

Smoking Is an Independent Risk Factor of Reoperation Due to Recurrent Lumbar Disc Herniation

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Abstract

Study Design: Retrospective cohort study.

Objectives: The purpose of the present study is to determine if age, gender, smoking status, and body mass index (BMI) are significant risk factors of symptomatic recurrent lumbar disc herniation (rLDH) leading to reoperation.

Methods: A cohort of 1378 consecutive patients who underwent discectomy for LDH from June 2010 to January 2015 at our institution were included. Patients who underwent reoperation due to rLDH prior to August 2015 were identified. Data on reoperations, age, gender, smoking status, and BMI were collected from our database. A comparison of age, gender, smoking status, and BMI was made between the controls (non-rLDH) and the cases (rLDH group). Binary logistic regression was performed to determine whether age, gender, smoking status, and BMI were independent risk factors for rLDH.

Results: Patients in the non-rLDH group (48.2 years) were older than the rLDH group (44.7 years; $P = .013$). Gender distribution (54.8% vs 48.5% males; $P = .222$) and BMI (26.6 vs 26.6; $P = .458$) were similar between the 2 groups. A significantly higher prevalence of smokers was found in the rLDH group (33.1% vs 51.5%; $P < .001$). Binary logistic regression analysis showed that smoking was an independent risk factor of rLDH (odds ratio = 2.12; 95% confidence interval = 1.39-3.15; $P < .001$).

Conclusions: Neither age, BMI, nor gender had any statistical significant association with the risk of rLDH. Smoking was associated with higher risk of reoperation due to rLDH.

Keywords

DaneSpine, lumbar disc herniation, recurrent lumbar disc herniation, risk factors, smoking

Introduction

Lumbar disc herniation (LDH) is a common and disabling condition. Patients with severe pain, limited physical function or threatened work capacity, and lack of improvement, despite appropriate conservative treatment, are often offered surgical intervention. In Denmark, around 2000 discectomies are performed every year due to LDH.¹

Despite effective clinical relief provided by surgical intervention, the overall risk of reoperation varies from 5% to 12.5%, and the rate of reoperation due to recurrent lumbar disc herniation (rLDH) ranges from 3% to 11%.² Many studies have reported rates of rLDH and sought to identify risk factors for rLDH. Factors including age, gender, smoking, alcohol consumption, herniation type, and operation technique have been studied. A review by Shin noted that the current literature reports multiple risk factors with

varying results.³ The aim of the present study was to examine the incidence of reoperations due to rLDH and to determine if age, gender, smoking status, and body mass index (BMI) are significant risk factors of symptomatic rLDH leading to reoperation.

Methods

All consecutive patients who underwent primary open- or microdiscectomy for LDH from June 1, 2010, until January

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31, 2015, at our institution were included. Patients who underwent reoperation due to rLDH prior to August 1, 2015, were identified. RLDH was defined as a disc herniation at the same level and side as the primary LDH, confirmed by magnetic resonance imaging with concordant symptoms. In this study, no definite pain-free period was specified as necessary for the diagnosis of rLDH.

Data on reoperation as well as preoperative data on age, gender, smoking status, and BMI are routinely collected as part of the Danish national surgical spine database—DaneSpine. As presented in a previous study, preoperative data was available for >99% of the patients.⁴ A comparison of age, gender, BMI, and smoking status was made between the non-rLDH group and the rLDH group. Length of symptom-free period, after primary surgery, was examined in patients who underwent surgery due to rLDH within 1 year after primary surgery. The 1-year interval was set to reduce the risk of recall bias.

All statistical analyses were carried out using STATA version 13. To account for multiple concurrent analysis, significance level was set at $P < .01$. Independent Student's t test was used to determine significant differences between continuous demographic variables. Pearson χ^2 test was used to compare categorical variables. Binary logistic regression analysis was performed to determine whether age, gender, smoking status, and BMI were independent risk factors of reoperation due to rLDH. These factors were included in the analysis as they are clinically readily available and have been previously shown to be potential risk factors in previous studies with smaller sample sizes. The study was submitted and reviewed by the Danish Data Protection Agency. As this was a retrospective review of previously collected data, subject consent was not required for inclusion in the study. No approval from the National Committee on Health Research Ethics was needed.

Results

A total of 1378 patients were included. A total 115 patients (8.35%) had reoperations; 103 patients (7.5%) for rLDH, 7 patients for recurrent stenosis, 2 patients for cerebral spinal fluid fistula, 1 for discitis, 1 for pain, and 1 for problems with the cicatrize. Patients in the non-rLDH group (48.2 years) were older than the rLDH group (44.7 years; $P = .013$), but this difference did not reach statistical significance. Gender distribution (54.8% vs 48.5% males; $P = .222$) showed no significant difference between the 2 groups. Mean BMI was equal in both groups (26.6 kg/m²; $P = .458$). A significant higher prevalence of smokers was found in the rLDH group (33% vs 52%; $P < .001$; Table 1). Binary logistic regression showed that, after controlling for all other factors, smoking is an independent risk factor of symptomatic rLDH (odds ratio = 2.12; 95% confidence interval = 1.39-3.15; $P < .001$; Table 2). A total of 73 patients had their reoperation within 1 year. Almost half of these cases (35, 48%) had a recurrence of symptoms within 4 weeks of their initial discectomy (Table 3). In 11 cases, the patients did not report when their symptoms recurred. The

Table 1. Summary of Demographic Data.

	Non-rLDH	rLDH	P
Age, mean (95% CI)	48.15 (47.36-48.95)	44.89 (42.74-47.04)	.013
Male/female (%)	693/572 (54.8/45.2)	50/53 (48.55/51.45)	.222
BMI, mean (95% CI)	26.64 (26.35-26.92)	26.58 (25.75-27.42)	.458
Smoker/ nonsmoker, n (%)	411/834 (33.12/66.88)	53/50 (51.45/48.55)	.000

Abbreviations: rLDH, recurrent lumbar disc herniation; CI, confidence interval; BMI, body mass index.

Table 2. Results of Multivariate Binary Logistic Regression Analysis.

	OR	95% CI	P
Age	0.986	0.97-1.00	.036
Sex	1.39	0.92-2.08	.117
BMI	1.00	0.96-1.04	.839
Smoker	2.12	1.39-3.15	.000

Abbreviations: OR, odds ratio; CI, confidence interval; BMI, body mass index.

Table 3. Cases Reoperated Within 1 Year Stratified by Time to Recurrence of Symptoms.

Recurrent Symptoms	Frequency	Percentage	Cumulative Percentage
<1 week	24	32.9	32.9
1-2 weeks	5	6.9	39.7
2-4 weeks	6	8.2	47.9
4-12 weeks	14	19.2	67.1
>12 weeks	13	17.8	84.9
Not known	11	15.1	100
Total	73		

Table 4. Cases Reoperated Within 1 Year Stratified by Time to Repeat Discectomy.

Reoperation	Frequency	Percentage	Cumulative Percentage
<1 month	9	12.3	12.3
<3 months	12	16.4	28.8
<6 months	32	43.8	72.6
<1 year	20	27.4	100

majority of cases (53, 73%) had their reoperation within 6 months after the initial discectomy (Table 4).

Discussion

Recurrent disc herniation is one of the major problems when surgically treating patients with LDH. The rate of rLDH in the present study (7.5%) corresponds to results presented in previous studies.² Multiple studies have shown that the outcomes for revision spine surgeries are inferior and have a higher rate of complications compared to primary cases.^{5,6} Identifying modifiable risk factors for recurrent disc herniation may help

surgeons decrease the rate of reoperation and therefore improve patient outcomes.

The result of the current study, showing that smoking increases the risk of symptomatic, is not surprising. Previous studies have shown that smoking is a risk factor for rLDH.^{7,8} However, these studies are limited by the relatively small sample size. Miwa et al⁷ reported on 32 cases out of 298 discectomies, and Shimia et al⁸ on 14 cases out of 40 discectomies. Smoking has been shown to accelerate disc degeneration,⁹ increase the risk of back pain,^{10,11} promote the development of LDH,¹² and has a negative effect on surgical outcomes.¹³ Several mechanisms contribute to recurrence of disc herniation, including the lack of nutrition to the disc, as smoking contracts capillary vessels that are detached to the bone-disc junction and thereby inhibits the diffusion of nutrition into the disc radically.¹⁴ Nicotine has also been shown to be a significant inhibitor of cell proliferation in the nucleus pulposus and extracellular matrix synthesis.⁹ Akmal et al also suggests that nicotine induces the inhibition of total collagen, which may reduce collagen content in the annulus fibrosis and may predispose the annulus to traumatic injury and degenerative changes, and thus presumably increase the risk of rLDH in smokers.⁹

The rLDH group was on average 3 years younger than the non-rLDH group, but this age difference did not reach statistical significance. To our knowledge, no previous studies have reported any significant difference or trend toward difference in age between the rLDH group and the non-rLDH group.^{7,15,16} Häkkinen et al reported that the age distribution of all patients in their study group was comparable to that of patients in the rLDH group. However, no mean value was described.²

Physical activity level among younger people may be higher and may increase their risk for rLDH.

No difference in mean BMI between the groups was found in this study, which is similar to other studies.^{2,8,9} However, Meredith et al found that obesity was a strong and independent risk factor of rLDH in patients who underwent sequestrectomy, though the cohort in Meredith's study consisted of 75 patients with only 4 reoperations for rLDH.¹⁷

Current literature on gender shows conflicting results. Like a few other studies, our study demonstrated that gender had no association with the risk of reoperation due to rLDH.^{2,7} In contrast, Jung Tae Oh found being female as a statistically significant risk factor of recurrence.¹⁵ Shimia et al concluded that being male could predict rLDH.⁸ Both studies, however, included a very small study population.

When looking at onset of symptoms there seems to be incongruence between the time of onset and the time of reoperation. This indicates that these patients presumably could be identified early and perhaps benefit from a more prompt action on reoperation, when symptoms reoccur. Having no definite pain-free period for the diagnosis of rLDH was chosen, as the identified reoperations were reported as operations due to rLDH by the surgeons. However, an absence of improvement or early onset of recurrence might be considered as an inadequate discectomy in the first place. Almost half of the included patients (49 of 103) had had their reoperation

within 3 months. If patients with a pain-free period of less than 3 months are excluded, the reoperation rate would only be 3.9%.

An early onset of recurrent symptoms might also raise an ongoing discussion on whether or not to have postoperative activity restrictions. All patients in this study were given recommendations on limiting heavy lifting or housework and postpone occupation with heavy load for 6 to 8 weeks. The adherence to these recommendations is not known. Further research is needed to determine whether or not restrictions can prevent the occurrence of rLDH.

The strength of this study is that the results were only considered significant when $P < .01$. The cohort was relatively large with 1378 patients included, with 103 patients in the rLDH group. All data was collected prospectively from a single clinic. Preoperative data existed on >99% of the patients.⁴ Limitations of this study is the lack of data on alcohol consumption, compliance to postoperative recommendations, level of daily activity, educational level, workload/return to work, or surgeon. Type of work (sedentary, light, moderate, or heavy physical labor) was not included in the analysis, as it was considered irrelevant, taking into account that recurrent symptoms had an early onset, which suggests that work was most often not resumed at the time of recurrence. A further limitation of this study is that the number of patients with asymptomatic recurrence, or symptomatic recurrence that resolved without surgery, is unknown.

Conclusion

In conclusion, the reoperation rate due to symptomatic rLDH in this current study was 7.5%. Neither age, BMI, nor gender had any statistical significant association with the risk of rLDH. Smoking was associated with higher risk of reoperation due to rLDH. Further research on whether smoking cessation can reduce the rate of reoperations is warranted.

Declaration of Conflicting Interests

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