



Original Article

Risk factors for reoperation after discectomy of lumbar herniated intervertebral disc disease

Cheng-Huan Peng^{a,b}, Ing-Ho Chen^{a,b}, Tzai-Chiu Yu^{a,b}, Jen-Hung Wang^c, Wen-Tien Wu^{a,b,*}, Kuang-Ting Yeh^{a,b,d,*}

^aDepartment of Orthopedics, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Hualien, Taiwan, ^bSchool of Medicine, Tzu Chi University, Hualien, Taiwan, ^cDepartment of Medical Research, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Hualien, Taiwan, ^dGraduate Institute of Clinical Pharmacy, Tzu Chi University, Hualien, Taiwan

ABSTRACT

Objectives: Discectomy is the most common surgery for lumbar herniated intervertebral disc (HIVD) disease. However, 5%–24% of patients undergo a second surgery due to recurrent disc herniation. **Materials and Methods:** This study was aimed to identify the risk factors for reoperation after discectomy of lumbar HIVD and recommend treatment for patients with a high risk of reoperation. We recruited patients diagnosed as having single-level lumbar HIVD who underwent open discectomy from January 1, 2000, to December 31, 2012 in our hospital. We used a survival curve to inspect the survival time and reoperation rate after surgery. We discussed the correlation of reoperation rate with discectomy level, body mass index, heavy lifting after surgery, sex, and age. Furthermore, we investigated the correlation between the experience of a surgeon and the reoperation rate. **Results:** A total of 619 patients were enrolled in our study. Most patients were 40–60 years old (48.8%), and most of them had herniation at L4/5 level (48.9%). The 8-year survival rate was 92%. Weight lifting after surgery may increase the reoperation rate by 115 and 18 times for those >60 years and <40 years, respectively. In addition, less experience of the surgeon and female sex had a high reoperation rate. **Conclusion:** Postoperative working modification may be very important for preventing patients from recurrent HIVD. For elderly people with HIVD, a more conservative therapy could be selected. If patients with lumbar spine hypermobility or severe degeneration require wide laminectomy, primary fusion should be considered.

KEYWORDS: Discectomy, Heavy lifting after surgery, Herniated intervertebral disc, Reoperation rate, Survival rate

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INTRODUCTION

Lumbar herniated intervertebral disc (HIVD) is a prevalent medical condition and stands as the leading cause of low back pain affecting a broad range of age groups, characterized by symptoms such as localized pain, sensory abnormalities, and motor deficits, the disease significantly impairs the quality of life of those who suffer from it. Encouragingly, available literature suggests that the medical history for up to 90% of HIVD patients is generally favorable, with leg pain substantially subsiding within an 8-week period from the onset of symptoms [1,2]. Numerous therapeutic strategies exist for managing HIVD, ranging from conservative treatments to more invasive surgical interventions. Physical therapy, when coupled with minimally invasive techniques such as epidural or selective nerve blocks, has proven effective in mitigating symptoms for a considerable subset of patients [3-5]. Surgical intervention becomes a viable option under specific circumstances: namely, the failure of conservative treatment protocols, the emergence of bowel or bladder dysfunctions, or

the progressive worsening of motor deficits. Among surgical procedures, discectomy is the most frequently performed operation aimed at treating lumbar spine issues. Despite its popularity and generally favorable outcomes, a notable fraction of discectomy patients – ranging from 5% to 24% – require a subsequent surgical intervention due to the recurrence of disc herniation or other complications [6-12].

In light of this, our study undertakes a comprehensive review of HIVD patients who have undergone discectomy over the past 12 years. Our primary objective is to ascertain the incidence rate of revision surgeries and to identify the

***Address for correspondence:** Dr. Kuang-Ting Yeh,

Department of Orthopedics, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, 707, Section 3, Chung-Yang Road, Hualien, Taiwan.

E-mail: micrograft@tzuchi.com.tw

Dr. Wen-Tien Wu,

Department of Orthopedics, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, 707, Section 3, Chung-Yang Road, Hualien, Taiwan.

E-mail: timwu@tzuchi.com.tw

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risk factors associated with such reoperations. Through this research, we aim to augment the current understanding of HIVD treatment paradigms and propose more targeted, effective treatment strategies for preventing the necessity of revision surgeries.

MATERIALS AND METHODS

Ethical approval for this retrospective study was granted by the Research Ethics Committee of Hualien Tzu Chi Hospital, under approval number IRB101-128. In alignment with the committee's guidelines, the requirement for written informed consent was waived. This was conducted in accordance with the Declaration of Helsinki.

We conducted a comprehensive review of medical records for patients diagnosed with single-level lumbar HIVD between January 1, 2000, and December 31, 2012, at Hualien Tzu Chi Hospital. Diagnoses were confirmed through magnetic resonance imaging (MRI) or myelographic studies. Patients were considered eligible for the study if they met the following inclusion criteria: (1) documented history of and ongoing sciatica symptoms; (2) single-level disc herniation, as verified through MRI; (3) a postoperative diagnosis by a qualified surgeon confirming the presence of disc herniation.

Patients were excluded from the study if any of the following criteria were present: (1) multilevel disc herniation or spinal stenosis; (2) a history of recurrent disc herniation; (3) prior spinal fusion accompanied by adjacent segment disease; (4) disc herniation with spinal instability requiring fusion; (5) presence of infection or discitis; and (6) incongruity between clinical symptoms and imaging findings.

All included patients underwent open discectomy procedures under general anesthesia while in a prone position. Surgical techniques utilized included annulotomy, subtotal discectomy, and the excision of extruded disc fragments.

To elucidate the etiological factors behind HIVD, we collected data on the incidence of herniation at each segment of the lumbar spine. This information was subsequently analyzed in conjunction with patient age and sex ratios. The endpoint for this study was defined as the time of reoperation. Survival curves were employed to evaluate the duration between initial discectomy and any subsequent reoperation. The study specifically aimed to assess the correlation between the rate of reoperation and various factors, including level of initial discectomy, body mass index, Modic change type measured from the T1-weighted and T2-weighted lumbar disc images, recent smoking habit, diabetes, incidence of heavy lifting postsurgery, sex, age, and surgeon's level of experience. For the purposes of this study, "occupational lifting" was defined as lifting weights >10 kg, with such lifting activities accounting for more than one-third of working hours, constituting significant physical loading [13]. The experience of the surgeon was also investigated as a potential risk factor for reoperation. For the context of this study, a surgeon was considered "senior" if they had 15 or more years of relevant surgical experience. Through this multifaceted approach, we aim to provide a comprehensive understanding of the risk factors associated with reoperation following discectomy for

lumbar HIVD, thereby informing more effective treatment strategies for this patient population.

Statistical analysis

Descriptive statistics were calculated for all the variables of interest. Categorical measures were summarized as counts and percentages and continuous measures were summarized as means and standard deviations. The results for the continuous variables were compared using the independent two-sample *t*-test. The categorical variables were compared using the Chi-squared test or Fisher's exact test. Multivariate Cox proportional hazard models for demographic and clinical covariates were used to investigate reoperation risk. $P < 0.05$ was considered statistically significant. All statistical analyses were performed using the SPSS software (version 17.0; SPSS Inc., Chicago, IL, USA).

RESULTS

Our study enrolled a total of 619 patients who underwent discectomy for lumbar HIVD between January 1, 2000, and

Table 1: Demographics of the patients who have received discectomy

| Item | Female | Male | Total | P |
|------------------------------------|------------|------------|------------|---------|
| <i>n</i> | 208 | 411 | 619 | |
| Age (years old) | | | | |
| <40 | 47 (22.6) | 118 (28.7) | 165 (26.7) | 0.027* |
| 40–60 | 97 (46.6) | 205 (49.9) | 302 (48.8) | |
| ≥60 | 64 (30.8) | 88 (21.4) | 152 (24.6) | |
| Level | | | | |
| L1–2 | 1 (0.5) | 0 | 1 (0.2) | 0.022* |
| L2–3 | 0 | 12 (2.9) | 12 (1.9) | |
| L3–4 | 23 (11.1) | 40 (9.7) | 63 (10.2) | |
| L4–5 | 109 (52.4) | 194 (47.2) | 303 (48.9) | |
| L5–S1 | 75 (36.1) | 165 (40.1) | 240 (38.8) | |
| Modic change type | | | | |
| 0 | 81 (38.9) | 152 (37.0) | 233 (37.6) | 0.151 |
| 1 | 14 (6.7) | 29 (7.1) | 43 (6.9) | |
| 2 | 41 (19.7) | 90 (21.9) | 131 (21.5) | |
| 3 | 72 (34.6) | 140 (34.1) | 212 (34.2) | |
| Diabetes | | | | |
| No | 200 (96.2) | 399 (97.1) | 599 (96.8) | 0.436 |
| Yes | 8 (3.8) | 12 (2.9) | 20 (3.2) | |
| Smoke habit | | | | |
| No | 207 (99.5) | 406 (98.8) | 613 (99) | 0.068 |
| Yes | 1 (0.5) | 5 (1.2) | 6 (1.0) | |
| BMI | | | | |
| Normal | 73 (36.9) | 111 (30.7) | 184 (32.9) | 0.095 |
| Underweight | 3 (1.5) | 9 (2.5) | 12 (2.1) | |
| Overweight | 54 (27.3) | 133 (36.8) | 187 (33.5) | |
| Obese | 68 (34.3) | 108 (29.9) | 176 (31.5) | |
| Surgeon | | | | |
| Junior | 7 (3.4) | 22 (5.4) | 29 (4.7) | 0.318 |
| Senior | 201 (96.6) | 389 (94.6) | 590 (95.3) | |
| Occupational lifting after surgery | | | | |
| No | 188 (90.4) | 276 (67.2) | 464 (75.0) | <0.001* |
| Yes | 20 (9.6) | 135 (32.8) | 155 (25.0) | |

* $P < 0.05$ was considered statistically significant after the test. Data are presented as *n* (%) or mean±SD. SD: Standard deviation, BMI: Body mass index

December 31, 2012. The cohort consisted of 411 men and 208 women, with a mean age of 49.1 years [Table 1]. The patients were followed up for an average period of 4.8 years. The age distribution was skewed toward middle age, with approximately 50% of the patients falling within the 40–60-year age bracket. Patients below 40 and above 60 years accounted for 25% of the population each. The most frequent sites for disc herniation were observed to be at the L4/5 (48.9%) and L5/S1 (38.8%) levels [Table 1]. 20 (3.2%) of them had diabetes, and 6 (1.0%) of them had recent smoking habit. 233 (37.6%) of the patients had Modic change type 0, 43 (6.9%) of them had Modic change type 2, 131 (21.5%) of them had Modic change type 2, and 212 (34.2%) of them had Modic change type 3. Notably, over 60% of the cohort was overweight, and 25% reported engagement in heavy lifting tasks [Table 1].

Analysis of survivorship data revealed that more than 92% of the 619 patients had a survival time exceeding 8 years postdiscectomy [Figure 1]. The overall reoperation rate was approximately 7.8% (48 patients), with an average interval to reoperation being 1.7 years. Among those who required reoperation, 25 patients (52%) underwent fusion surgery due to lumbar hypermobility, 20 patients (42%) had repeated discectomies, and the remaining 3 patients (6%) received debridement procedures.

Our multivariate analysis yielded significant insights into risk factors associated with reoperation. The significant risk factors included age more than 60 years ($P < 0.001$), female gender ($P = 0.001$), surgeon experience < 15 years ($P = 0.047$), and occupational lifting after surgery ($P < 0.001$) [Table 2].

DISCUSSION

HIVD results in lumbar pain and motor and sensory deficit. Approximately 70%–90% of patients received a positive outcome with a nonsurgical treatment [14–18]. For severe and persistent leg pain and persistent paresis such as motor deficit and bowel bladder and disturbance, discectomy could improve the symptoms. The results have shown worse outcomes after reoperation for patients with sciatica for a duration of > 8 months [19,20]. The earliest discectomy was described in 1934 by Mixter and Barr, who demonstrated an effective treatment for sciatica symptoms caused by HIVD [21,22]. However, the long-term reoperation rate was up to 24% after lumbar discectomy [6–12,23], and the most common reason was recurrent disc herniation [11,24–46]. The average time for reherniation was 45.6–80.8 months [24,47]. Histological analysis showed that $> 75\%$ of these recurrent substances were endplate material [25].

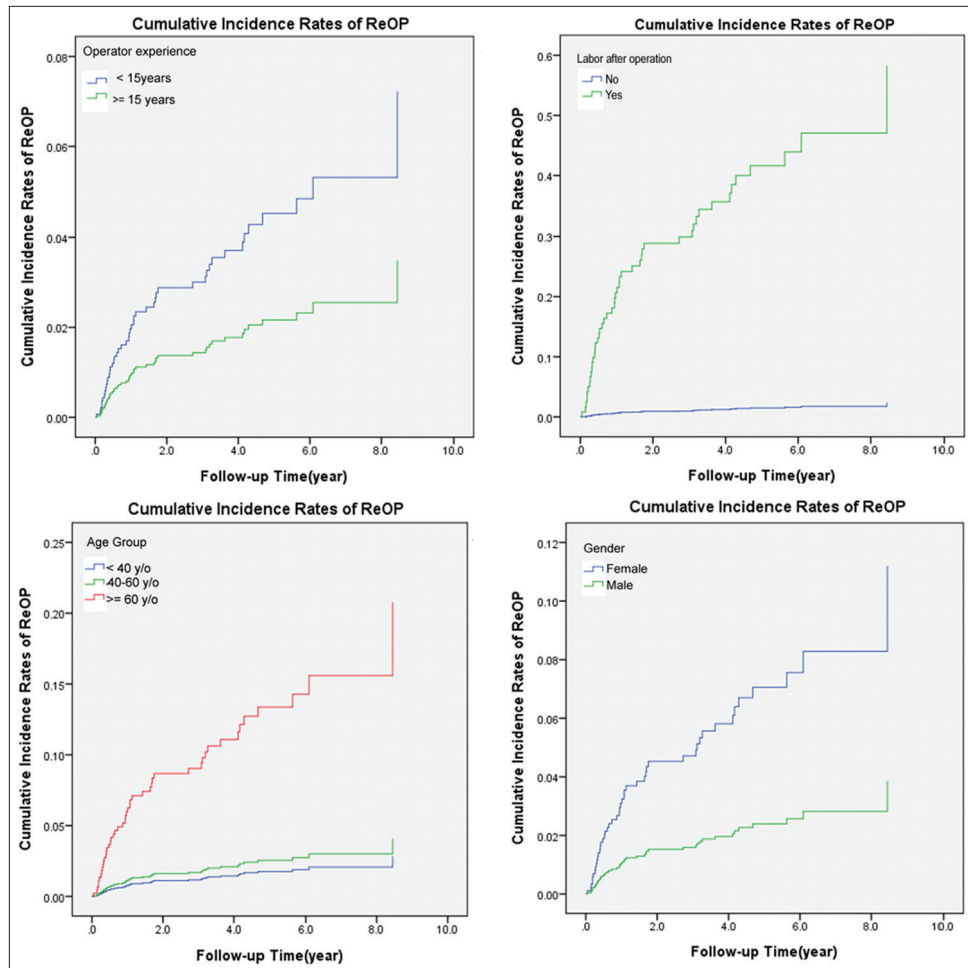


Figure 1: Cumulative incidence of reoperation after surgery of herniated intervertebral disc disease

Table 2: Hazard ratios for reoperation according to prognostic factors (n=606)

| Prognostic variables | Reoperation, n (%) | Hazard ratio ^b (95% CI) | | | |
|------------------------------------|--------------------|------------------------------------|---------|---------------------|---------|
| | | Crude | P | Adjusted | P |
| Age group (years old) | | | | | |
| <40 | 13 (7.9) | 1.00 | | 1.00 | |
| 40–60 | 22 (7.5) | 0.94 (0.48–1.89) | 0.890 | 1.46 (0.67–3.18) | 0.345 |
| ≥60 | 13 (8.8) | 1.25 (0.58–2.71) | 0.566 | 8.09 (2.81–23.35) | <0.001* |
| Gender | | | | | |
| Female | 18 (8.7) | 1.00 | | 1.00 | |
| Male | 30 (7.5) | 0.84 (0.47–1.50) | 0.554 | 0.33 (0.17–0.65) | 0.001* |
| Level | | | | | |
| L3–4 | 5 (7.9) | 1.00 | | 1.00 | |
| L4–5 | 21 (6.9) | 0.84 (0.32–2.22) | 0.719 | 0.69 (0.24–1.93) | 0.475 |
| L5–S1 | 22 (9.2) | 1.15 (0.44–3.04) | 0.777 | 1.04 (0.36–3.01) | 0.936 |
| Modic change type | | | | | |
| 0 | 15 (6.4) | 1.00 | | 1.00 | |
| 1 | 7 (16.3) | 1.35 (0.74–2.03) | 0.352 | 1.02 (0.71–2.02) | 0.293 |
| 2 | 24 (18.3) | 1.47 (0.81–2.16) | 0.311 | 1.08 (0.82–2.23) | 0.251 |
| 3 | 2 (0.9) | 0.75 (0.54–1.12) | 0.412 | 0.81 (0.62–1.17) | 0.481 |
| Diabetes | | | | | |
| No | 42 (7.0) | 1.00 | | 1.00 | |
| Yes | 6 (30.0) | 3.02 (1.02–3.61) | 0.041* | 1.84 (0.91–3.84) | 0.098 |
| Smoke habit | | | | | |
| No | 46 (7.5) | 1.00 | | 1.00 | |
| Yes | 2 (33.3) | 3.14 (1.21–4.32) | 0.032* | 2.01 (0.98–4.12) | 0.085 |
| BMI | | | | | |
| Normal | 14 (7.7) | 1.00 | | 1.00 | |
| Underweight | 1 (8.3) | 0.97 (0.13–7.39) | 0.976 | 1.35 (0.17–10.71) | 0.777 |
| Overweight | 19 (10.3) | 1.36 (0.68–2.71) | 0.383 | 1.35 (0.65–2.80) | 0.423 |
| Obesity | 7 (9.9) | 1.38 (0.56–3.43) | 0.486 | 1.76 (0.70–4.47) | 0.233 |
| Surgeon experience (years) | | | | | |
| <15 | 38 (9.1) | 1.00 | | 1.00 | |
| ≥15 | 10 (5.3) | 0.63 (0.31–1.26) | 0.191 | 0.47 (0.23–0.99) | 0.047* |
| Occupational lifting after surgery | | | | | |
| No | 12 (2.6) | 1.00 | | 1.00 | |
| Yes | 36 (23.5) | 9.67 (5.03–18.59) | <0.001* | 36.40 (15.37–86.18) | <0.001* |

* $P < 0.05$ was considered statistically significant, ^aMissing value for any predictor were excluded from the analysis, ^bCox's proportional hazards model. CI: Confidence interval, BMI: Body mass index

Our study showed that the recurrent rate was approximately 7.8%, the average time was 20.3 months, and the reoperation rate was <8%. Some opine that subtotal discectomy is an acceptable technique to reduce the reherniation rate after lumbar discectomy [24]. However, sequestrectomy or discectomy cannot prevent reherniation [25]. Moreover, some authors have demonstrated that lumbar disc herniation with massive herniation or segmental instability require fusion at the first time of surgery [44,46,48]. Among patients undergoing reoperation, 20 (42%) received discectomy and 25 (25%) received fusion surgery. Most of the patients belonged to the working class, of which 44% consisted of laborers. However, 25% of the patients continued occupational lifting after the surgery, which is the most important risk factor for revision surgery. Furthermore, obesity increased the load of lumbar spine that may lead to low back pain and disc degeneration [49–54]. Hence, we hypothesized that obesity may increase the reoperation rate, but the difference was statistically nonsignificant. The notable presence of elderly patients representing a quarter of our study cohort with lumbar disc herniation reflects several broader trends. First, the aging

global population and increased lifespan have resulted in a higher incidence of spinal conditions, including disc herniation, in the elderly [55]. Advances in diagnostic techniques, particularly MRI, have also improved the detection of such conditions in older adults. The evolving lifestyle and activity levels of modern elderly populations may predispose them to conditions traditionally associated with younger individuals. In addition, the elderly often present with a combination of degenerative spinal changes and disc herniation, necessitating intervention [56]. These factors, along with a need to reevaluate epidemiological perspectives on spinal conditions in different age groups, could explain the higher than expected proportion of elderly patients in our study.

For patients aged <40 and >60 years, the reoperation rate increased by 18 times. These results agree with previous studies that have indicated that young patients could obtain better outcomes [21]. For the elderly people, the discectomy may disturb the stability of the lumbar spine and increase the symptoms due to poor disc quality and combination hypermobility. Therefore, elderly patients may be considered

for the primary fusion, considering factors such as disc quality, symptoms with degeneration, and wide laminectomy. The primary fusion could reduce the reoperation rate. In addition, the reoperation rate was related to the operation experience of the surgeon involved. Therefore, the reoperation risk decreased if a senior surgeon performed the surgery. Our observation that female gender is a risk factor for reoperation after lumbar discectomy is multifaceted, influenced by biomechanical, hormonal, and lifestyle factors. Women's unique spinal biomechanics, including variations in pelvic structure and lumbar curvature, can affect lumbar disc stress [57]. Hormonally, estrogen plays a significant role in collagen synthesis within intervertebral discs, potentially impacting healing postdiscectomy [58]. Postmenopausal women are more susceptible to reduced bone density, influencing spinal stability. In addition, gender differences in muscle mass and pain perception could affect postoperative outcomes and pain management, leading to a higher reoperation rate in women [59]. Finally, lifestyle and occupational factors, such as heavy lifting, might disproportionately impact women due to these physiological differences [60].

There were some limitations of this study. This was a retrospective study, and we did not record the pain-related score and functional outcomes, before and after the surgery. We analyzed only patients who underwent reoperation but excluded patients who refused surgery and were unable to undergo surgery due to lumbar hypermobility. Thus, we may have overestimated the reoperation rate by including patients who just needed conservative treatment but opted for an operation. We did not classify disc herniation based on severity, which may cause a difference in the reoperation rate.

CONCLUSIONS

The reoperation rate may decrease if a senior surgeon performs the surgery. Furthermore, the surgeon must educate the patients regarding the need to decrease occupational lifting after the discectomy. For elderly patients, HIVD may be considered for the degeneration of the lumbar spine, or a conservative treatment may be selected.

Data availability statement

All the data generated or analyzed during this study are included in this published article.

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Conflicts of interest

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