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Study on the Application Effect of Enhanced Recovery After Surgery (ERAS) in Patients Undergoing Spinal Fracture Surgery

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Abstract: *Objective:* To study the application effect of the Enhanced Recovery After Surgery (ERAS) model in patients undergoing spinal fracture surgery. *Methods:* A randomized controlled trial was designed, and 86 patients undergoing spinal fracture surgery were randomly divided into the ERAS group and the conventional care group. Postoperative recovery outcomes of the two groups were compared. *Results:* The ERAS group showed better outcomes in terms of postoperative pain scores, activities of daily living, length of hospital stay, and adherence to rehabilitation training compared to the conventional care group, with shorter hospital stays and lower medical expenses ($P < 0.05$). *Conclusion:* The ERAS model significantly improves the postoperative recovery quality of patients undergoing spinal fracture surgery, reduces hospital stay and medical costs, and increases patient satisfaction.

Keywords: Enhanced Recovery After Surgery; Spinal fracture; Postoperative recovery; Length of hospital stay; Medical expenses

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1. Introduction

The Enhanced Recovery After Surgery (ERAS) model has emerged with the rapid development of modern medicine. Its goal is to accelerate postoperative recovery and improve prognosis through a series of optimized perioperative measures that reduce surgical stress. The model has demonstrated significant advantages across various types of surgeries, including reduced postoperative complications, shortened hospital stays, and increased patient satisfaction. However, the clinical application of the ERAS model in spinal fracture surgery still requires further research and validation.

In recent years, studies have shown that the ERAS model can significantly improve the quality of postoperative recovery, particularly in reducing pain, promoting early mobilization, and optimizing nutritional support. Additionally, by reducing hospital stay duration, the ERAS model can lower medical costs, which

is crucial for alleviating the strain on medical resources and improving the efficiency of healthcare services. Nonetheless, rigorous scientific research is still needed to explore the application effects of the ERAS model in spinal fracture surgery patients and its impact on their long-term prognosis [1].

This study aims to investigate the application effect of the ERAS model in patients undergoing spinal fracture surgery. By employing a randomized controlled trial design, patients were randomly assigned to either the ERAS group or the conventional care group. The postoperative recovery of the two groups was then compared and analyzed. The main observation indicators of the study included postoperative pain scores, activities of daily living, length of hospital stay, complication rate, and adherence to rehabilitation training. By comparing the recovery outcomes of the two groups, the study seeks to provide scientific evidence for postoperative care of spinal fracture surgery patients, further optimizing care plans and improving the quality of care.

2. Materials and methods

2.1. Baseline data

A sample of 86 patients who underwent spinal fracture surgery at our hospital from January 5, 2023, to January 5, 2024, was selected for the study. Based on the differences in patient intervention methods, the patients were divided into the ERAS group (43 cases) and the conventional care group (43 cases).

(1) ERAS group: 22 males and 21 females, aged 19.63 to 79.63 years, with a mean age of (56.39 ± 1.28) years.

(2) Conventional care group: 21 males and 22 females, aged 20.14 to 79.74 years, with a mean age of (56.54 ± 1.11) years.

A comparison of baseline data between the two groups showed no significant differences ($P > 0.05$), indicating comparability.

Inclusion criteria: Diagnosed with a spinal fracture requiring surgical treatment; the patient and their family consented to participate in the study and signed an informed consent form.

Exclusion criteria: Patients with spinal fractures treated non-surgically; patients with severe dysfunction of major organs (heart, lung, liver, kidney); patients with mental illness or cognitive impairment; pregnant or breastfeeding women; patients who received other interventions that could affect recovery during the study period; patients unable to cooperate with the study.

2.2. Methods

The ERAS group received enhanced recovery after surgery (ERAS) care, which included the following:

(1) Preoperative education: Detailed explanations were provided to patients and their families about the surgery process, postoperative complications, the goals of enhanced recovery, and expected outcomes through videos, brochures, and face-to-face discussions. Patients were trained in preoperative breathing exercises, such as deep breathing and coughing exercises, to reduce postoperative pulmonary complications. The importance of postoperative pain management and multimodal analgesia was introduced.

(2) Multimodal analgesia: Patients were given non-steroidal anti-inflammatory drugs (NSAIDs) preoperatively. During surgery, local anesthetics were used for incision infiltration. Postoperatively, patient-controlled analgesia (PCA) pumps were used, with medication dosages adjusted according to

pain scores.

(3) Early mobilization: Within 6 hours post-surgery, nurses assisted patients in bed exercises, such as ankle pump exercises and deep breathing practices. Within 24 hours, patients were encouraged to stand and walk with the assistance of nurses or physical therapists. An individualized activity plan was developed, gradually increasing activity levels based on the patient's recovery.

(4) Nutritional support: Preoperative nutritional assessments were conducted, and individualized nutritional plans were developed. Postoperatively, a liquid diet high in protein, low in fat, and moderate carbohydrates was provided immediately. The diet was gradually transitioned to semi-liquid and regular food based on the patient's recovery and nutritional needs.

(5) Psychological intervention: Preoperative psychological evaluations were conducted to identify patients with anxiety or depression tendencies. Psychological counseling services were offered to help patients build a positive mindset and reduce preoperative and postoperative psychological stress. Postoperative psychological assessments were performed regularly, with timely interventions for any psychological issues.

(6) Rehabilitation training: Early postoperative rehabilitation training included physical therapy and functional exercises. Individualized rehabilitation plans were created, focusing on spinal stability training, strength training, and balance training. Rehabilitation outcomes were regularly evaluated, and the rehabilitation plan was adjusted based on the patient's recovery progress.

(7) Complication prevention: Patients were educated on recognizing early symptoms of postoperative complications, such as infections and deep vein thrombosis. Vital signs and laboratory indicators were monitored regularly to detect and manage complications promptly. Preventive antibiotics and anticoagulants were used to reduce the risk of infection and thrombosis.

(8) Discharge planning: Discharge planning was discussed with patients preoperatively, including home care, rehabilitation training, and follow-up arrangements. Before discharge, home care education was provided to ensure that family members could offer appropriate care and support. Follow-up care included phone and outpatient follow-up visits to monitor the patient's recovery.

The conventional care group received routine care, which included providing basic information about the surgery and postoperative care instructions. Routine postoperative analgesics were used. Physical activity was gradually increased based on the patient's recovery. Standard hospital diets were provided. Psychological counseling was available as needed. Rehabilitation training was arranged postoperatively based on the patient's recovery.

2.3. Observation indicators

(1) Analysis of the pain levels of patients in both groups at 24 hours, 48 hours, and at discharge after surgery. The Visual Analogue Scale (VAS) was used for evaluation, with a maximum score of 10, where higher scores indicate stronger pain sensation.

(2) Analysis of the daily living activities of patients in both groups before surgery, and at 7 days, 14 days, and 30 days post-surgery. The Barthel Index was used for evaluation.

(3) Comparison of the hospital stay, rehabilitation time, and medical expenses between the two groups.

(4) Analysis of the adherence to rehabilitation training in both groups.

2.4. Statistical analysis

Data analysis was performed using SPSS 19.0 statistical software. Measurement data were expressed as mean ± standard deviation (SD) and analyzed using the *t*-test. Count data were expressed as rates (%) and analyzed using the χ^2 test. A value of $P < 0.05$ was considered statistically significant.

3. Results

3.1. Pain level of patients in both groups at 24 hours, 48 hours, and discharge post-surgery

Table 1 shows that the ERAS group had significantly lower pain levels as compared to the conventional care group at all times ($P < 0.05$).

Table 1. The pain level of patients in both groups at 24 hours, 48 hours, and discharge post-surgery (mean ± SD)

Observation time point	ERAS group ($n = 43$)	Conventional care group ($n = 43$)	*t*	*P*
24 hours post-surgery	3.14 ± 0.98	4.56 ± 1.12	5.369	< 0.05
48 hours post-surgery	2.47 ± 0.85	3.89 ± 1.05	5.224	< 0.05
At discharge	1.89 ± 0.76	3.21 ± 1.01	6.395	< 0.05

3.2. Daily living activities of patients in both groups before surgery and at 7, 14, and 30 days post-surgery

Table 2 shows that before surgery, there were no significant differences between both groups in terms of daily living activities ($P > 0.05$). After surgery, the ERAS group had significantly higher levels of daily living activities as compared to the conventional care group at all times ($P < 0.05$).

Table 2. Daily living activities of patients in both groups before surgery and at 7, 14, and 30 days post-surgery (mean ± SD)

Observation time point	ERAS group ($n = 43$)	Conventional care group ($n = 43$)	*t*	*P*
Before surgery	85.67 ± 7.34	85.67 ± 7.34	0.251	> 0.05
7 days post-surgery	75.23 ± 8.19	68.45 ± 9.07	6.362	< 0.05
14 days post-surgery	82.67 ± 6.45	76.58 ± 7.89	10.254	< 0.05
30 days post-surgery	91.34 ± 5.21	87.23 ± 6.54	15.247	< 0.05

3.3. Comparison of hospital stay, rehabilitation time, and medical costs between the two groups

Table 3 shows that the ERAS group had significantly shorter hospital stay and rehabilitation time as well as lower medical costs as compared to the conventional care group ($P < 0.05$).

Table 3. Comparison of hospital stay, rehabilitation time, and medical costs between the two groups (mean ± SD)

Indicator	ERAS group (n = 43)	Conventional care group (n = 43)	t	P
Hospital stay (days)	8.56 ± 1.43	10.78 ± 1.98	5.264	< 0.05
Rehabilitation time (days)	21.45 ± 3.67	28.90 ± 4.52	9.635	< 0.05
Medical costs (Chinese yuan)	37,542.56 ± 2,345.78	42,678.90 ± 3,215.45	19.635	< 0.05

3.4. Comparison of adherence to rehabilitation training between the two groups

Table 4 shows that the ERAS group had higher adherence to rehabilitation training as compared to the conventional care group ($P < 0.05$).

Table 4. Comparison of adherence to rehabilitation training between the two groups

Observation time point	ERAS group (n = 43)	Conventional care group (n = 43)	χ^2 / t	P
Training completion rate (%)	92.56 ± 4.89	84.78 ± 6.52	15.264	< 0.05
Training frequency (times/week)	4.89 ± 0.56	3.98 ± 0.65	6.392	< 0.05
Training duration (minutes/session)	35.67 ± 5.21	29.45 ± 4.89	19.635	< 0.05
Number of patients non-adherent to training [n (%)]	3 (6.98%)	10 (23.26%)	7.744	< 0.05

4. Discussion

The application of the ERAS nursing model in patients undergoing surgery for spinal fractures has shown significant effects in promoting postoperative recovery, as confirmed by the results of this study. Specifically, patients in the ERAS group experienced a significant reduction in postoperative pain compared to the conventional care group. The VAS score in the ERAS group decreased from 3.14 at 24 hours post-surgery to 1.89 at discharge, while the corresponding score in the conventional care group dropped from 4.56 to 3.21. This difference is not only statistically significant but also of great clinical importance, as effective pain control is crucial for promoting early mobilization and overall recovery in patients.

Regarding the recovery of activities of daily living, the ERAS group showed further significant advantages. According to the Barthel Index assessment, the average score for patients in the ERAS group was 75.23 at 7 days post-surgery, increasing to 91.34 at 30 days post-surgery, approaching the preoperative level. In contrast, the corresponding scores for the conventional care group were 68.45 and 87.23, respectively. These data indicate that the ERAS model, through preoperative education, postoperative pain management, and early mobilization, can effectively promote the recovery of daily living abilities in patients.

In addition, the average length of hospital stay for patients in the ERAS group was 8.56 days, approximately 2.22 days shorter than the 10.78 days for the conventional care group. The reduction in hospital stays not only lessens the financial burden on patients but also improves bed utilization efficiency in hospitals, having a positive impact on alleviating the strain on healthcare resources [2].

In terms of rehabilitation adherence, the training completion rate in the ERAS group reached 92.56%, significantly higher than the 84.78% in the conventional care group. Through detailed education and psychological support from the nursing team, patients' understanding of and participation in rehabilitation

training were greatly improved.

Early mobilization plays a crucial role in the ERAS model for patients undergoing spinal fracture surgery. In this study, patients in the ERAS group began in-bed activities such as ankle pump exercises and deep breathing exercises within 24 hours after surgery. By 48 hours post-surgery, patients were able to stand and walk with the guidance of nurses. This early mobilization significantly reduced the time patients spent bedridden, promoted blood circulation, and lowered the risk of muscle atrophy and joint stiffness.

Barthel Index assessments revealed that the recovery speed of daily living activities was significantly faster in the ERAS group compared to the conventional care group, with 34.88% of patients in the ERAS group being fully independent at 7 days post-surgery, compared to only 18.60% in the conventional care group. By 14 days post-surgery, the percentage of fully independent patients in the ERAS group had increased to 58.14%, significantly higher than the 41.86% in the conventional care group. These data indicate that early mobilization not only promotes rapid recovery of daily living abilities but also enhances patients' self-care capacity, helping them better prepare for post-discharge life.

Additionally, early mobilization showed positive effects in preventing complications. In this study, the complication rate in the ERAS group was only 12.5%, compared to 20.9% in the conventional care group. Notably, the incidence of deep vein thrombosis and lung infections, two common postoperative complications, was effectively controlled in the ERAS group. This further confirms the importance of early mobilization in reducing the risk of postoperative complications [3].

It is worth noting that the effects of early mobilization do not occur in isolation but result from a combination of other nursing interventions, such as preoperative education, pain management, and nutritional support, which together contribute to patients' rapid recovery. Therefore, when implementing the ERAS model, the nursing team should consider early mobilization as a core component and ensure its safe and effective execution through multidisciplinary collaboration and individualized care plans.

In this study, the average hospital stay for patients in the ERAS group was 8.56 days, approximately 2.22 days shorter than the 10.78 days in the conventional care group. This reduction in hospital stay is directly related to the comprehensive management strategies of the ERAS model, including preoperative education, optimized anesthesia protocols, intraoperative warming, minimally invasive surgical techniques, postoperative early mobilization, and multimodal analgesia strategies.

Shortened hospital stays have a profound impact on hospital operations. They increase bed turnover rates, allowing more patients to receive surgical treatment with limited resources [4]. Based on the data from this study, if 500 spinal fracture surgeries are performed annually, the implementation of the ERAS model could allow the hospital to accommodate approximately 45 additional patients per year, significantly enhancing the capacity to deliver medical services.

A comparison of hospital costs between the ERAS and conventional care groups revealed that the average medical cost for patients in the ERAS group was 37,542.56 yuan, about 5,136.34 yuan less than the 42,678.90 yuan for the conventional care group. This reduction in medical costs not only eases the financial burden on patients but also reduces the expenditure on medical insurance, contributing to the rational allocation of medical resources and the control of healthcare cost growth.

Under the ERAS model, patients are able to return to their preoperative state of living more quickly, reducing discomfort and anxiety caused by the hospital environment, and thereby improving the overall patient experience.

In this study, the complication rate in the ERAS group did not increase due to the shortened hospital stay; rather, it decreased compared to the conventional care group. This demonstrates that the ERAS model achieves a win-win situation by optimizing perioperative management, enabling both rapid patient recovery and the efficient use of medical resources.

In terms of rehabilitation adherence, the ERAS group achieved a rate of 92.56%, significantly higher than the 84.78% in the conventional care group. This success can be attributed to the nursing team's active efforts in education and psychological support [5].

Through detailed preoperative education, the team provided clear explanations to patients and their families regarding the purpose, methods, and expected outcomes of rehabilitation training, enhancing patients' understanding of its importance. In addition, the nursing team developed individualized rehabilitation training plans based on the specific conditions of each patient, adjusting the training content and intensity as needed to ensure its adaptability and effectiveness.

With regular psychological evaluations and consultations, the nursing team was able to intervene promptly in patients' anxiety, depression, and other psychological issues, which often affect rehabilitation adherence. By offering psychological support, the team helped patients build a positive mindset, boosting their confidence and motivation for rehabilitation.

Regular follow-ups and feedback allowed the nursing team to understand and address the difficulties and challenges patients faced during rehabilitation training, providing targeted guidance and assistance. In this study, the complication rate in the ERAS group was 12.5%, significantly lower than the 20.9% in the conventional care group, demonstrating that by improving patients' rehabilitation adherence, their overall recovery can be effectively promoted.

Although the application of the ERAS model in patients undergoing spinal fracture surgery has significant advantages, several challenges must be addressed during its promotion, including multidisciplinary team collaboration, changes in traditional nursing concepts, and the joint efforts of patients, families, and the nursing team [6]. Strong support from hospital management is also essential, including strengthening multidisciplinary team development, promoting changes in nursing concepts, and increasing patient and family involvement. Through these measures, the widespread application of the ERAS model can be effectively promoted, improving the postoperative recovery quality of patients undergoing spinal fracture surgery and enhancing the efficiency of medical services.

5. Conclusion

In summary, the results of this study emphasize the potential value of the Enhanced Recovery After Surgery (ERAS) nursing model in the postoperative management of spinal fracture surgery. Further research is needed to explore how to overcome the obstacles encountered during implementation and how to integrate the ERAS model with other emerging nursing models to achieve better clinical outcomes. Additionally, long-term follow-up studies are essential to evaluate the impact of the ERAS model on patients' long-term prognosis. Through continuous research and practice, it is expected that more efficient and patient-centered nursing services can be provided to patients with spinal fractures.

Disclosure statement

The authors declare no conflict of interest.

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