Outcomes following discectomy for lumbar disc herniation in patients with substantial back pain

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OBJECTIVE Patients with lumbar disc herniation (LDH) typically present with lower-extremity radiculopathy. However, there are patients who have concomitant substantial back pain (BP) and are considered candidates for fusion. The purpose of this study was to determine if patients with LDH and substantial BP improve with discectomy alone.

METHODS The DaneSpine database was used to identify 2399 patients with LDH and baseline BP visual analog scale (VAS) scores ≥ 50 who underwent a lumbar discectomy at one of 3 facilities between June 2010 and December 2017. Standard demographic and surgical variables and patient-reported outcomes, including BP and leg pain (LP) VAS scores (0–100), Oswestry Disability Index (ODI), and European Quality of Life–5 Dimensions Questionnaire (EQ-5D) at baseline and 12 months postoperatively, were collected.

RESULTS A total of 1654 patients (69%) had 12-month data available, with a mean age of 48.7 years; 816 (49%) were male and the mean BMI was 27 kg/m². At 12 months postoperatively, there were statistically significant improvements ($p < 0.0001$) in BP (72.6 to 36.9), LP (74.8 to 32.6), ODI (50.9 to 25.1), and EQ-5D (0.25 to 0.65) scores.

CONCLUSIONS Patients with LDH and LP and concomitant substantial BP can be counseled to expect improvement in their BP 12 months after surgery after a discectomy alone, as well as improvement in their LP.

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KEYWORDS back pain; leg pain; discectomy; lumbar disc herniation; patient-reported outcomes

LUMBAR disc herniation (LDH) is a common disease with a prevalence of 2%–3%, and the highest incidence for men in the 4th to 5th decade of life.¹ LDH traditionally presents with radicular pain in the lower extremities, also known as sciatica, but can also cause low-back pain (LBP). Most patients with LDH can be treated nonsurgically. Nonoperative treatment normally includes analgesics, physiotherapy, chiropractic manipulation, and, at certain facilities, epidural steroid injections.² In some cases, surgery is indicated due to neurological deficit, untenable pain and disability, or unsuccessful conservative treatment.

Surgery for LDH is common, accounting for approximately one-third of the spine surgeries performed annually in Denmark.³ In the 1930s, Mixter stated that discectomy should be combined with fusion to strengthen an

already weakened spine.⁴ This has been challenged by a few studies, the largest being the Spine Patient Outcomes Research Trial (SPORT) with 743 patients, and found that discectomy alone is an effective treatment of back pain (BP) caused by LDH.⁵ Kuslich et al.⁶ tried to define the origin of LBP and sciatica in 1991 with the use of local anesthesia in 193 patients with LDH. They proposed that leg pain (LP) originated from an affected nerve root and LBP came from the posterior portion of the intervertebral disc. This finding provides the theoretical rationale for performing a discectomy alone without the need for a fusion.

The aim of this study was to evaluate the effectiveness of discectomy alone for patients with LDH, LP, and substantial BP in a pragmatic study of patients prospectively enrolled in the DaneSpine Database.⁷

ABBREVIATIONS BP = back pain; EQ-5D = European Quality of Life–5 Dimensions Questionnaire; LBP = low-back pain; LDH = lumbar disc herniation; LP = leg pain; MCID = minimal clinically important difference; ODI = Oswestry Disability Index; PRO = patient-reported outcome; SCB = substantial clinical benefit; SPORT = Spine Patient Outcomes Research Trial; VAS = visual analog scale.

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TABLE 1. Patient demographics

Variable	Value
No. of patients	1654
Mean age $\pm$ SD, yrs	48.75 $\pm$ 14.66
Males	816 (49.3%)
Smokers	556 (33.6%)
Mean BMI $\pm$ SD, kg/m ²	26.91 $\pm$ 4.71

Methods

Study Population

This study included patients with LDH treated with a discectomy at one of 3 Danish Spine units (Center for Spine Surgery & Research, Middelfart Hospital; Center for Rheumatology and Spine Diseases, Rigshospitalet–Glostrup; and Department of Orthopaedic Surgery, Regionshospitalet Silkeborg) between June 2010 and December 2017. All patients were treated following the Danish national guidelines for treatment of LDH, which include physiotherapy, low-back specific exercises, and in some cases steroid injections.⁸ In cases of unsuccessful conservative treatment, the patients were referred to a spine specialist along with MRI. All patients who were offered surgery had an MR image concordant with the clinical findings and, in general, at least 12 weeks of symptom duration, despite conservative treatment. The primary indication for surgery was LP.

Data Collection

The data was collected through the DaneSpine database, the national spine surgery database in Denmark. Therefore, this was a retrospective longitudinal study using prospectively collected data, including patient-reported outcomes (PROs) preoperatively and at 12 months postoperatively. The questions include data on age, sex, height, weight, smoking status, BP visual analog scale (VAS) score (0–100), LP VAS score (0–100),⁹ Oswestry Disability Index (ODI),¹⁰ and European Quality of Life–5 Dimensions Questionnaire (EQ-5D).¹¹

Statistical Analyses

Only patients with LP and BP VAS scores of 50 points or greater at baseline were included. The threshold of ≥ 50 points of 100 total BP VAS points was selected to capture patients whose BP was an important contributor to their symptomatology.¹² All statistical analyses were performed using the SPSS statistical program (version 25.0, IBM Corp.). Baseline PROs were compared to 12-month PROs using paired t-tests.

Results

A total of 4426 patients were treated with a discectomy and had at least 1 year of follow-up. Of these 4426 patients, 2399 had a preoperative BP VAS score ≥ 50 , and 1654 of these patients (69%) answered the 1-year follow-up questionnaires. The mean patient age was 48.75 $\pm$ 14.66 years at the day of operation: 816 (49.3%) were men, 556

TABLE 2. Comparison between baseline and 1-year follow-up measures

Outcome Measure	Baseline (SD)	1-Yr Follow-Up (SD)	p Value
Mean BP VAS (SD), 0–100	72.57 (14.23)	36.92 (29.61)	<0.0001
Mean LP VAS (SD), 0–100	74.82 (18.48)	32.63 (31.15)	<0.0001
Mean ODI (SD), 0–100	50.94 (17.33)	25.07 (19.10)	<0.0001
Mean EQ-5D (SD), 0–1.0	0.25 (0.33)	0.65 (0.31)	<0.0001

(33.6%) were smokers, and the average BMI was 26.91 $\pm$ 4.71 kg/m² (Table 1).

At the 1-year follow-up, the BP VAS score improved from 72.57 to 36.92 and the LP VAS score reduced from 74.82 to 32.63. The ODI improved from 50.94 to 25.07, and the EQ-5D score increased from 0.25 to 0.65. All these results were statistically significant (Table 2).

Regarding BP VAS scores, a minimal clinically important difference (MCID) was achieved by 75.9% of the patients, and 62.5% achieved substantial clinical benefit (SCB). Concerning LP VAS, 71.0% achieved MCID and 66.3% SCB. MCID and SCB were 70.3% and 61.2%, respectively, regarding the ODI (Table 3). Baseline variables in responders and nonresponders were analyzed and did not show any statistically significant differences (Table 4).

Two hundred seven patients required a reoperation in the follow-up period. These reoperations included discectomy due to recurrent disc herniation (n = 161), repeat decompression (n = 28), evacuation of hematoma (n = 10), infection (n = 4), fusion (n = 2), and dural tear repair (n = 2).

Discussion

This study showed statistically and clinically significant^{10,13,14} improvements in self-reported BP, LP, mobility, and quality of life in patients with LDH and substantial BP after discectomy surgery without fusion. These findings are consistent with the most influential studies on this field: the Weber cohort,¹⁵ the Maine Lumbar Spine Study by Atlas et al.,^{16,17} and the SPORT cohort by Weinstein et al.⁵ Both the Weber and Atlas studies had 10 years of follow-up, with statistically significant improvements in BP 1 year postoperatively. These improvements persisted during the follow-up, although at 10 years they were no longer statistically significant (but a tendency remained). Patients in the SPORT observational cohort had 2 years of follow-up, showing statistically significant improvements during the entire follow-up period. These results converged over time, which is in accordance with the tendency in the Weber and Maine studies. A recent longitudinal observational cohort study by Owens and colleagues¹⁸ involved 2262 patients with a preoperative BP VAS score ≥ 50 , who were treated with 1- or 2-level discectomy without fusion, and showed similar outcomes.

A prospective study by Sun et al.¹⁹ compared decompression alone versus decompression with fusion. They found no significant differences at the 1-year follow-up between the two groups, but at 3 and 6 months, there were significantly better improvements in LBP for the decompression-alone group. Physical function according to the

TABLE 3. Patients achieving MCID and SCB

Outcome Measure	MCID (%)	SCB (%)
BP VAS	75.9	62.5
LP VAS	71.0	66.3
ODI	70.3	61.2

Japanese Orthopaedic Association scale showed significantly better results after 3 months for the decompression-alone group. At 1-year follow-up, the results were similar for the two groups. Therefore, patients were able to achieve greater physical function and pain relief earlier with only a decompression procedure.

Our study has a few limitations, including the lack of a control group. This makes us unable to comment on the spontaneous improvement in this cohort, despite the fact that all the patients underwent conservative treatment prior to surgery. The natural course of LDH has a good prognosis, and patients can expect substantial improvement over a 2-year period.²⁰ The relatively short follow-up period, and lack of additional data within the first year, prevent us from being able to evaluate whether the improvements persist over time.

The impact on the length of symptoms prior to surgery was not evaluated in this study. A recent study by Støttrup et al.²¹ found that prolonged duration of preoperative symptoms resulted in an inferior outcome. The optimal window to perform the operation should be between 3 and 12 months after first detecting symptoms, and prolonged preoperative symptoms increase the risk of reoperation.

There are many different surgical techniques to decompress the nerve root, which have an impact on the postoperative backache secondary to muscle dissection and bone excision. All patients treated at our facilities received either an open discectomy or microdiscectomy. The surgical technique chosen is determined by the operating surgeon at each facility and depends on the location of the LDH and any associated pathologies. Whichever surgical technique is selected, the main goal with the surgery is to decompress the affected nerve root to ease the patient's radicular pain and improve neurological function. The operational technique was not examined in this study.

Approximately one-third of the patients did not complete the 1-year PROs. This dropout rate might lead to a distortion of the results. A dropout analysis by Højmark et al.⁷ using the DaneSpine database did not show any bias in the conclusions of the study. The nonresponders were generally younger men, and too busy with work and family responsibilities. Furthermore, the nonresponders demonstrated better improvement of health-related quality of life as measured on the EQ-5D compared to the responders. The responders and nonresponders in our study did not show any differences in baseline variables (Table 4). Therefore, the high dropout rate might have only a minor influence on the outcome, despite the fact that a lack of complete follow-up is a possible source of bias.

The strengths of this study are the large population studied, the fact that it was a multicenter trial at 3 facilities, and that the data were collected prospectively even

TABLE 4. Baseline variables for responders and nonresponders

Variable	Responders	Nonresponders	p Value
No. of patients	1654	745	
Mean age (SD), yrs	48.75 (14.66)	48.34 (14.22)	0.345
Males	816	353	0.377
Smokers	556	222	0.072
Mean BMI (SD), kg/m ²	26.91 (4.71)	26.93 (4.79)	0.894
Mean BP VAS (SD), 0–100	72.57 (14.23)	72.89 (14.04)	0.692
Mean LP VAS (SD), 0–100	74.82 (18.48)	74.24 (19.50)	0.431
Mean ODI (SD), 0–100	50.94 (17.33)	49.21 (17.60)	0.652
Mean EQ-5D (SD), 0–1.0	0.25 (0.33)	0.23 (0.32)	0.0531

though they were evaluated retrospectively. All these strengths reduce the risk of bias and make the results more reproducible.

Because decompression without fusion involves a shorter surgical duration, less blood loss, a shorter hospital stay, and lower costs,¹⁹ a discectomy should be the first option in patients with LDH, unless a facet resection is necessary as in cases of foraminal or extraforaminal herniations.¹⁸

Conclusions

This present study adds to the evidence that a discectomy without fusion in patients with LDH, LP, and substantial BP is an appropriate treatment and can produce improvements in BP, LP, mobility, and quality of life, without the need for a concomitant fusion.

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Author Contributions

Conception and design: Andersen, Carreon. Acquisition of data: Bech-Azeddine, Fruensgaard, Andersen. Analysis and interpretation of data: Sørensen, Carreon. Drafting the article: Sørensen. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Sørensen. Statistical analysis: Carreon.

Supplemental Information

Previous Presentations

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