain is “segmental instability”.<sup>16,19</sup> However, a clear definition of, and specific criteria to diagnose segmental instability are lacking.<sup>15,36,56</sup> Therefore, the symptom chronic low back pain itself is often used as the major “diagnostic” criterion for further treatment.<sup>19,52,53,57,58</sup> In order to better delineate this group of patients we have added some specific selection criteria.

### Discography

Out of the patients with chronic low back pain, we sought those patients with an important “discogenic” component by discography. We do not think that MRI can replace discography in this patient selection. In a mainly MRI-based categorisation by Zdeblick<sup>61</sup>, patients with segmental degeneration are grouped into those with spondylosis, discogenic pain, or facet syndrome. In spondylosis MRI shows disc space narrowing, loss of water content of the disc and marrow changes of the adjoining end-plates.<sup>33</sup> Patients with signs of discogenic low back pain have relatively normal radiographs but MRI may show decreased signal intensity within the disc (often called “black disc”).<sup>45</sup> Finally, patients with facet syndrome show signs of joint degeneration on MRI. Unfortunately, this MRI-based categorisation is not useful in selecting “discogenic” pain because spondylosis, painful disc degeneration and facet syndrome are not complete different entities. In fact spondylosis and facet syndrome are sequelae of disc degeneration<sup>2</sup> and consequently there is overlap as seen on MRI.

In conclusion, the morphometric status of a motion segment, including the disc, can be visualised by MRI while information obtained during discography is restricted to the disc.<sup>17</sup> However, discography can, in addition to the morphometric disc status, provide information on the painfulness of the disc. When degenerated changes are accompanied by a pain response on injection of saline or contrast material a discogenic cause of the low back pain becomes more likely. We therefore think that in future studies the levels for discography can be determined by corresponding levels of abnormal MRI findings.

Discographically observed degeneration of a disc does not necessarily mean that this disc is a source of low back pain since grossly degenerated discs can be asymptomatic.<sup>60</sup> Seventeen percent of the operated patients in this study had at least one severely degenerated disc that did not cause pain on discography. These levels could be ignored and only the degenerative levels with positive pain reproduction were fused in these patients. It is still unclear to what extent positive pain reproduction corresponds with successful surgical outcomes. Calhoun et al.<sup>7</sup> showed an 88% surgical success rate in patients with positive pain reproduction at discography, but even regardless the discographic outcome, surgery was still successful in 82%. Despite this and other

ongoing criticism of discography (Holt<sup>24</sup>, Scheiderman<sup>47</sup>, Shapiro<sup>48</sup>, Nachemson<sup>34</sup>), many surgeons gratefully use discography in deciding whether or not, and what levels to fuse.

### **External spinal immobilisation**

Preoperative spinal immobilisation by casts<sup>44</sup> or by external spinal skeletal fixation (ESSF)<sup>12,28,40,59</sup> is used to create a “temporary fusion”. This temporary fusion can be of help in selecting patients with permanent internal fusion. ESSF is believed to be superior to casting because of its more rigid immobilisation and its accuracy in selecting the lumbar spinal motion segments. However, ESSF is an invasive procedure in which, under general anaesthesia, an external frame is placed on percutaneously placed screws. The predictive values of ESSF and casting on the clinical outcome of spinal fusion are similar<sup>12,44</sup> that implies a preference for temporary immobilisation by casting.

In this study we have obtained an overall fusion rate of 60% which is rather disappointing. Fusion results were highest in the group of patients who underwent a one-level fusion operation. Clinical outcome results were best in patients after a single level fusion who in addition showed bony union. The satisfaction percentage in these patients came close to 90%. The presence of a clear correlation between clinical satisfaction and bony union should incite us to strive for a solid bony union. Several studies<sup>11,18,20,21,35,49</sup> report an improvement of the fusion rate using additional pedicle fixation (pedicle screws and fixation rods). The fusion rates claimed in these studies vary between 85% and 100%. After internal fixation it is also possible to mobilise patients in the early days postoperatively and without the use of a lumbar spica. We therefore now advocate the combination of interbody fusion with spinal instrumentation.

In conclusion, it is our opinion that in patient selection for spinal fusion, it is important to gain an insight into the amount of pain and the concomitant disability. Likewise, the patient’s and surgeon’s expectations on the effect of a lumbar fusion must be discussed. The patient might expect to be pain-free and return to a high functional level, while the surgeon simply hopes to alleviate some of the pain and improve the patient’s function modestly. Therefore, in deciding whether a patient with chronic low back pain might benefit from lumbar spinal fusion, patient characteristics as well as medical factors must be evaluated carefully. The results of this study, not with standing scientific shortcoming, show that handling strict criteria to selected patients, lumbar spinal fusion is successful in the majority of cases. Especially when one-level pathology becomes one of the inclusion criteria, lumbar spinal fusion has the better results.

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