Risk factors of recurrent lumbar disk herniation: A single center study and review of the literature

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ABSTRACT

Background. The recurrence of lumbar disc herniation (LDH) is a major problem in the treatment of LDH. The purpose of this study was to investigate the risk factors for recurrent LDH.

Methods. Between April, 2005 and March, 2008, 298 patients with LDH, who underwent surgical treatment, were enrolled in this study. The patients were divided into a non-recurrent group (N group) and a recurrent group (R group). We compared their clinical parameters including age, gender, body-mass index (BMI), smoking, alcohol, sports activity, occupational lifting, and occupational driving. The relationships between the variables and recurrent LDH were evaluated by univariate analysis and multiple logistic regression analysis.

Results. The N group had 266 patients (89.3%) and the R group had 32 patients (10.7%). Univariate analysis showed that current smoking ($P < 0.001$) and occupational lifting ($P = 0.02$) significantly correlated with recurrent LDH. Multivariate analysis showed that current smoking significantly related with recurrent LDH (OR=3.47, 95% CI: 1.55-7.80, P=0.003).

Conclusions. Our study suggests that smoking cessation and restraining from lifting may significantly decrease the incidence of recurrent LDH.

INTRODUCTION

Lumbar disc herniation (LDH) is one of the most frequent diseases of the lumbar diseases.

Treatments of LDH are comprised of conservative and surgical treatments. In our institute, we choose surgical treatment in cases that show no response to conservative treatment for three months, and in patients who suffer from motor palsy, sensory palsy, or bowel bladder disturbance. A large proportion of patients with LDH obtain satisfactory results, but there remain some cases with unsatisfactory results. The overall rate of unsatisfactory results following discectomy is between 5% and 20%.[1-5] The causes of failure of discectomy are surgery performed at the wrong segment, insufficient removal of herniated and degenerative changed disc tissue, unrecognized second disc herniation, trauma of a nerve root, unrecognized displaced sequestration, insufficient decompression of spinal stenosis, tumors, spondylolisthesis, extravertebral nerve compression, and polyneuropathia.[6,7] Recurrent LDH has been reported in 5–15% of patients after disc excision.[8-10] Therefore, the recurrence of LDH is a major problem in the surgical treatment of LDH. It is important to analyze the risk factors of recurrent LDH in order to prevent recurrence. In this study, we investigated the frequency of recurrent LDH and analyzed the risk factors for recurrent LDH by comparing clinical parameters including age, gender, BMI, smoking, alcohol, sports activity, occupational lifting, and occupational driving.

MATERIALS AND METHODS

Patients

A total of 298 patients, who underwent microdiscectomy for LDH from April, 2005 to March, 2008 in Saiseikai Kanazawa Hospital, were included in this study. The levels of disc herniation were L1–L2 in 2 cases (0.7%), L2–L3 in 10 cases (3.4%), L3–L4 in 38 cases (12.8%), L4–L5 in 145 cases (48.7%), and L5–S1 in 103 cases (34.6%). All of the patients were diagnosed radiologically by magnetic resonance imaging (MRI). All the patients or relatives gave informed consent to participate in this study.

The patients were divided into a recurrent group (R group) and a non-recurrent group (N group), and their clinical parameters were compared including age, sex, body-mass index (BMI), smoking, alcohol, sports activity, occupational lifting, occupational driving, and the type of herniation. Recurrent LDH was defined as a disc herniation at the same level, regardless of ipsilateral or contralateral herniation, in a patient who experienced a pain-free interval of at least 6 months after prior surgery.[10] All patients with recurrent LDH underwent repeat surgery and the herniated discs were detected at the same level as the primary discectomy.

Operative technique

Surgery was performed by two surgeons using microdiscectomy techniques.[11] The lamina was partially resected and partial discectomy was done after retracting the nerve root medially. We made a small square window through the annulus, each side measuring about 3 mm, and removed the

herniated disc and about 1/3 of the disc material. We left the annular window open without any covering after surgery. The type of herniation was classified as protrusion, subligamentous extrusion, transligamentous extrusion, and sequestration after review of the surgical records.

Physical findings

Each subject's height and weight were recorded and body mass index (BMI) was calculated. The cutoff point between low and high values was set at 25 kg/m^2 according to the criteria of the Japan Society for the Study of Obesity.[12]

Questionnaire

A questionnaire of physical and lifestyle factors was given to all patients to complete at the time of admission. The following questions concerning current smoking habits, current drinking habits, occupational lifting, occupational driving, and sports history were used for the analysis: Do you smoke cigarettes? Do you drink alcoholic beverages? Have you ever engaged in an occupation that involved lifting weight? Have you worked as an occupational driver? Have you ever participated in a sport?

Statistical Analysis

Univariate analysis was performed using an unpaired Student *t* test and χ^2 test for clinical and radiologic parameters. The Mann-Whitney *U* test was used to compare group means of continuous data. Multiple logistic regression analysis was used to identify independent risk factors for recurrent LDH. Any variable with a P-value not more than 0.4 on univariate analysis was included in the multiple logistic regression models. Statistical significance was defined as $P < 0.05$ and analyses were performed using SPSS software.

RESULTS

The study group was composed of 212 men and 86 women, whose ages ranged from 13 to 82 years (49.0 ± 16.3 years). The no-recurrence group (N group) had 266 patients and the recurrence group (R group) had 32 patients (Table 1). The follow-up period ranged from 14 to 61 months (39.0 ± 11.5 months). The % lost to follow-up was 8.7%. The mean period between initial operation and recurrence was 14.6 months. The N group had 29 cases (10.9%) of protrusion type, 67 cases (25.2%) of subligamentous extrusion type, 93 cases (35.0%) of transligamentous extrusion type, and 77 cases (28.9%) of sequestration type (Table 2). The R group had 3 cases (9.4%) of protrusion type, 8 cases (25.0%) of subligamentous extrusion type, 7 cases (21.9%) of transligamentous extrusion type, and 14 cases (43.8%) of sequestration type.

The results of univariate analysis for clinical parameters (age, gender, body mass index

(BMI), current smoking, alcohol, sports activity, occupational lifting, and occupational driving) are shown in Table 3. The R group had a significantly higher rate of smokers than the N group (68.8 *vs.* 36.5%, P < 0.001). There was also a significant difference between the groups in terms of occupational lifting (28.1 *vs.* 12.8%, P = 0.020). The recurrence rates in smokers and non smoker were 18.5% and 5.6%, respectively. The recurrence rates in patients with or without lifting occupations were 20.9% and 9.1%, respectively. There were no significant differences between the R group and N group in terms of age ≥ 40 (25.0 *vs.* 30.4%, P = 0.683), sex (male, 71.9 *vs.* 71.1%, P = 0.923), BMI ≥ 25 (26.3 *vs.* 31.3, P = 0.552), current drinking (46.9 *vs.* 39.1%, P = 0.396), sports activity (25.0 *vs.* 26.7%, P = 0.838), or occupational driving (12.5 *vs.* 6.4%, P = 0.202).

Any variable with a P-value no greater than 0.4 on univariate analysis was included in the multiple logistic regression model. On multivariate analysis, the entered variables were current smoking, current drinking, occupational lifting, and occupational driving (Table 4). Multiple logistic regression analyses revealed that smoking (P = 0.003) was an independent risk factor for recurrent LDH.

DISCUSSION

This study showed that 32 (10.7%) of 298 patients, who underwent microdiscectomy had recurrent LDH and this frequency was similar to previously reported rates of recurrence.[8-10] Many reports

have regarded the risk factors of recurrent LDH (Table 5). Cinotti[13] reported that some risk factors were found to be associated with recurrent herniation; male patients with marked degenerated discs were more likely to experience recurrent herniation, particularly after an isolated injury or a precipitating event. Suk[10] reported that young age, male gender, smoking, and traumatic events as risk factors. Carragee[14] found that the degree of annular competence after discectomy and the type of herniation were correlated with the recurrent rates after discectomy. Kim[15] reported that old age, high BMI, protrusion type disc, and positive Modic change were risk factors after percutaneous endoscopic discectomy. However, Swartz and Trost[16] found that age, gender, smoking status, level of herniation and duration of symptoms were not associated with recurrent LDH. Controversy remains regarding the risk factors of recurrent LDH, which are difficult to define because of the many clinical and complicated biomechanical parameters involved. In this study, we analuzed the occurrence of recurrent LDH in relation to clinical parameters consisting of gender, BMI, smoking, status, alcoholic habit, sports activity, occupational lifting, and occupational driving. We found that there was a significant correlation between smoking habits and recurrent LDH, while occupational lifting showed a tendency to correlate with recurrent LDH.

Smoking is known to have a negative effect on surgical outcomes. Cigarette smoke is composed of over 4,000 toxins that potentially undermine normal ligament repair after injury.[17] Many of these toxins, such as nicotine, carbon monoxide, and hydrogen cyanide have been shown to affect

processes thought to be essential for physiologic ligament healing such as tissue perfusion, blood oxygenation, and cellular proliferation.[17,18] One factor that appears to be very important in normal ligament healing is collagen. Type I collagen is the major structural component of extracellular matrix and is critical for normal ligament function and biomechanics.[19] In a previous study, cellular density in an injured ligament increased between 3 and 7 days after injury in normal wound healing and the increase in cell density was inhibited by exposure to cigarette smoke.[20] By interfering with cellular and molecular processes important in ligament repair, smoking may impair or delay the normal progression of events that restore mechanical stability to posterior longitudinal ligament after discectomy. The first study to show an association between smoking and increased postoperative complications was published in 1944.[21] Since then, a number of papers have confirmed this association.[17, 22-24] It has been shown that smoking impairs healing of skin, bone, and soft tissues, thus resulting in flap necrosis,[22-24] non-unions, delayed unions, failure of wound-healing, and infections as well as anastomotic leakage.[25-29] Mills conducted a systematic review of all randomized trials evaluating the effect of smoking cessation on postoperative complications and all observational studies evaluating the risk of complications among past smokers compared with current smokers.[30] Kelsey reported that smoking is a risk factor of lumbar disc herniation, and suggested that the cough movement caused by smoking increased intervertebral pressure.[31] In experimental studies, nicotine, the main component element of cigarette smoke, induced intervertebral disc degeneration and caused

vasoconstriction followed by decreased blood flow around intervertebral discs.[18,20] Battie[32] reported that lumbar disc degeneration in smokers is 18% higher than in non-smokers, and that vasospasms or arteriosclerotic changes caused by smoking may have a negative effect on the blood supply to the discs, subsequently affecting disc nutrition. A window in the disc and posterior longitudinal ligament after resection of the nucleus is thought to be restored in normal conditions. However, it is thought that the hypoxia and poor circulation caused by smoking inhibited closure of the window. Therefore, smoking cessation seems to be beneficial for the prevention of postoperative complications including recurrent LDH.

There are no reports describing that occupational lifting is a risk factor for recurrent LDH. However, epidemiological studies have identified heavy tasks, frequent bending and lifting as risk factors in low back pain, disc degeneration, and LDH.[33,34] Physical workload has been associated with disc degeneration, especially at the L4- L5 and L5- S1 discs.[35,36] Spangfort indicated that lifting movement is a risk factor of LDH.[37] Cinotti suggested that the annular incision performed at surgery makes the operated disc more susceptible to sudden prolapse, particularly under conditions of mechanical overload experienced during lifting or driving.[13] Although it was univariate analysis, our study showed that occupational lifting is a risk factor for recurrent LDH.

CONCLUSIONS

This study revealed that current smoking (OR 3.47, 95%CI 1.5-7.8) and occupational lifting (OR 2.17, 95%CI 0.9-5.3) were risk factors of recurrent LDH. These results suggest that cessation of smoking and avoiding frequent lifting may be effective for prevention of recurrent LDH.

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Table 1. Patient clinical characteristics

Characteristic	Number of patients
Follow up period (months)	39.0±11.5
Age (years)	49.0±16.3
<40	209
≥ 40	89
Male/female	212/86
Body mass index (BMI)	23.5±3.4
>25	80
≤25	218
Level of hearniation	
L1-L2	2
L2-L3	10
L3-L4	38
L4-L5	145
L5-S1	103
Type of herniation	
Protrusion	32
Subligamentous Extrusion	75
Transligamentous Extrusion	100
Sequestration	91
Current smoking	119 (39.9%)
Alcohol	119 (39.9%)
Sports activity	79 (26.5%)
Occupational lifting	43 (14.4%)
Occupational Driving	21 (7.0%)

Data are presented as mean ± SD (standard deviation of the mean)

Table 2. Correlation between the type of LDH and the recurrence

	N group (n = 266)	**R group (n = 32)**
Protrusion	29 (10.9%)	3 (9.4%)
Subligamentous Extrusion	67 (25.2%)	8 (25.0%)
Transligamentous Extrusion	93 (35.0%)	7 (21.9%)
Sequestration	77 (28.9%)	14 (43.8%)

Table 3. Risk factors for recurrent LDH using univariate analysis

	N group (n = 266)	**R group (n = 32)**	**P value**
Age ≥ 40	81 (30.4%)	8 (25.0%)	0.683
Male	189 (71.1%)	23 (71.9%)	0.923
BMI ≥ 25	70 (26.3%)	10 (31.3%)	0.552
Current smoking	97 (36.5%)	22 (68.8%)	< 0.001**
Current drinking	104 (39.1%)	15 (46.9%)	0.396
Sports activity	71 (26.7%)	8 (25.0%)	0.838
Occupational lifting	34 (12.8%)	9 (28.1%)	0.020**
Occupational driving	17 (6.4%)	4 (12.5%)	0.202

* P<0.1, ** P<0.05

Table 4. Risk factors for recurrent LDH using multiple logistic regression analysis

	OR	**95% CI**	**P value**
Current smoking	3.472	1.547-7.795	0.003**
Current drinking	1.181	0.550-2.538	0.669
Occupational lifting	2.168	0.891-5.276	0.088*
Occupational driving	1.200	0.357-4.032	0.768

* P<0.1, ** P<0.05

Table 5. Risk factors for recurrent LDH

Authors	**Risk factors for rLDH**
Cinotti (1998)	male, degenerated disc
Suk (2001)	male, smoking, trauma
Carragee (2003)	anular competence, type of herniation
Kim (2007)	old age, high BMI, protrusion type
Our study	smoking, occupational lifting