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Original Article

Influence of rapid recovery nutritional support on functional recovery and hospitalization duration in patients undergoing minimally invasive lumbar surgery

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Abstract: Objective: To examine the impact of a nutrition support model, specifically focused on rapid recovery, on postoperative recovery in patients with degenerative lumbar spinal stenosis who underwent minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF). Methods: A retrospective analysis was conducted, utilizing the medical records of 114 patients with degenerative lumbar spinal stenosis who underwent MIS-TLIF at the Affiliated Hospital of Gansu University of Chinese Medicine from February 2020 to October 2022. Among these patients, 63 individuals received a nutrition support model based on the concept of rapid recovery, comprising the observation group, while the remaining 51 patients received conventional postoperative support, forming the control group. The study compared the post-intervention lumbar function recovery, postoperative pain score, perioperative hospital stay, and patient satisfaction with nursing work between the two groups. Results: There was no statistically significant difference in the Japanese Orthopaedic Association (JOA) score and Oswestry Disability Index (ODI) at 6 months after the intervention between the two groups ($P>0.05$). Similarly, there was no statistically significant difference in the modified Barthel index and visual analog scale scores at 6 months after the intervention between the two groups ($P>0.05$). In terms of operation time and intraoperative blood loss, there was no statistically significant difference observed between the observation group and the control group ($P>0.05$). However, when compared to the control group, the observation group showed significant shorter hospital stay and time to ambulation after the intervention, leading to a decrease in treatment cost ($P<0.01$). Multivariate logistic regression analysis revealed that age, history of diabetes, nursing plan, operation time, and preoperative JOA score were identified as independent risk factors for prolonged hospital stay ($P<0.05$). Conclusion: The nutrition support model, which is based on the concept of rapid recovery, has been found to have several benefits for patients with degenerative lumbar spinal stenosis undergoing MIS-TLIF. These benefits include reducing the hospital stay, treatment cost, and the time to ambulation. Additionally, logistic regression analysis has identified several independent risk factors that can affect the length of hospital stay. These risk factors include age, history of diabetes, nursing plan, operation time, and preoperative JOA score.

Keywords: Rapid recovery concept, nutrition support model, minimally invasive transforaminal lumbar interbody fusion, degenerative lumbar spinal stenosis

Introduction

Lumbar diseases, the second most prevalent joint condition after knee diseases, have high incidence rates, early onset, and severe impairment [1]. Degenerative disorders of a single lumbar segment primarily affect middle-aged women around 45 years old [2]. This is mainly attributed to the gradual decline in hormone levels as women age, leading to degeneration and atrophy of the articular cartilage of the lumbar facet joints. Consequently, degenerative changes occur in the lumbar joints [3]. In some cases, patients may experience lumbar instability or slippage, significantly impacting their lumbar mobility and overall quality of life.

Surgery is currently the preferred treatment for this condition when conservative methods fail [4]. Traditional open surgery can effectively address spinal stenosis, but it often leads to extensive surgical trauma and a long recovery period, which may not be suitable for elderly patients seeking to restore physical function. In some cases, severely ill patients may not be able to tolerate traditional surgery [5]. Though spinal decompression surgery can effectively relieve patients' symptoms, some researchers have suggested that decompression alone can result in instability between the vertebrae, or iatrogenic instability caused by the decompression itself [6]. Therefore, taking various factors into consideration, spinal decompression and fusion surgery has become the mainstream approach for treating degenerative lumbar diseases, effectively alleviating low back and leg pain in patients. There are several types of spinal fusion surgeries, including transforaminal lumbar interbody fusion (TLIF), anterior lumbar interbody fusion (ALIF), posterior lumbar interbody fusion (PLIF), lateral lumbar interbody fusion (LLIF), minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF), and percutaneous endoscopic lumbar foraminotomy and discectomy (PELD) [7]. Among these, PLIF and TLIF have shown significant improvements in low back pain and lumbar function in elderly patients with single-level degenerative lumbar disease. However, the extensive removal of paravertebral soft tissues during these surgeries can result in substantial surgical trauma [8]. As a result, minimally invasive techniques have gained popularity as an alternative in recent years.

MIS-TLIF, a minimally invasive surgical method derived from lumbar minimally invasive fusion surgery, has shown positive clinical outcomes in patients with lumbar spinal stenosis [9, 10]. However, to ensure a prompt recovery, timely and appropriate nursing interventions are still necessary after MIS-TLIF. The Enhanced Recovery After Surgery (ERAS) program, which encompasses pre-admission, pre-surgery, intraoperative, and postoperative stages [11], is essential for achieving rapid recovery. Evidence-based perioperative interventions can effectively reduce surgical stress and trauma, expediting the recovery process. Additionally, surgical trauma often leads to postoperative malnutrition due to significant protein and fat loss from excessive blood loss [12]. Malnutrition poses a risk for complications and negatively impacts patient health. Nutritional support has been shown to enhance albumin and hemoglobin levels in elderly patients with hip fractures [13]. However, it is not yet clear whether ERAS combined with a nutrition support model can accelerate the postoperative recovery of patients with degenerative lumbar spinal stenosis.

In this study, our aim is to analyze the impact of a nutrition support model based on the rapid recovery concept on the postoperative recovery of patients with degenerative lumbar spinal stenosis undergoing MIS-TLIF, and to identify the factors influencing the occurrence of postoperative complications in patients, hoping to provide novel guidance for clinical nursing plans.

Materials and methods

Clinical data

We retrospectively analyzed the medical records of 148 patients with degenerative lumbar spinal stenosis who underwent minimally invasive channel fusion surgery at the Affiliated Hospital of Gansu University of Chinese Medicine from February 2020 to October 2022. This study was approved by the medical ethics committee of Affiliated Hospital of Gansu University of Chinese Medicine (2022-130).

Diagnostic criteria

The diagnostic criteria for degenerative lumbar spinal stenosis are derived from the Evidence-Based Guidelines issued by the North American Spine Society (NASS) in 2007 [14]. For a patient to be diagnosed with degenerative lumbar spinal stenosis, they must exhibit: a chronic history of lower back pain, with some patients also having a history of trauma; persistent recurrence of pain in the lower back and legs or intermittent claudication; limitations in lumbar extension accompanied by pain; radicular symptoms in the lower limbs, predominantly bilateral, becoming more prominent during walking; osteophyte formation within the vertebral body and hypertrophy of the small joints (suggested by lumbar X-ray); a lumbar spinal canal cross-sectional area of less than 100 mm^2 and a nerve root canal (lateral recess) measuring less than 4 mm (revealed by CT scans). For a definitive diagnosis of degenerative lumbar spinal stenosis, in the absence of other correlated diseases, patients must meet both the first and second criteria, at least one of the fifth or sixth criteria, and a minimum of one from the third or fourth criteria.

Inclusion and exclusion criteria

The patient inclusion criteria are as follows: (1) patients who meet the diagnostic criteria for degenerative lumbar spinal stenosis; (2) patients with clear surgical indications, including a. severe lower limb pain that significantly affects their quality of life, b. objective signs of nerve damage such as decreased lower limb sensation, atrophy of lower limb muscles, and decreased lower limb strength, c. typical neurogenic intermittent claudication symptoms with a walking distance of less than 500 m, severely impacting their daily life, and d. persistent symptoms for over 3 months without improvement after conservative treatment, severely affecting their quality of life; (3) patients who were willing to cooperate with the interventions; (4) patients with complete clinical data. The patient exclusion criteria are as follows: (1) patients with concurrent mental illness or intellectual disability; (2) patients with other poorly controlled diseases during hospitalization that severely affected their quality of life; (3) patients with severe infectious diseases; (4) patients with severe liver and kidney dysfunction, tumors, or diseases of the blood or immune system.

Sample selection

According to the inclusion and exclusion criteria, 148 patients were screened and 114 patients were included in this study. We calculated the number of subjects we needed according to the sample size calculation formula:

$$n = \left(\frac{\left(Z_{\alpha/2} + Z_{\beta}\right)^2 \times \left(p_1\left(1 - p_1\right) + p_2\left(1 - p_2\right)\right)}{\left(p_1 - p_2\right)^2} \right).$$

The event rates for the two groups: p1 = 26.9% and p2 = 56.8%, where $Z\alpha/2$ was 1.96 for a significance level of 0.05. The target efficacy was 0.8, at which $Z\beta$ was approximately 0.84. The required sample size for each group was calculated to be 39 individuals. In order to make comparisons between the two groups, the total sample size should be 78 individuals. Based on the actual situation we collected a total of 114 patients and the number of patients in each group exceeded the expected number, our sample size meets the requirements. Among them, 51 patients who underwent the conventional support mode after surgery were included in the control group; 63 patients who underwent nutritional the support mode based on the concept of fast recovery were assigned to the observation group.

Nursing schemes

The patients in the control group underwent minimally invasive spinal fusion surgery + routine orthopedic care. Routine care included: instructing the patient to fast and abstain from water as required by the doctor before surgery, closely monitoring the patient's vital signs during surgery, routinely using a tourniquet to control bleeding, carrying out passive knee joint rehabilitation training with the assistance of a nurse after surgery, gradually resuming normal hydration and feeding rhythm, and providing pain relief with a pain pump.

The observation group received an additional nutritional support plan based on the concept of accelerated recovery surgery. Specific measures were as follows: routine nutritional assessment for patients, collaboration with the nutrition department for malnourished patients, preoperative nutritional support, and selection of nutritional support route in the following order - oral, enteral, parenteral. Joint nutritional assessment was performed with a dietician to formulate a nutritional plan. Patients were encouraged to consume eggs, lean meat and other high-quality proteins. Elemental diets or high-protein nutritional drinks were prepared for malnourished patients or those with hypoalbuminemia. Gastrointestinal motility drugs and digestive aids were used. Preoperative and postoperative nutrition meal plans were customized in cooperation with the nutrition department.

On the day of surgery, fasting time before anesthesia was determined according to the type of food - clear fluids 2 h, formula milk 6 h, easily digestible solids (e.g., white porridge, steamed buns) 6 h, in cooperation with the anesthesia department and nutrition department. Orthopedic quick recovery clear drinks were prepared, including preoperative nutritional drinks, postoperative appetite soups, etc. Patients could eat normally the night before surgery and did not need special bowel preparation in the morning. Since most orthopedic patients do not need routine bowel preparation, the next step is to promote preoperative nutritional drinks and postoperative appetite soups throughout the orthopedic department.

Various perioperative blood management measures were taken, including preoperative assessment of expected blood loss, preoperative hemoglobin level, nutritional status, medical complications, and patient's stress response. For preoperative anemia, the potential cause was evaluated and targetedly treated. Nutritional guidance and balanced diet were provided to increase protein and iron/folate/vitamin intake while avoiding inhibitors of iron absorption. Collaboration with anesthesiologists was established to ensure controlled hypotension and tourniquet use. Postoperatively, ice, pressure dressings and nutritional support were used.

Early rehabilitation exercise was initiated as soon as possible postoperatively. Discharge criteria included ability to dress and ambulation (get in/out of bed, stand from chair/toilet, walk ≥70 m with aids). Post-discharge guidance on medication, rehabilitation, and follow-up was provided.

Clinical data collection

Patient clinical data were collected from electronic medical records and outpatient follow-up records. The clinical data included age, gender, surgical site, Body Mass Index (BMI), systolic blood pressure, diastolic blood pressure, heart rate, smoking history, alcohol abuse history, diabetes, and hypertension. Functional scores included Visual Analog Scale (VAS), Oswestry Disability Index (ODI), Modified Barthel Index (MBI), and Japanese Orthopaedic Association Score (JOA). General data included surgical time, intraoperative blood loss, hospital stay duration, treatment cost, and time to ambulation post-surgery.

Outcome measures

The baseline differences were compared between the two patient groups. The pre- and post-intervention JOA and ODI scores were compared between the groups. The surgical time, intraoperative blood loss, length of hospital stay, and treatment costs were compared between the groups. The changes in MBI and VAS scores before and after intervention were compared between the groups. The factors affecting length of hospital stay were analyzed, categorizing patients with >7 days of stay as prolonged stay and ≤7 days as normal stay. The risk factors for prolonged hospital stay were identified.

Functional scores

VAS is subjective scale evaluating pain severity. VAS scores range from 0-10, with 0 as no pain and 10 as maximum pain. Higher scores indicate greater pain [15].

ODI was applied to assess functional disability in spinal conditions. ODI scores range from 0-100 and are categorized as: 0-20% (minimal disability), 20-40% (moderate disability), 40-60% (severe disability), 60-80% (crippling disability), and 80-100% (bedridden). Higher scores indicate greater disability [16].

MBI was employed to evaluate patients' ability to perform activities of daily living. MBI scores range from 0-100, with 100 as fully independent and 0 as totally dependent. Higher scores indicate greater self-care ability [17].

JOA scale is a clinical assessment tool for orthopedic diseases, especially spinal conditions. The total score is 17, with higher scores indicating milder symptoms. The scoring system varies based on the specific condition [18].

Statistical analysis

Statistical analyses were conducted using SPSS 26.0. Count data are presented as percentages (%), with the chi-square test employed for intergroup comparisons. Measurement data are denoted as mean ± SD. The independent sample t-test facilitated between-group comparisons, while the paired t-test was applied for intragroup comparisons. Logistic regression analysis was applied to identify the risk factors

Table 1. The baseline data sheet

Factor	Control Group (n = 51)	Observation Group (n = 63)	χ^2/t value	*P* value
Age (years)			1.341	0.247
≥60	33	34		
<60	18	29		
Gender			0.339	0.56
Male	28	38		
Female	23	25		
Operative site			0.625	0.428
L4/5	24	25		
L5/S1	27	38		
BMI (kg/m^2)			0.135	0.713
≥25	13	18		
<25	38	45		
Systolic blood pressure (mmHg)	112.25±14.85	109.86±15	0.852	0.395
Diastolic blood pressure (mmHg)	84.57±12.32	84.19±10.42	0.177	0.859
Heart rate (beats/min)	84.9±8.53	84.78±8.64	0.076	0.939
Smoking history			0.339	0.56
Present	28	38		
Absent	23	25		
Alcohol abuse history			0.122	0.726
Present	5	5		
Absent	46	58		
Diabetes history			2.318	0.127
Present	11	7		
Absent	40	56		
Hypertension history			0.228	0.632
Present	11	16		
Absent	40	47		

Note: BMI, Body Mass Index.

influencing extended hospital stay. Statistical significance is set at a *p*-value of <0.05.

Results

Baseline data comparison

A thorough statistical evaluation of clinical data from both patient groups was undertaken. The results reveal no significant variances in parameters such as age, gender, surgical site, BMI, systolic/diastolic blood pressure, heart rate, and histories of smoking, alcohol consumption, diabetes, and hypertension between the two cohorts (P>0.05, **Table 1**).

Comparison of pre- and post-intervention disability scores

The JOA and ODI scores of both patient groups were juxtaposed pre-intervention and six months post-intervention. Preliminary results highlighted no discernible differences in the pre-intervention JOA and ODI scores between the groups (P>0.05, **Figure 1**). At the six-month post-intervention mark, there was a notable elevation in the JOA scores and a commensurate decline in the ODI scores for both groups (P>0.05, **Figure 1**). Yet, no significant disparities were observed in the JOA and ODI scores between the groups at this juncture (P>0.05, **Figure 1**).

Comparison of pre- and post-intervention self-care ability and pain scores

The study also encompassed a comparative analysis of the MBI and VAS scores for both patient groups pre- and post-intervention. Initial results indicated no statistical variations in the pre-intervention MBI and VAS scores across the groups (P>0.05, **Figure 2**). Post the

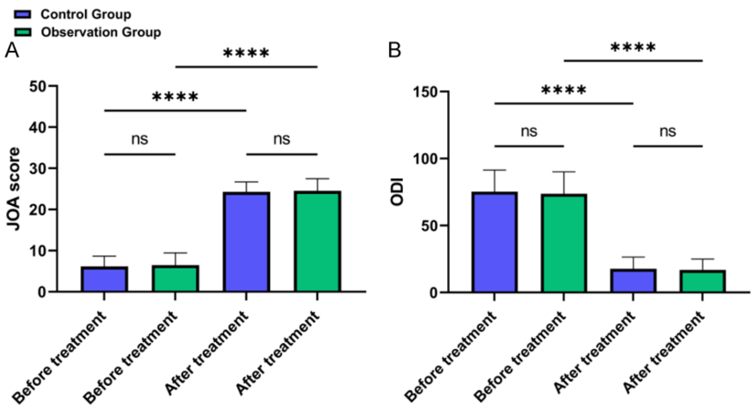

Figure 1. Changes in JOA scores and ODI before and after patient intervention. A. Comparison of JOA scores before and after patient intervention. B. Comparison of ODI before and after patient intervention. Note: nsP>0.05, ****P<0.0001; JOA, Japanese Orthopaedic Association Score; ODI, Oswestry Disability Index.

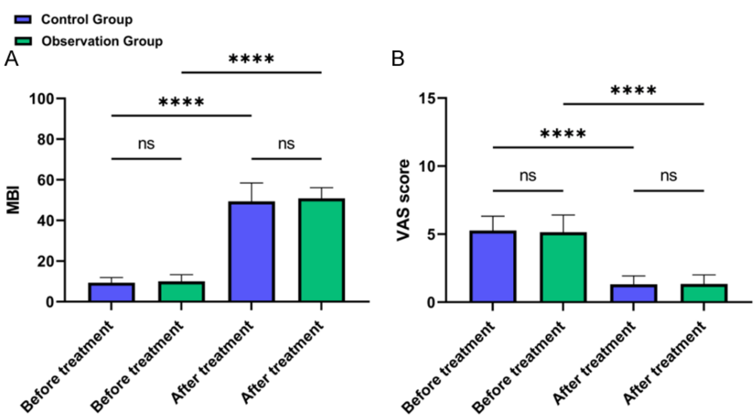

Figure 2. Changes in MBI and VAS scores before and after patient intervention. A. Comparison of MBI before and after patient intervention. B. Comparison of VAS scores before and after patient intervention. Note: nsP>0.05, ****P<0.0001; VAS, Visual Analog Scale; MBI, Modified Barthel Index.

six-month intervention, both groups exhibited a pronounced escalation in MBI scores and a corresponding descent in VAS scores (P<0.05, **Figure 2**). Yet, the MBI and VAS scores remained statistically consistent between the groups at this stage (P>0.05, **Figure 2**).

General data comparison

Factors such as surgical duration, intraoperative blood loss, hospital stay length, treatment expenses, and post-surgery mobility were assessed and compared. While no significant differences emerged in surgical duration and intraoperative blood loss between the observation group and the control group (P>0.05, **Figure 3**), the observation group showcased a markedly shorter hospital stay and quicker post-operative mobility, coupled with lower treatment costs compared to the control group (P<0.01, **Figure 3**).

Risk factors analysis for prolonged hospital stay

Patients were categorized based on hospital stay: those with a stay exceeding 7 days were designated as the 'prolonged group', and those with a stay within or equal to 7 days were set as the 'normal group'. Out of the total, 46 patients were classified into the prolonged group, while the remaining 68 were allocated to the normal group. Univariate analysis revealed that attributes such as age, history of diabetes, nursing approach, surgical duration, intraoperative blood loss, post-surgery mobility time, and preoperative JOA scores were significantly associated with long hospital stay (P<0.05, **Table 2**). After assigning data values (**Table 3**), logistic regression analysis identified age, history of diabetes, nursing plans, surgical duration, and preoperative JOA score as independent risk factors for prolonged hospital stay (P<0.05, **Table 4**).

Discussion

Lumbar spinal stenosis is a common condition among middle-aged and elderly individuals, and its prevalence has been increasing in recent years. As a result, postoperative care has become a significant focus of attention [19]. When the lumbar canal narrows, it can compress the cauda equina nerves, leading to symptoms such as lower back and leg pain. In some cases, the nerve roots may also be compressed due to lateral narrowing, which dis-

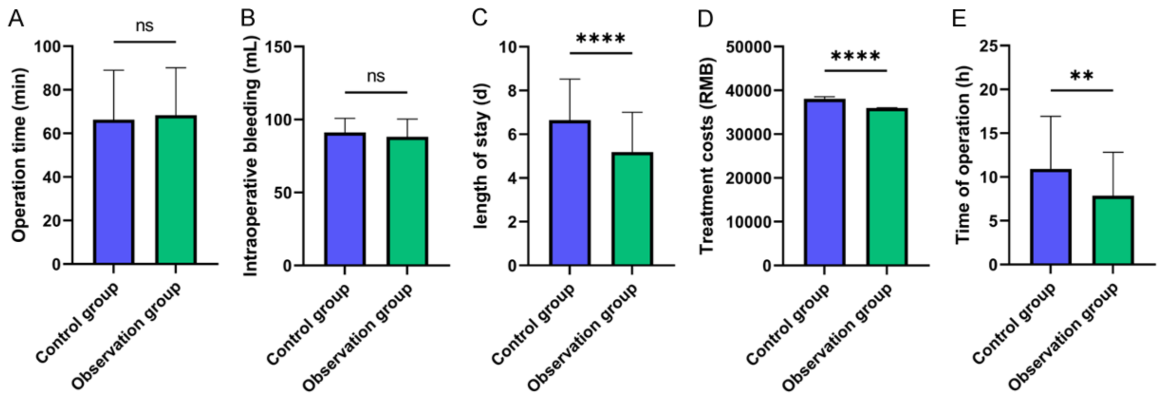

Figure 3. Comparison of general patient information. A. Comparison of surgery time between two groups of patients. B. Comparison of intraoperative blood loss between two groups of patients. C. Comparison of hospital stay between two groups of patients. D. Comparison of treatment costs between two groups of patients. E. Comparison of the time to ambulation between two groups of patients. Note: nsP>0.05, **P<0.01, ****P<0.0001.

rupts the flow of axoplasm, causes swelling of the nerve sheath, and stimulates nerve endings. Additionally, patients may experience lower back and leg pain due to tissue hypoxia caused by blood circulation blockage or local congestion from venous reflux obstruction [20, 21]. The pain experienced by many patients with lumbar spinal stenosis severely limits their mobility and significantly impacts their daily lives. These long-term symptoms also impose immense psychological pressure on the patients.

MIS-TLIF, an evolution of lumbar fusion surgery, is a minimally invasive solution that has shown effective clinical outcomes in patients with lumbar spinal stenosis [22]. However, the postoperative phase of MIS-TLIF still requires timely and relevant nursing interventions to expedite patient recovery. The nutritional support model, integrated into the rapid recovery framework, takes a comprehensive and structured approach to nutritional management. Its main goals include reducing preoperative fasting time, increasing postoperative nutritional intake, preventing complications, and promoting postoperative recovery through strategic nutritional supplementation [23]. This model begins with a thorough preoperative nutritional assessment to determine the patient's nutritional needs. It then aims to reduce surgical stress and maintain optimal blood sugar levels by minimizing preoperative fasting and providing nutritional support. Following surgery, the model supports resuming dietary intake as soon as vital signs stabilize. It promotes recovery through personalized nutritional interventions, with a focus on replenishing proteins and energy nutrients in a careful manner [24]. By implementing this comprehensive nutritional plan, the rapid recovery paradigm aims to reduce surgical complications, increase patient satisfaction, and speed up the recovery process [25].

In our investigation, we found that the rapid recovery nutritional support paradigm did not lead to any noticeable differences in JOA, ODI, MBI, or VAS scores between the two patient groups six months after the intervention. This suggests that the rapid recovery nutritional model does not significantly affect the functional impairment, quality of life, or postoperative pain experience of patients with degenerative lumbar spinal stenosis. We hypothesize that this could be due to the effectiveness of both models. By the six-month evaluation, patients may have reached their maximum recovery, leaving little room for further improvement. Additionally, the six-month duration may not have been enough to show clear distinctions between the two approaches. Furthermore, the response to recovery can vary among patients. While some may benefit greatly from the rapid recovery nutritional model, others may not, potentially canceling out any statistical differences. This sentiment aligns with the findings of Kerolus et al. [26], who also found no differences in postoperative pain scores among patients undergoing MIS-TLIF when using the rapid recovery framework. These results support our own observations and emphasize that

Table 2. Univariate analysis of factors affecting prolonged hospital stay

Factor	Delayed Group (n = 46)	Normal Group (n = 68)	χ^2/t value	*P* value
Age (years)			9.542	0.002
≥60	35	32		
<60	11	36		
Gender			1.972	0.160
Male	23	43		
Female	23	25		
Operative site			0.466	0.494
L4/5	18	31		
L5/S1	28	37		
BMI (kg/m^2)			0.409	0.522
≥25	14	17		
<25	32	51		
Smoking history			0.280	0.596
Present	28	38		
Absent	18	30		
Alcohol abuse history			0.424	0.514
Present	5	5		
Absent	41	63		
Diabetes history			12.441	0.001
Present	14	4		
Absent	32	64		
Hypertension history			0.723	0.394
Present	9	18		
Absent	37	50		
Nursing plan			10.451	0.001
Control group	29	22		
Observation group	17	46		
Systolic blood pressure (mmHg)	111.54±14.24	110.51±15.45	0.359	0.719
Diastolic blood pressure (mmHg)	84.04±11.95	84.57±10.85	0.245	0.806
Heart rate (beats/min)	83.91±7.65	85.46±9.12	0.944	0.347
Operation time (min)	75.91±21.85	61.74±20.49	3.529	0.001
Intraoperative blood loss (mL)	93.39±10.83	86.9±10.62	3.179	0.002
Treatment cost (RMB)	37159.89±1096.22	36761.50±1055.96	1.946	0.054
Time to get up (h)	10.54±6.57	8.34±4.77	2.077	0.040
Preoperative JOA score	3.88±2.85	5.52±2.39	2.666	0.008
Preoperative ODI	75.35±15.12	73.76±17.06	0.508	0.612
Preoperative MBI	9.63±3.17	9.82±2.82	0.34	0.733
Preoperative VAS score	5.09±1.09	5.28±1.22	0.861	0.390

Note: BMI, Body Mass Index; JOA, Japanese Orthopaedic Association Score; ODI, Oswestry Disability Index; VAS, Visual Analog Scale; MBI, Modified Barthel Index.

the rapid recovery model does not automatically alleviate postoperative pain.

In our study, we found no significant differences in surgical duration or intraoperative blood loss as compared with the control group. This can be attributed to the consistent use of surgical techniques and the expertise of the surgical team. Since both groups were managed by equally skilled teams, the surgical duration and intraoperative blood loss measures were similar. Interestingly, after the intervention, the observation group showed a noticeable decrease in both hospitalization duration and

Table 3. Assignments

Factor	Value Assignment
Age (years)	≥60 = 1, <60 = 0
History of Diabetes	Present = 1, Absent = 0
Operation Time (min)	≥60 = 1, <60 = 0
Intraoperative Blood Loss (mL)	≥90 = 1, <90 = 0
Time to get up (h)	≥9 = 1, <9 = 0
Preoperative JOA Score	≥6 = 1, <6 = 0
Extended Discharge Time	Delayed Group = 1, Normal Group = 0

Note: JOA, Japanese Orthopaedic Association Score.

the time to ambulation. As a result, there was a reduction in treatment costs. The findings of Chang et al. [27] confirmed that the use of a rapid recovery model could reduce the hospitalization period for patients undergoing TLIF procedures. Similarly, Feng et al. [28] found that implementing the rapid recovery concept-based nursing resulted in significant reductions in hospitalization duration and treatment costs in patients undergoing MIS-TLIF surgery, which aligns with our own observations. We believe that these positive outcomes are a result of taking a comprehensive approach to patient health, starting with a thorough preoperative nutritional assessment and optimization. By taking proactive measures, the potential for surgical complications is minimized, leading to a faster postoperative recovery and shorter hospital stays. Additionally, dietary protocols have been improved, including updated fasting guidelines and early resumption of dietary intake, along with the introduction of appetizing postoperative soups to aid in recovery. Perioperative blood management enhancements, which include preoperative evaluations and careful monitoring of hemostasis intra- and postoperatively, contribute to the reduction of postoperative complications and facilitate a more efficient recovery process. Early initiation of rehabilitative exercises, with guidance for patients to promptly engage in postoperative activities, not only accelerates recovery but also shortens the hospitalization period. Additionally, providing comprehensive discharge instructions empowers patients to continue their recuperation seamlessly at home, minimizing the need for rehospitalization or follow-up visits. Collectively, these strategic measures result in a significant decrease in overall treatment expenses.

The concept of rapid recovery has gained significant attention from clinicians and patients, particularly in relation to postoperative hospitalization duration [29]. In our research, we examined the factors that contribute to extended hospital stays for patients. Our findings identified age, history of diabetes, nursing strategies, duration of surgery, and preoperative JOA scores as independent risk factors for prolonged hospital stay. Older individuals often have diminished physiological functions, which can result in a slower recovery process. In addition, the elderly population is more susceptible to complications and other illnesses, which can hinder postoperative recovery and require longer hospital stays. This sentiment is supported by Ulrike et al. [30], who emphasized the vulnerability that comes with aging, resulting in a decreased resilience across bodily systems, a weakened response to stressors, and an increase in negative outcomes such as longer hospital stays and higher mortality risk. Maintaining proper blood sugar levels is crucial for diabetic patients' postoperative recovery. Elevated glucose levels can increase the risk of infection, slow down wound healing, and impact overall recovery [31]. Furthermore, a longer surgery duration means the patient is under anesthesia for a longer period, requiring a longer recovery time to recuperate from both the surgical procedure and the effects of anesthesia [32]. The JOA score is used to evaluate symptoms such as lower back pain, leg discomfort, sensory issues in the legs, and bladder dysfunction. A lower score indicates greater severity, suggesting that patients with more severe symptoms may experience a longer recovery after surgery, leading to an extended hospital stay [33]. The rapid recovery surgical paradigm focuses on reducing surgical trauma, speeding up patient recovery, and implementing a comprehensive management approach that covers the preoperative to postoperative phases. This includes providing health education and nutritional enhancements before surgery, optimizing anesthesia and surgical procedures during surgery, and managing pain and nutrition, as well as promoting early mobilization after surgery. These measures collectively contribute to faster patient recovery, lower complication rates, and shorter hospital stays.

Table 4. Logistics regression analysis of factors affecting prolonged hospital stay

Factor	β	SD	χ^2	*P* value	OR value	95% CI	
						Lower	Upper
Age	1.263	0.498	6.418	0.011	3.536	1.331	9.392
History of Diabetes	2.027	0.728	7.740	0.005	7.588	1.820	31.635
Care Plan	1.094	0.485	5.090	0.024	2.985	1.154	7.720
Operation Time	1.510	0.515	8.585	0.003	4.526	1.649	12.426
Intraoperative Blood Loss	0.717	0.485	2.185	0.139	2.048	0.792	5.297
Time to get up	0.438	0.486	0.812	0.368	1.550	0.598	4.018
Preoperative JOA Score	-1.361	0.507	7.202	0.007	0.256	0.095	0.693

Note: JOA, Japanese Orthopaedic Association Score.

In this retrospective analysis, we investigated the impact of the nutritional support model based on the fast recovery concept on the postoperative recovery of patients with degenerative lumbar spinal stenosis undergoing MIS-TLIF. However, it is important to acknowledge the limitations of this study. Firstly, we did not collect long-term follow-up data, which leaves uncertainty regarding the long-term prognosis of patients. Secondly, the sample size obtained for this retrospective study was limited, potentially introducing bias in the analysis results. Lastly, since this study was conducted at a single center, further experimental data are needed to validate the generalizability of our findings. Therefore, we recommend conducting additional clinical experiments in future research to further refine our conclusions.

In conclusion, this study found that implementing the nutritional support model based on the fast recovery concept can reduce hospital stay, treatment cost, and time to ambulation for patients with degenerative lumbar spinal stenosis undergoing MIS-TLIF. Logistic regression analysis confirmed that age, history of diabetes, nursing plans, surgical duration, and preoperative JOA scores were independent risk factors that contribute to prolonged hospital stay in patients.

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Disclosure of conflict of interest

None.

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