The outcome of decompression surgery for lumbar herniated disc is influenced by the level of concomitant preoperative low back pain

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Abstract Decompression surgery is a common and generally successful treatment for lumbar disc herniation (LDH). However, clinical practice raises some concern that the presence of concomitant low back pain (LBP) may have a negative influence on the overall outcome of treatment. This prospective study sought to examine on how the relative severity of LBP influences the outcome of decompression surgery for LDH. The SSE Spine Tango System was used to acquire the data from 308 patients. Inclusion criteria were LDH, first-time surgery, maximum 1 affected level, and decompression as the only procedure. Before and 12 months after surgery, patients completed the multidimensional Core Outcome Measures Index (COMI; includes 0–10 leg/buttock pain (LP) and LBP scales); at 12 months, global outcome was rated on a Likert scale and dichotomised into “good” and “poor” groups. In the “good” outcome group, mean baseline LP was 2.8 (SD 3.1) points higher than LBP; in the “poor” group, the corresponding value was 1.1 (SD 2.9) ($p < 0.001$ between groups). Significantly fewer patients with back pain as their “main problem” had a good outcome (69% good) when compared with those who reported leg/buttock pain (84% good) as the main problem ($p = 0.04$). In multivariate regression analyses (controlling for age, gender, co-morbidity), baseline LBP intensity was a significant predictor of the 12-month COMI score, and of the global outcome (each $p < 0.05$) (higher LBP, worse outcome). In conclusion, patients with more back pain showed significantly worse outcomes after decompression surgery for LDH.

This finding fits with general clinical experience, but has rarely been quantified in the many predictor studies conducted to date. Consideration of the severity of concomitant LBP in LDH may assist in establishing realistic patient expectations before the surgery.

Keywords Herniated disc · Outcome · Back pain · Predictors

Introduction

Lumbar disc herniation (LDH) is one of the most common pathologies in lumbar spinal surgery. The typical presentation is a patient with predominant radicular leg pain on one side, with or without additional neurological disturbances; the amount of concomitant low back pain can vary greatly. The treatment is initially conservative [23], but if this fails, then decompression surgery of the affected nerve root is usually performed, and is associated with a generally favourable outcome [1, 12, 27].

LDH may be regarded as an early expression of degenerative disc disease, a process that may or may not continue over time [3, 26]. A substantial amount of concomitant low back pain prior to surgery can make decision making difficult, since surgery is primarily performed to alleviate the radicular leg pain and is not intended to address the back pain problem of the patient. In addition, if these symptoms are not remedied by the surgery, it might be hypothesised that they would have a negative impact on the overall outcome of the discectomy.

Predictors of outcome for decompression surgery in lumbar disc herniation have been studied extensively [5, 8, 9, 11, 19, 21]. However, the amount of concomitant preoperative low back pain has rarely been examined as a risk

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factor. Some studies have ascertained that the presence of LBP [20] and a long history of LBP [6] preoperatively are associated with a poorer outcome and/or lower quality of life, but none have actually quantified the relative levels of LBP and LP prior to surgery. To advise our patients and set reasonable expectations in such circumstances, we need to better understand the relationship between preoperative low back pain and the outcome of surgical treatment.

In a recent study, Kleinstuck et al. examined whether the level of preoperative low back pain was a predictor of outcome in patients with lumbar spinal stenosis undergoing surgical decompression [10]. They found that the greater the amount of preoperative low back pain relative to leg pain, the worse the outcome of decompression surgery. It could not be ascertained whether the influence of preoperative LBP indicated that these patients should in fact have undergone more extensive treatment, i.e. fusion in addition to decompression, or whether LBP was simply a risk factor for a poor outcome of decompression per se.

Lumbar disc herniation presents a very similar problem to stenosis, i.e. the patient typically has predominant leg pain because of nerve root compression. Hence, the same question arises concerning the influence of preoperative low back pain on the outcome of discectomy. Because pain is usually the main reason for performing the surgery and alleviation of these symptoms is the key to a good outcome, more detailed analysis of the preoperative pain pattern of the patient appears to be warranted.

The present study sought to examine how the relative severity of LBP influences the outcome of lumbar decompression surgery for lumbar disc herniation.

Methods

Inclusion criteria

The study was carried out using the framework of the Spine Society of Europe (SSE) Spine Tango Spine Surgery Registry together with our own local spine surgery outcomes database. It included the prospectively collected data of consecutive patients undergoing surgery in our own Spine Center, part of a specialised orthopaedic hospital, from March 2004 to April 2008. The patients had to have a good understanding of written German or English or (after 2006) French, Spanish, Italian or Portuguese, have a 1-year follow-up questionnaire, and satisfy the study's surgical admission criteria. The latter made use of the options ticked in relation to the given fields on the Spine Tango Surgery form and were as follows: single level disc herniation of the lumbar or lumbosacral region of the spine with no additional pathology, posterior decompression by means of discectomy or sequestrectomy, with no additional

fusion or stabilisation. The herniated disc itself was diagnosed based on the surgeon's own clinical impression from the clinical history and appropriate radiological imaging (i.e. the normal clinical work-up, as per their everyday practice).

All patients had decompression of the affected nerve root. The procedure in our institution is the standard open discectomy, usually with the aid of the operative microscope.

Questionnaires

Before and 12 months after surgery, patients were requested to complete the multidimensional Core Outcome Measures Index (COMI) questionnaire [14, 16]. On each occasion, the questionnaires were sent to the patients to complete at home to ensure that the information given was free of care provider influence. The COMI is a multidimensional index consisting of validated questions covering the domains of pain (leg/buttock and back pain intensity, each measured separately on a 0–10 graphic rating scale), function, symptom specific well being, general quality of life, and social and work disability. Patients also indicated by means of a multiple-choice question what they considered their “main/greatest problem” to be: back pain, leg/buttock pain, and neurological disturbances. In addition to these questions answered both before and 12 months after surgery, at the 12-month follow-up, there was a further question enquiring about the global outcome of surgery: “how much did the operation help your back problem?”, with 5 response categories: (1) helped a lot (2) helped, (3) helped only little, (4) did not help, and (5) made things worse. The global outcome was dichotomised into “good” (1 and 2) and “poor” (3, 4 and 5) for the purposes of some of the subsequent analyses.

Comorbidity was assessed with the American Society of Anesthesiologists Physical Status Score (ASA Score), recorded within the Spine Tango Surgery documentation form.

Statistical analyses

Descriptive data are presented as mean $\pm$ standard deviations (SD). For each patient, the preoperative LP intensity minus the preoperative LBP intensity was determined (LP-LBP).

Linear regression analyses were used to examine the relationship between the preoperative LP-LBP scores and (1) the change in COMI score (from pre-surgery to 12 months post-surgery), (2) the global outcome category at 12 months. The significance of the difference between the “good” and “poor” outcome groups for their preoperative LP-LBP scores was analysed using an unpaired

Student's *t* test. This gave a first approximation as to whether the LP-LBP score might be associated with, i.e. act as a statistical predictor of outcome.

The association between the “main problem” and “global outcome” (dichotomised as good and poor) was analysed using contingency analyses/chi-squared, and the change in COMI score for each of the “main problems” (back, leg and neurological) was examined using a one-way analysis of variance, with a post hoc Fisher's PLSD test being used to locate the significance of any paired differences.

Multivariate longitudinal regression analysis was used to predict the 12-month post-op COMI score after decompression surgery. The baseline COMI score, age, gender, and comorbidity were entered first (as control variables, since they are recognised potential confounders in analyses of such patients), followed by preoperative LP, LBP and LP-LBP scores (as potential predictors, using forward conditional selection).

Multivariate logistic regression analysis was used to predict the 12-month outcome category (good or poor, based on the dichotomisation described above). In addition, age, gender and comorbidity were first entered (as control variables), followed by preoperative LP, LBP and LP-LBP scores (as potential predictors, using forward conditional selection).

Statistical significance was accepted at the $p < 0.05$ level.

Results

In relation to the Registry data collected within our Spine Center, the average compliance rate for the surgeons' completion of the Surgical Forms after the initial work-in phase was 85% (i.e. 85% percent of all spine surgeries carried out in the Spine Center had an accompanying Spine Tango Surgery Form). Hence, potentially, up to 15% of eligible patients were not included in the present study (the exact number is unknown, because a completed Tango surgery form was a prerequisite for identifying patients who fulfilled the study's surgical inclusion criteria). 92% of patients who were sent a 12-month follow-up questionnaire returned it complete.

Of the 4,319 patients in our local spine surgery database (operated between Mar 04 and April 08, and with 12 months' follow-up), 308 patients satisfied the study's admission criteria. Their baseline data are shown in Table 1. Although all 308 patients had a 12-month questionnaire, 46 of them had no baseline questionnaire due to administrative errors ($N = 5$) or because the patient was admitted on an emergency basis ($N = 36$).

Global outcomes

At the 12-month follow-up, the patient-rated global outcomes were as follows: 173/308 (56.4%) operation helped a lot; 76/308 (24.8%) operation helped; 37/308 (12.0%)

Table 1 Patients' demographic and baseline self-rated clinical data, and operative procedures (means $\pm$ SD, or % values)

Variable	
Age (years)	48.0 $\pm$ 13.0
Gender	131 women (43%) 177 men (57%)
Comorbidity, ASA score (%)	
I	211 (68.5%)
II	89 (28.9%)
III	8 (2.6%)
Baseline leg pain intensity ^a (0–10 scale)	6.9 $\pm$ 2.5
Baseline back pain intensity ^a (0–10 scale)	4.4 $\pm$ 3.0
Leg pain minus back pain ^a (–10 to 10)	2.5 $\pm$ 3.1
Baseline multidimensional COMI score ^a (0–10 scale)	7.8 $\pm$ 1.7
Main problem (patient-rated) (%) ^a	
Back pain	14.6
Leg pain	55.1
Neurological disturbances	30.3
Types of decompression used ^b (% cases)	
Discectomy	54.5
Sequestrectomy	70.8
Laminotomy	14.6
Hemi-laminectomy	14.6
Facet joint resection partial	19.5

^a Baseline questionnaire data were available for $N = 267$ (87%) patients; there were 41 missing questionnaires due to emergency admissions ($N = 36$) and administrative errors ($N = 5$)—see text for further details

^b Do not add up to 100%, since multiple procedures were sometimes used in a given patient

operation helped only little; 17/308 (5.5%) operation did not help; 4/308 (1.3%) operation made things worse. Hence, 249/308 (81.1%) patients had a “good” outcome, and 58/308 (18.9%) had a “poor” outcome.

Main complaint and baseline symptoms

Patients that had declared that back pain was their “main problem” had a baseline mean LBP score of 7.0 (SD 2.6) and a mean LP of 6.2 (SD 2.9); those with leg pain as the declared main problem had a mean LBP score of 3.9 (SD 2.8) and a mean LP of 7.6 (SD 2.0), and those with neurological disturbances, a mean LBP score of 4.3 (SD 3.0) and a mean LP of 5.9 (SD 2.8).

Baseline leg pain and back pain in relation to outcome

There was a low, but nonetheless significant correlation between the preoperative LP-LBP score and the change in COMI score from pre-surgery to 12 months post-surgery, i.e. the more that leg pain predominated at baseline in relation to back pain, the greater the improvement in the multidimensional COMI score at 12 months’ follow-up ($r = 0.20$, $p = 0.001$). The LP-LBP scores also showed a low but significant correlation ($r = -0.19$, $p = 0.002$) with the global outcome score: the higher the preoperative LP-LBP score, the better the 12-month global outcome score.

When comparing the baseline data in the dichotomised outcome groups, patients with a “good” outcome had a significantly lower preoperative LBP intensity (4.3 ± 3.0) than did those with a “poor” outcome (5.8 ± 2.9) ($p = 0.0005$). However, LP intensity did not differ significantly between the outcome groups (6.9 ± 2.7 and 6.9 ± 2.4 for good and poor groups, respectively; $p = 0.99$). In the group of patients with a “good” global outcome, the mean baseline LP-LBP score was $2.8 (\pm 3.1)$, i.e. LP was higher than LBP by 2.8 points, and in the “poor” outcome group, the corresponding value was $1.1 (\pm 2.9)$. The difference between the outcome groups was significant ($p = 0.0006$), but the SDs were rather high in each group indicating that there was large inter-individual variability for the LP-LBP score *within* each of the two outcome groups.

Fewer patients with back pain as their declared “main problem” had a good outcome at 12 months (69% good) when compared with those who reported leg/buttock pain (84% good) or neurological disturbances (80% good) to be the main problem (Fig. 1). The difference was significant between the “back pain” and the “leg pain” groups ($p = 0.04$), but not between any other groups.

The mean (SD) reductions in COMI score (i.e. the degree of improvement) after 12 months for the “main problem” groups were 3.5 (SD 3.3) for “back pain”, 5.1 (SD 2.7) for “leg pain” and 3.8 (SD 2.7) for “neurological disturbances” (Fig. 1). The “leg pain” group differed significantly from both the “back pain” ($p = 0.002$) and

Fig. 1 Influence of “worst symptom” at baseline on the change in COMI score, LBP intensity and LP intensity from pre-op to 12 months follow-up

“neurological disturbance” ($p = 0.002$) groups. The corresponding values for the reduction in back pain (0–10 scale) were 3.0 (SD 3.5) for the “main problem, back pain” group, 1.4 (SD 3.4) for “leg pain” and 1.4 (SD 3.4) for “neurological disturbances” (Fig. 1). The differences were significant between the “back pain” and “leg pain” groups ($p = 0.01$) and between the “back pain” and “neurological disturbance” groups ($p = 0.02$). The reduction in leg pain (0–10 scale) was 3.2 (SD 3.1) for the “main problem back pain” group, 5.2 (SD 2.8) for “leg pain” and 3.1 (SD 3.1) for “neurological disturbances” (Fig. 1). The leg pain group differed significantly from both the back pain group ($p = 0.0002$) and neurological disturbance group ($p < 0.0001$).

In multiple regression analysis (after controlling for age, gender, co-morbidity, and baseline COMI score), baseline LBP scores were the most significant unique predictor of the 12-month COMI score ($p < 0.001$) (Table 2). A higher baseline COMI score and higher comorbidity were also significantly associated with a higher COMI score (worse outcome) at 12 months. The multivariate model explained 10% variance in outcome (Table 2). The positive B coefficient of 0.20 for the LBP score indicates that, all else being equal, for each 1-point increase in LBP intensity at baseline, there is a 0.20-point increase in the 12-month COMI score (i.e. a worse outcome).

In multiple logistic regression analysis (after controlling for age, gender and co-morbidity), baseline LBP scores were also the most significant predictor of the 12-month dichotomised outcome score (Table 3). The odds ratio of 0.821 indicates that the odds of a good outcome are decreased by approximately 18% for each unit increase in baseline LBP.

Discussion

The natural history of lumbar disc herniation has been studied extensively, although the relationship between the extent of disc degeneration and the severity of symptoms—whether radicular pain or low back pain—remains unclear [24]. The overall course of the condition is generally favourable, whether managed surgically or nonoperatively [1, 28, 29], but it is still of interest to identify patients that may not benefit as much from a given type of treatment.

The main finding of the present study was that patients with a higher level of back pain preoperatively showed worse outcomes 12 months after decompression surgery for herniated disc. This was so in terms of both the global outcome (a retrospective rating of the patient’s perceived success of the procedure), the prospectively measured changes in the multidimensional patient-orientated COMI

Table 2 Results after the final step of the longitudinal multiple regression analysis to quantify the relative role of baseline leg pain (LP), low back pain (LBP) and LP-LBP scores in predicting the COMI score 12 months after surgery

Independent variables	Unstandardised regression coefficients (B)	95% CI for B		Standardised coefficients (Beta)	Sig (p value)	Percentage of explained variance in COMI at 12 months R^2
		CI low	CI high			
(Constant)	−1.022				0.421	10.0
Baseline COMI score	0.291	0.074	0.509	0.173	0.009	
Gender (0F, 1M)	0.136	−0.556	0.828	0.024	0.70	
Age	−0.013	−0.042	0.015	−0.062	0.366	
Comorbidity (ASA score)	0.757	0.068	1.446	0.147	0.031	
Baseline LBP	0.204	0.089	0.319	0.223	0.001	

LP and LP-LBP were not selected for inclusion in the final forward conditional step, once LBP had been selected as the most significant predictor

Table 3 Results of the multiple logistic regression analysis to identify predictors of a “good” global outcome 12 months after surgery (good 1, poor 0)

Independent variables	Unstandardised regression coefficients		Significance p value	Odds ratio [Exp (B)]	95% CI for odds ratio	
	B	Standard error			Lower	Upper
Gender (0F, 1 M)	−0.532	0.342	0.120	0.587	0.300	1.148
Age	0.011	0.014	0.454	1.011	0.983	1.040
Comorbidity (ASA score)	−0.271	0.335	0.418	0.763	0.396	1.470
Baseline LBP	−0.197	0.055	0.0004	0.821	0.737	0.915

score and the reduction in leg pain. This finding correlates well with our clinical experience and may appear intuitive; however, it has been formally investigated in very few studies to date [6, 20].

In a recent systematic review of prospective studies examining predictors of outcome of discectomy, a high preoperative pain level was identified as carrying “positive evidence” for being one of many bio-psychosocial risk factors for a poor outcome [5]. However, the review did not differentiate between back pain and leg pain, making the relevance of this finding obscure. The present study showed that it was only the level of LBP, not LP, that was predictive of outcome and hence the two need to be distinguished as independent predictors in their own right.

Pearson et al. [20] compared the results of operative versus conservative treatment of lumbar disc herniation in the presence of low back pain and found that while both treatment groups showed improvement of low back pain, surgical treatment seemed more favourable. In both groups, the relief of back pain was less than the relief of leg pain. However, the study did not evaluate the influence of the level of preoperative back pain as a predictor of outcome and did not divide the groups in relation to their having either predominant leg or back pain, as we did.

Several studies have linked back pain in cases of lumbar disc herniation to more pronounced disc degeneration and associated Modic changes [2, 4]. Chin studied patients undergoing microdiscectomy for lumbar disc herniation, dividing them into a group with Modic changes and a group without. Both groups showed similar improvements in symptoms of sciatica and back pain, but there was a tendency for a greater improvement in disability in the patients without Modic signs that reached borderline significance ($p = 0.09$) even in the small group sizes examined ($N = 15$ each) [4]. This tends to support the notion of more widespread painful degenerative changes being associated with an overall poorer outcome.

Jansson et al. [6] examined predictors of health-related quality-of-life in patients who had undergone surgery for herniated disc and found that, in addition to smoking and a short preoperative walking distance, a long history of back pain was a significant predictor of a lower quality of life at follow-up. Although the specific intensity of back pain in relation to leg pain was not assessed, these findings lend further support to the concept of back pain having a generally negative influence on postoperative well being.

Two groups have examined the influence of preoperative LBP on the outcome of decompression surgery for lumbar spinal stenosis [7, 10], another degenerative disorder associated primarily with nerve root compression. Jonsson et al. [7] reported that patients with a preoperative duration of symptoms of <4 years and patients with no

preoperative back pain tended to have better surgical outcomes. In an analogous study to the present one (in terms of the data source, outcome measures, and methods of analysis used), Kleinstuck et al. identified a significant positive correlation between baseline LP minus LBP scores and the 1 year outcome, i.e. the greater the LP relative to LBP at baseline, the better the overall outcome of decompression [10]. Significantly fewer patients with back pain as their “main problem” had a good outcome compared with those who reported leg/buttock pain to be their main problem. This finding is entirely corroborated by the results of the present study on patients with LDH.

In reviewing the current literature, it becomes apparent that, surprisingly, and despite the many predictor studies carried out to date [5, 13], the quantitative relationship between the predominant clinical symptoms in LDH, i.e. back pain and leg/buttock pain, has been poorly examined as a candidate predictor. In our clinical practice of treating patients with lumbar disc herniation, we are usually faced with two types of presentation: predominant leg pain and leg pain with back pain. The leg pain group seems to be most responsive to our surgical treatment, with 84% patients reporting a good outcome. However, the back pain predominant group, despite having similarly severe symptoms related to nerve root compression, i.e. leg pain, seems to be less responsive (69% good outcomes at 12 months). This may become important in the assessment of the long-term follow-up and prognosis in these patients, and may serve as an argument to advise more extensive forms of treatment and rehabilitation postoperatively.

The study also confirms our knowledge of the various symptoms of nerve root compression and their respective recovery. The patients with predominant leg pain showed a significantly better alleviation of symptoms than did the patients with predominantly neurological disturbances; the latter typically reflect a more substantial irritation of the affected nerve root [17, 22].

Limitations of the study

One of the shortcomings of the present study is the uncertainty regarding the definition of buttock pain and the “location” to which it is best classified as belonging—back or leg. This problem has been discussed extensively in a previous study [10].

The reliability of determining an individual’s dominant pain, leg or back, has been questioned before [25] and the same uncertainties pertain also to the present study. However, we were able to demonstrate a good correlation between our “main complaint” categories and the associated leg pain and back pain scores, which at least provides some evidence for the validity of the “main complaint” question used.

Whether higher levels of preoperative back pain are typical of patients that in the long term will do worse and that may progress more rapidly in their degenerative disc disease remains unknown and is beyond the scope of the present study. Our further, long-term follow-up of these patients will hopefully shed some light on this issue. Because a completed Spine Tango Surgery form was required to identify patients fitting the inclusion criteria for the study, those patients for whom no form had been completed by the surgeon yet who would have been eligible for inclusion represented a source of missing data (estimated as maximum 15%). However, we have no reason to believe that these were anything other than “missing at random”. Further, due to the nature of the disease, a number of patients entered the hospital on an emergency basis and were treated immediately. These patients ($N = 36$), and a small minority ($N = 5$) in whom administrative errors within the questionnaire system had occurred, were unable to be assessed preoperatively with our patient-based questionnaire, although all completed a 12-month questionnaire. As such, these cases were not able to be included in the predictor analyses. Instead, our findings relate to the more common situation seen in patients with herniated disc, in which symptoms are initially treated conservatively and only when this has failed is semi-elective decompression surgery [18] performed.

Conclusion

The results of our study indicate that we should carefully assess the main complaint and the amount of preoperative leg pain and back pain in our patients prior to surgery, to better inform them about the likely outcome. In the present study, both groups of patients—those with predominant leg pain and those with predominant back pain—showed a similar level of preoperative leg pain, justifying the treatment with decompression. And, given the fact that 69% of patients with predominant back pain still had a good result after decompression surgery, we would not alter our recommendation regarding surgical treatment. However, it is important that the patient be educated about the likely impact of their LBP on their overall outcome and the possible need for subsequent treatment to deal with any residual problems. This may help in altering patients’ expectations and thereby improve patients’ satisfaction with outcome [15].

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