<u>Original Research</u>

Influences of Enhanced Recovery After Surgery on Rehabilitation Effect and Postoperative Pain in Patients with Oblique Lumbar Interbody Fusion

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ABSTRACT

Objective • This study aimed to investigate the effects of an enhanced recovery after surgery (ERAS) protocol on postoperative rehabilitation and pain levels in patients undergoing oblique lateral interbody fusion (OLIF), with the goal of promoting postoperative rehabilitation and providing a reference for clinical practice.

Methods • Total of 165 OLIF patients were randomly divided into a control group and an ERAS group, with each group receiving different perioperative nursing approaches. Differences in postoperative pain, lumbar dysfunction, ability to daily living, nursing satisfaction, and total complication rate were compared.

Results • The time of first getting out of bed, hospital stay, anal exhaust time, defecation time, and bowel sound recovery time in the ERAS group were shortened by 14.51 h, 2.45 d, 9.74 h, 10.82 h, and 7.59 h, respectively (all P < .05). In contrast to the control group, the Visual Analogue Scale score in the ERAS group decreased by 2.51 points 24h, 3.58 points 48 h, and 0.42 points 72 h after surgery (all P < .05). The Oswestry Disability Index score

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INTRODUCTION

Lumbar spine is the only bony connection between the body and pelvis, which can withstand physiological activities in all body directions, so it is easy to damage and degeneration.¹ Lumbar degenerative diseases, including lumbar intervertebral disc herniation and lumbar spinal stenosis, may be caused by disc degeneration, reduced stability of the in the ERAS group decreased by 3.73 points at 30 days and 4.35 points at 90 days after surgery. The Japanese Orthopaedic Association score in the ERAS group increased by 4.26 points at 30 days and 4.08 points at 90 days after surgery in contrast to the control group. The Barthel score in the ERAS group increased by 5.08 points and 12.28 points at the postoperative 30 days and 90 days, respectively (both P < .05). The postoperative nursing satisfaction score in the control group was 89.57 ± 5.68 and that in the ERAS group was 96.29 ± 6.01 (P < .05).

Conclusions • Incorporating ERAS in OLIF patients' perioperative care resulted in reduced postoperative pain and complications, improved lumbar function and daily living ability, and higher nursing satisfaction. ERAS contributes to effective postoperative rehabilitation.

Significance and Implications • Incorporating ERAS in OLIF patients' perioperative care contributes to effective postoperative rehabilitation. (*Altern Ther Health Med.* 2024;30(1):198-204).

lumbar spine, nerve root compression, or arthritis, which cause pain and reduce function, have seriously threatened people's health and quality of life (QOL).² Lumbar interbody fusion is an important surgical method for the treatment of lumbar degenerative diseases, which can be divided into posterior lumbar interbody fusion, transforaminal lumbar interbody fusion, oblique lateral interbody fusion (OLIF), etc.³ Lumbar intervertebral fusion can effectively reduce pain, restore lumbar disc height and stability, promote lumbar function recovery, and improve the QOL.⁴

Disadvantages include large trauma, large damage degree of normal anatomical structure, postoperative pain, and long recovery time for posterior lumbar interbody fusion and transforaminal lumbar interbody fusion.⁵ OLIF is a new type of lumbar interbody fusion, which could reduce damage to anatomical structures and potential for quicker recovery. OLIF can enter the vertebral body through the gap between the lumbar great vascular sheath and the psoas major muscle,

avoid interference in the spinal canal during surgery, and reduce the risk of nerve root adhesion.⁶ Studies have confirmed that OLIF can ensure the integrity of the posterior structure and increase the stability of the lumbar spine after surgery.^{7,8} OLIF is increasingly used in the clinical treatment of degenerative diseases of the lumbar spine because it can reduce spinal canal exposure and nerve damage without affecting the posterior tension band compared to other traditional lumbar interbody fusion procedures.

Perioperative enhanced recovery after surgery (ERAS) is a multidisciplinary and multi-modal optimization methods based on evidence-based medical evidence designed to reduce surgical trauma and stress responses, accelerate recovery, and optimize all aspects of the surgical process. It can effectively improve patients' physiological and psychological stress and trauma during the perioperative period, thus improving the effect of surgical treatment, reducing perioperative complications, improving QOL, and accelerating the effect of postoperative rehabilitation.9 Compared with conventional perioperative patient management, ERAS protocols have been associated with a reduction in overall complications and length of stay.¹⁰ ERAS has been widely applied in perioperative nursing of patients undergoing general surgery and has achieved excellent results.^{11,12} ERAS can effectively improve perioperative outcomes and shorten hospital stay in patients with esophageal cancer resection, liver surgery and gynecologic/ oncology. This work investigated how ERAS impacts postoperative recovery, pain, daily living ability, nursing satisfaction, and complication rates in patients with OLIF. This work aimed to promote the postoperative rehabilitation of OLIF patients and improve the QOL of patients, thus offering a reference basis.

PATIENTS AND METHODS

Brief introduction of OLIF patients

A total 165 patients who received OLIF treatment in China Coast Guard Hospital of The People's Armed Police Force from January 2017 to October 2022 were enrolled here. Criteria based on which the patients were enrolled were described as follows: (1) all patients age>18 years; (2) patients diagnosed with lumbar lesions including degenerative lumbar disc disease, degenerative lumbar spondylolisthesis, discogenic pain, and lumbar stenosis; (3) all patients are required and agree to undergo OLIF. The patients were excluded according to the criteria: (1) patients with serious organic diseases such as heart, liver, lung, and brain; (2) patients with multiple spinal diseases; (3) patients with surgical site infection or previous history of lumbar surgery; (4) patients with autoimmune diseases; (5) patients with cognitive dysfunction or who were unable to communicate normally; (6) the clinical treatment data for patients was not complete. The study was allowed by the hospital's ethics committee. The patients and their families were aware of the content and methods of the study and agreed to sign the informed consent forms. When patients agreed to receive OLIF treatment, all patients were randomly rolled into

Table 1. Baseline data for all patients

	ERAS group	Control group	
Variables	(n = 83)	(n = 82)	P value
Male (%)	29(34.9)	28(34.1)	.915
Age (years)	61.00 ± 8.00	62.00 ± 7.19	.400
Disease type (%)			
degenerative lumbar disc disease	41(49.4)	44(53.7)	.631
degenerative lumbar spondylolisthesis	28(33.7)	25(30.5)	.674
discogenic pain	7(8.4)	8(9.8)	.276
lumbar stenosis	7(8.4)	5(6.1)	.198

a control group (82 cases) and an ERAS group (83 cases) by randomizing the numbers using SPSS software. The control group comprised 28 males and 54 females; their average age was (62.00 ± 7.19) years (35-86 years old). 44 cases were degenerative lumbar disc disease, 25 were degenerative lumbar spondylolisthesis, 8 were discogenic pain, and 5 were lumbar stenosis. In the ERAS group, 29 males and 54 females exhibited an average age of (61.00 ± 8.00) years (34-83 years old). There were 41 cases of degenerative lumbar disc disease, 28 cases of degenerative lumbar spondylolisthesis, 7 cases of discogenic pain, and 7 cases of lumbar stenosis. This work was approved by the Ethics Committee of the China Coast Guard Hospital of The People's Armed Police Force, and the patients signed informed consent. The patients from the control and ERAS groups presented no obvious difference in gender, age, disease type, and other basic data (P > .05) (Table 1).

Nursing modes

82 patients in the control group received perioperative routine nursing. Routine health education and psychological counseling should be carried out before the surgery. Patients should be informed of the operation method, fasting, water prohibition for 8 hours, skin preparation, and blood preparation. The medical staff should improve the preparation before the operation and instruct the patients and their families to use the toilet on the bed. After the surgery, routine post-anesthesia care was carried out to monitor the changesin patient's vital signs, observe the movement sensation of lower limbs, wound bleeding, and so on. The family members were instructed to help the patient to turn over the axis, and a small amount of water and liquid food were given 4 hours after the operation. The patients were instructed to carry out postoperative observation, functional exercise, and pipeline nursing. An intravenous analgesic pump or etoricoxib may be given if the patient suffered from severe pain. In addition, the routine discharge guidance should be arranged.

Eighty-three patients received ERAS during the perioperative period.

(1) **Pre-operation Nursing** The medical staff should inquire about the basic medical history of patients, improve the medical environment, and evaluate and improve the mental state of the patients. The OLIF method and the success rate of the operation were introduced in detail to the patients and their families to help the patients eliminate psychological stress and fear. Meanwhile, it should pay attention to the psychological dynamics of patients, establish a good doctor-nurse-patient relationship, and communicate with the patients or their families timely and patiently. Questions about OLIF were answered to patients and their families based on models and pictures, and preoperative guidance was provided. Before surgery, routine tests such as electrocardiograms, plain radiographs, three-dimensional CT reconstructions, and other laboratory tests should be completed. Patients' lower extremity motor and sensory function were assessed, the lung function was exercised with deep breathing, correct expectoration methods were instructed, and the methods of postoperative functional exercise were trained. Routine preparation of the skin for a drug allergy test, fasting, and water prohibition 8 hours before surgery, and clean enema were conducted carefully. In addition, the routine vital signs were checked early in the morning on the day of surgery.

(2) Intraoperative Nursing Firstly, the medical staff had to pay attention to keeping warm during the operation, control the room temperature at $22 \sim 25^{\circ}$ C and avoid limb exposure. Secondly, it should control the infusion volume and temperature, communicate with the anesthesiologist, and do early postoperative analgesia.

(3) Postoperative Nursing Postoperative nursing was carried out as follows. The medical staff should routinely monitor patients' vital signs, and observe the incision bleeding, lower limb motor, sensory function, and urine and stool. General anesthesia with tracheal intubation was used, so removing pillows and lying flat for 6 h after surgery was necessary to prevent aspiration and asphyxia. Meanwhile, the family members should be guided to turn over the axis and lie on the side to prevent spinal distortion. Postoperative fasting for six h had to be guaranteed, followed by a small amount of liquid diet and semi-liquid diet. The patients and their families were informed not to eat milk, soy milk, eggs, and other foods high in fat and sugar to avoid bloating. If the patient has abdominal distension, it can be solved by anal catheter exhaust or enema. The patient was instructed to perform early ankle pump, quadriceps, and upper limb exercises. In addition, sitting and standing training can be carried out with waist and other protective gear 1 day after surgery. Straitening leg movement and passive elevation of lower limbs can be carried out 2 days after surgery, and functional exercise of lumbar and back muscles can be carried out 7 days after surgery.

(4) **Post-discharge Nursing** The patients were told to wear waist circumference correctly for 3 months after discharge and try to avoid bending, waist twisting, weight-bearing, and strenuous exercise. It could provide continuity of care services, told patients to adhere to rehabilitation exercises and regular review, and solve the problems encountered by patients through telephone, Wechat, and outpatient methods.

Observation indicators

To detect changes in postoperative recovery, pain, daily living ability, and nursing satisfaction in OLIF patients, the following observation indicators were included. (1) General situation of patients was recorded, including the time of first getting out of bed, hospital stay, postoperative exhaust time, postoperative defecation time, and postoperative bowel sound recovery time. (2) VAS score was performed at 24 h, 48 h, and 72 h after surgery.¹³ The total VAS score was 10, with 0 indicating no pain and 10 indicating excruciating pain. A higher VAS score suggested a more severe postoperative pain. (3) The Oswestry Disability Index (ODI) was evaluated preoperative 1 and postoperative 30 and 90 days.¹⁴ With a total ODI rating of 50 points, a higher score meant the more severe the lumbar dysfunction of the patient. (4) The Japanese Orthopaedic Association Scores (JOA) was evaluated preoperative 1 day and postoperative 30 and 90 days.¹⁵ The total score of the JOA evaluation was 29, and a higher score was determined as less lumbar dysfunction of the patient. (5) The Barthel scale was evaluated pre-operative 1 day and postoperative 30 and 90 days.¹⁶ The patients' daily living ability would be better if the Barthel score was high, with the highest score of 100 points. (6) The quality of nursing services before discharge was evaluated using the satisfaction survey scale (100 points). The score showed a directly proportional relationship with the quality of nursing. (7) The number of complications such as urinary tract infection and lower extremity deep vein thrombosis, was recorded.

Statistical analysis

Statistical Product and Service Solutions (SPSS) 19.0 (IBM, Armonk, NY, USA was utilized for data analysis. The data conforming to the normal distribution of continuous variables was expressed using the mean \pm standard deviation ($\overline{x} \pm$ SD) and the differences between the groups of independent sample *t* test. Binary variables were represented by frequency (%), and differences between groups were compared by χ^2 test. It meant a difference with statistical significance at *P* < .05.

RESULTS

Gastrointestinal function and recovery

The time of first getting out of bed, hospital stay, anal exhaust time, defecation time, and bowel sound recovery were compared for patients receiving the ERAS and routine nursing, as illustrated in Figure 1. The time of first getting out of bed, hospital stay, anal exhaust time, defecation time, and bowel sound recovery time in the ERAS group were shortened by 14.51 h, 2.45 d, 9.74 h, 10.82 h, and 7.59 h, respectively. The patients receiving ERAS and routine nursing exhibited great differences in the above indicators, with P < .05. ERAS could promote gastrointestinal function and recovery more effectively.

Postoperative pain scores

The differences in VAS pain scores between the two groups at 24 h, 48 h, and 72 h were compared, as demonstrated in Figure 2. In contrast to the control group, the VAS score in the ERAS group decreased by 2.51 points 24 h, 3.58 points 48 h, and 0.42 points 72 h after surgery. A great difference with P < .05 was observed in VAS pain scores at postoperative 24 h, 48 h, and 72 h.

Figure 1. Comparison of indicators to evaluate the postoperative recovery. (A): time of first getting out of bed; (B): hospital stay; (C): anal exhaust time; (D): defecation time; (E): bowel sound recovery time.



^asuggested a difference with P < .05.

Figure 2. Postoperative VAS scores of patients receiving different nursing modes.



^asuggested a difference with P < .05.

Figure 3. Postoperative ODI lumbar function scores of patients.



Lumbar function recovery

The lumbar function ODI scores of the patients with different nursing methods were compared before surgery and 30 d and 90 d after surgery. Figure 3 displayed that the ODI score in the ERAS group decreased by 3.73 points at 30 days and 4.35 points at 90 days after surgery. Therefore, the ODI scores at postoperative 30 d and 90 d exhibited a difference with P < .05 for patients receiving various nursing methods. The differences in lumbar dysfunction JOA scores before surgery, 30 d, and 90 d









^aindicated a difference with P < 0.05 to the Control group.





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after the surgery were compared in Figure 4. The JOA score in the ERAS group increased by 4.26 points at 30 days and 4.08 points at 90 days after surgery in contrast to the control group. Therefore, the difference in JOA scores of patients receiving routine nursing and ERAS at the postoperative 30 and 90 days was observed to be great (P < .05). ERAS significantly improved lumbar function of patients after surgery.

Daily Living Ability

The ability to daily living using the Barthel score of patients before surgery, 30 d, and 90 d after the surgery was compared in Figure 5. It revealed that the Barthel score in the ERAS group increased by 5.08 points and 12.28 points at the postoperative 30 days and 90 days, respectively (P < .05). ERAS significantly improved the daily living ability of patients.

Nursing satisfaction

Figure 6 compares the differences in postoperative nursing satisfaction scores between patients receiving different nursing methods. The figure displayed that the postoperative nursing satisfaction score in the control group was 89.57 \pm 5.68 and that in the ERAS group was 96.29 \pm 6.01. Such results indicated that the nursing satisfaction score in the ERAS group increased by 6.72 points and exhibited a difference with *P* < .05 compared with the condition in the control group.

Postoperative Complications

Figure 7 describes the differences in postoperative complications of patients after they received ERAS or routine nursing. In the control group, the numbers of patients with nausea and vomiting, waist and leg pain, leg numbness, urinary tract infection, lung infection, incision infection, constipation, pressure sore, and deep venous thrombosis of lower limbs were 3, 2, 11, 2, 1, 3, 5, 2, and 3, respectively; while those were 1, 0, 5, 0, 1, 1, 2, 1, and 0 in the ERAS group, respectively. The TCR was 39.02% (32 cases) in the control group and 13.25% (11 cases) in the ERAS group, showing a difference with *P* < .05.

DISCUSSION

Advantages of ERAS Nursing

OLIF is a practical, minimally invasive method for the treatment of degenerative diseases of the lumbar spine. Compared with traditional lumbar interbody fusion, OLIF has the advantages of less trauma, shorter operation time, less intraoperative blood loss, no damage to the posterior lumbar structure, less damage to the spinal canal and nerve roots, better fusion effect, lower postoperative TCR, and faster postoperative recovery.^{7,17} However, OLIF patients may suffer complications such as postoperative pain, nausea and vomiting, stress reaction, and movement disorders. Therefore, giving reasonable nursing measures and rehabilitation guidance to such patients during the perioperative period is also very important. ERAS concept was proposed by Danish scholar Professor Henrik Kehlet in 1997 as a measure to follow the concept and optimize perioperative management. It can effectively reduce the traumatic stress response and postoperative TCR of patients undergoing surgery to achieve the purpose of rapid postoperative recovery.^{18,19} This study analyzed the effect of the perioperative ERAS concept on postoperative rehabilitation of patients. Due to the relatively older age of patients with lumbar degenerative diseases and lumbar slippage, which can lead to limited activities, patients will suffer from incontinence in severe cases. In addition, the functions of various organs and systems in elderly patients are reduced, and problems such as hypothermia can easily occur during the operation. The compliance of postoperative functional rehabilitation training is also poor, which affects the postoperative rehabilitation effect.²⁰

Effect on Postoperative Pain

In this work, the VAS pain score of OLIF patients receiving ERAS during the perioperative period was remarkably lower than that of patients with routine nursing at postoperative 24 h, 48 h, and 72 h. This is similar to

Figure 7. The number of patients with postoperative complications. I: nausea and vomiting; II: lumbar and leg pain; III: leg numbness; IV: urinary tract infection; V: pulmonary infection; VI: incision infection; VII: constipation; VIII: pressure sore; IX: deep venous thrombosis of the lower extremities.



previous research, but we found the influences on early recovery.^{21,22} Preoperative and specific assessment of perioperative ERAS includes nutritional status assessment, psychological status assessment, lumbar and leg pain, function assessment, QOL assessment, and rehabilitation assessment. Adequate preparation before surgery is helpful in relieving patients' back and leg pain and improving their comfort level, while postoperative pain intervention can effectively reduce the degree of pain and facilitate functional exercise as soon as possible after surgery.²³ ERAS can effectively reduce postoperative pain and improve patient comfort through reasonable analgesia protocols. It indicates that ERAS concept can effectively reduce postoperative pain in OLIF patients.

Impact on Gastrointestinal Function

ERAS has been widely applied in general surgery, orthopedics, cardiovascular, and other medical fields and has achieved excellent results, which is more in line with the concept of minimally invasive.²⁴ Since patients in surgical operations have different levels of anxiety and tension before surgery, it will not only affect the smooth operation but also induce different levels of adverse reactions, which is not conducive to the postoperative rehabilitation process.²⁵ This work suggested that the postoperative time of first getting out of bed, hospital stay, anal exhaust time, defecation time, and bowel sound recovery time of OLIF patients receiving ERAS nursing during the perioperative period were greatly shorter than those of patients with the routine nursing. Based on the above content, ERAS concept is proven to improve patients' cognitive level and psychological state by health education and psychological nursing before surgery. In addition, early postoperative waistline protection, preoperative intestinal preparation, and postoperative diet management are beneficial in improving intestinal peristalsis and reducing gastrointestinal complications and the recovery of postoperative gastrointestinal function. Temperature management during surgery can reduce

intraoperative blood loss and shorten postoperative anesthesia recovery time.²⁶ The retention of water and sodium caused by excessive fluid supplementation can be avoided, thus reducing the cardiopulmonary burden of patients and accelerating the recovery of gastrointestinal function.²⁷ In addition, the application of ERAS concept in the perioperative period was beneficial to the recovery of gastrointestinal function in OLIF patients.

Enhanced Lumbar Function Recovery

In addition, ERAS nursing philosophy urges patients to get out of bed early after surgery and perform functional exercises, and it is known that patients perform rehabilitation exercises after discharge, promoting the rehabilitation of postoperative function. Long-term bed rest will weaken patients' muscle strength and damage lung function, increasing the risk of deep vein thrombosis of lower limbs.²⁸ Early ambulation and functional exercise can improve postoperative muscle strength and reduce pulmonary infection rate.²⁹ In this work, the ODI score of lumbar dysfunctions of patients with ERAS was observable lower than that of patients with routine nursing at postoperative 30 and 90 days, while the JOA score and Barthel score were higher. Such results show that ERAS can effectively improve postoperative lumbar function recovery and postoperative ability to daily living in OLIF patients. Patients undergoing spinal surgery are at great risk of postoperative nerve injury, such as reduced muscle strength due to hematoma compression and neurological dysfunction due to incorrect internal fixation.^{30,31} The TCR of patients who underwent routine nursing was 39.02% (32 cases), while that for patients with ERAS was 13.25% (11 cases) in this study. Therefore, ERAS nursing is better than conventional nursing in OLIF patients during the perioperative period.

ERAS nursing for OLIF patients is worthwhile in clinical practice to enhance the rehabilitation effect of patients. But ERAS is a comprehensive treatment model, and the specific implementation measures will vary between different surgeries and patient groups. Specific advice for the individual's condition is required before ERAS.

Study Limitations

Some limitations were present in our study. First, this was a single-center study, and all participants voluntarily visited the hospital for examination. Thus, selection bias may be present, and the results may not generalize to common populations. Second, the sample size of this study was small; a larger sample size is needed. Despite this limitation, the results still provide clinical implications in that we determined the effect of ERA on OLIF patients. Last, this work only analyzed the influences of perioperative ERAS intervention on the early recovery of OLIF patients. It did not include the postoperative follow-up data to analyze its influence on the long-term prognosis of patients. It is expected to further expand the experimental data to explore the factors influencing the long-term prognosis of OLIF patients.

CONCLUSION

ERAS emphasizes preoperative preparation, postoperative management, and early recovery. By rational use of antibiotics, standardized fluid management, pain relief measures, etc. Perioperative application of ERAS can effectively promote postoperative recovery of gastrointestinal and lumbar function, shorten hospital stay, alleviate postoperative pain in OLIF patients, enhance the postoperative ability to daily living, reduce the TCR, and improve nursing satisfaction, and achieve rapid recovery. The results here are useful in guiding the application of ESRA in the rehabilitation of patients after OLIF, and provide a reference for the future clinical application and optimization of ERAS in OLIF patients ..

CONFLICT OF INTEREST

The authors have no potential conflicts of interest to report relevant to this article.

AUTHOR CONTRIBUTIONS

TZ and JZ designed the study and performed the experiments, TZ and JH collected the data, JZ and JH analyzed the data, TZ and JZ prepared the manuscript. All authors read and approved the final manuscript.

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