

Bone and Arthroscopy Science

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Bone and Arthroscopy Science

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Bone and Arthroscopy Science is a peer-reviewed articles across a wide spectrum of clinical treatise, basic research, review, frontier of orthopedics, case analysis and comment. This journal is aimed at professionals at all levels engaged in the basic and clinical work of orthopedics. Each issue is guest-edited by an acknowledged expert and focuses on a single topic or controversy.

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Analysis of the Clinical Effect of Pedicle Screw Fixation Combined with Surgical Methods in Patients with Severe Osteoporosis and Compression Vertebral Fractures

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Abstract: *Objective:* To explore the therapeutic effect of pedicle screw fixation combined with surgical methods in patients with severe osteoporosis and compression vertebral fractures (OVCF). *Methods:* Eighty-two patients with severe osteoporosis and OVCF admitted to our hospital from January 2023 to January 2024 were selected as study subjects. They were randomly divided into a control group ($n = 41$) receiving conventional conservative treatment and an observation group ($n = 41$) undergoing pedicle screw fixation combined with vertebroplasty. The treatment effects and overall patient satisfaction rates were compared between the two groups three months after surgery. *Results:* The total effective rate of the observation group was 97.56% (40/41), significantly higher than the 70.73% (29/41) of the control group ($P < 0.05$). Additionally, the overall satisfaction rate of the observation group was significantly higher than that of the control group ($P < 0.05$). *Conclusion:* Pedicle screw fixation combined with vertebroplasty is significantly effective in treating severe OVCF, with higher patient satisfaction, and is worthy of promotion.

Keywords: Pedicle screw internal fixation; Severe OVCF; Bone cement; Vertebroplasty

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1. Introduction

Patients with severe osteoporosis (OP) are at a high risk of fractures due to decreased bone mineral density, particularly compression vertebral fractures (OVCF), which severely impact their quality of life and may lead to chronic pain and functional impairment. With the increasing aging population, the incidence of OVCF continues to rise, making it a significant health concern for the elderly. Traditional conservative treatments, such as pharmacotherapy and brace fixation, can alleviate symptoms to some extent but have limited efficacy in improving fracture stability and long-term prognosis^[1]. In recent years, advancements in spinal surgery have led

to the widespread adoption of pedicle screw fixation combined with vertebroplasty. This approach has become an essential treatment option for OVCF due to its ability to provide immediate stability and pain relief. Pedicle screw fixation enhances spinal stability by implanting screws into the vertebrae, while vertebroplasty restores vertebral height and strength by injecting bone cement. The combination of these techniques aims to achieve biomechanical reconstruction of the fractured vertebrae and rapid pain relief. To further clarify the actual clinical efficacy of this treatment approach, this study selected 82 patients with severe OVCF admitted to our hospital in recent years. They were randomly assigned to a control group receiving conventional conservative treatment and an observation group undergoing pedicle screw fixation combined with vertebroplasty, with 41 patients in each group. The treatment outcomes were compared, and the findings are reported as follows.

2. Materials and methods

2.1. General information

Eighty-two patients with severe OVCF admitted to our hospital from January 2023 to January 2024 were selected as study subjects. They were randomly divided into a control group ($n = 41$) receiving conventional conservative treatment and an observation group ($n = 41$) undergoing pedicle screw fixation combined with vertebroplasty. In the observation group, there were 11 males and 30 females, aged between 63 and 83 years, with an average age of 73.13 ± 3.17 years. Fracture locations included 17 lumbar vertebrae and 24 thoracic vertebrae. In the control group, there were 10 males and 31 females, aged between 62 and 82 years, with an average age of 72.97 ± 2.89 years. Fracture locations included 16 lumbar vertebrae and 25 thoracic vertebrae. There were no statistically significant differences in general information between the two groups, making them comparable ($P > 0.05$). All patients signed informed consent forms.

2.2. Methods

2.2.1. Control group treatment

The control group received conventional conservative treatment. Patients were required to rest in a supine position on a hard bed. Calcium and vitamin D supplements were provided to enhance bone density and promote bone health. Nonsteroidal anti-inflammatory drugs (NSAIDs) were administered to relieve pain and control inflammation, while opioids were used as needed for pain management. Additionally, bisphosphonates were prescribed to inhibit bone resorption and slow the progression of osteoporosis. Depending on the patient's condition and hormone levels, selective estrogen receptor modulators (SERMs) or estrogen replacement therapy (ERT) were applied individually to reduce the risk of further fractures.

In terms of physical therapy, treatments such as thermotherapy, electrical stimulation, and ultrasound therapy were employed to relieve muscle spasms, improve local blood circulation, and promote fracture healing. Functional exercises were also an essential part of conservative treatment. Patients were guided to perform progressive back muscle and core muscle exercises to enhance spinal stability and support, reducing the risk of further vertebral collapse. Additionally, depending on the patient's condition, spinal braces were used to limit spinal movement and reduce vertebral load.

2.2.2. Observation group treatment

The observation group was treated with pedicle screw fixation combined with vertebroplasty. Preoperatively, a detailed analysis of the patient's imaging data was conducted to determine the exact location and morphology of

the fractured vertebrae, allowing for an individualized surgical plan. During surgery, the patient was placed in a prone position under general anesthesia. With the assistance of a C-arm X-ray machine, the pedicle and vertebral body were precisely located. A small incision was made to expose the pedicle, and specialized instruments were used for pedicle drilling and tapping. The pedicle screws were then precisely implanted, ensuring their firm anchorage within the vertebral body and pedicle. This step was critical for the success of the procedure, as it provided a solid foundation for the subsequent vertebroplasty and helped restore and maintain the physiological curvature of the spine. Next, a working channel was inserted into the vertebral body via the guidewire at the end of the pedicle screw. Vertebroplasty was then performed using balloon dilation or direct injection of bone cement. In the balloon dilation method, a cavity was created within the vertebral body to restore its height, after which the balloon was removed, leaving an empty space. Bone cement was then injected into this cavity to enhance vertebral stability and strength. Postoperatively, the medication regimen and physical therapy were the same as those for the control group.

2.3. Observation indicators

The study compared the treatment efficacy and overall patient satisfaction between the two groups. The criteria for evaluating treatment efficacy were as follows:

- (1) Significantly effective: After three months of treatment, medical imaging confirmed bony union, substantial recovery of injured vertebrae, absence of scoliosis, and complete resolution of pain symptoms at the affected site.
- (2) Effective: After three months of treatment, there was a noticeable improvement in pain symptoms, and medical imaging showed a near-bony union with mild scoliosis.
- (3) Ineffective: No improvement was observed after three months of treatment, or there was a recurrence of fracture.

The overall response rate was calculated using the formula: Overall response rate = (Significant efficacy + Effective) / Total cases \times 100%.

Patient satisfaction was assessed through a survey questionnaire that included options for “Very satisfied,” “Satisfied,” “Neutral,” and “Dissatisfied.” Patients selected one option based on their personal experience three months after treatment. The overall satisfaction rate was calculated using the formula: Overall satisfaction rate = (Very satisfied + Satisfied) / Total cases \times 100%.

2.4. Statistical analysis

Data were processed using SPSS22.0 software. Measurement data were represented using parentheses “()” and analyzed by the *t*-test. Count data were expressed as [*n* (%)] and analyzed using the chi-square test (χ^2). Statistical significance was indicated when $P < 0.05$.

3. Results

3.1. Treatment efficacy

The overall treatment efficacy in the observation group was significantly higher than that in the control group ($P < 0.05$). See **Table 1** for details.

Table 1. Comparison of the total treatment effective rate between two groups of patients

Group	Total cases (<i>n</i>)	Significantly effective	Effective	Ineffective	Total effective rate (%)
Observation group	41	23	17	1	97.56
Control group	41	8	21	12	70.73
χ^2					11.0613
<i>P</i>					0.0009

3.2. Satisfaction rate

The total satisfaction rate of the observation group was significantly higher than that of the control group, with $P < 0.05$. See **Table 2**.

Table 2. Comparison of total satisfaction rates between two groups of patients

Group	Total cases (<i>n</i>)	Very satisfied	Satisfied	Neutral	Dissatisfied	Total satisfaction rate (%)
Observation group	41	24	15	1	1	95.12
Control group	41	9	17	6	9	63.41
χ^2						12.5412
<i>P</i>						0.0004

4. Discussion and conclusion

4.1. Causes and characteristics of OVCF

Osteoporosis is a skeletal disease characterized by reduced bone mass and microstructural deterioration, leading to increased bone fragility and, consequently, a higher risk of fractures [2]. In elderly individuals, the natural decline in bone density, coupled with prolonged bone loss, makes vertebrae susceptible to compressive changes even under minor external forces. These fractures typically involve the anterior part of the vertebral body, resulting in a reduction in vertebral height and kyphotic deformity, commonly referred to as “wedge-shaped” or “biconcave” deformities. Additionally, OVCF is characterized by acute pain, which is often associated with changes in body position and worsens under weight-bearing conditions, severely affecting patients’ daily lives and mobility.

The primary population affected by OVCF consists of elderly individuals, particularly postmenopausal women, who experience significant bone density loss due to decreased estrogen levels, thereby increasing fracture risk. Other high-risk factors for OVCF include hyperthyroidism, hyperparathyroidism, prolonged use of glucocorticoids, and unhealthy lifestyle habits. These factors not only contribute to osteoporosis but also disrupt normal bone metabolism and repair processes, leading to fractures. Due to the significant decrease in bone density and support capacity in these patients, even minor injuries can trigger fractures.

4.2. Dangers of severe OVCF

OVCF commonly manifests as anterior vertebral compression along with severe osteoporotic changes, making it difficult to restore the vertebrae to their original shape and function. In the early stages of fracture, patients may experience acute pain, usually related to microdamage within the vertebral body. As the fracture worsens, the pain

may become chronic, associated with vertebral compression deformity and loss of spinal stability ^[3]. The pain caused by this condition not only restricts movement but also significantly reduces the patient's quality of life, making walking difficult and even affecting self-care abilities.

Following the onset of OVCF, spinal kyphosis, or hunchback, often develops, which not only affects physical appearance but also reduces thoracic volume, negatively impacting lung function and leading to symptoms such as respiratory difficulties and shortness of breath. Additionally, spinal deformities can increase abdominal pressure, affecting digestive function and causing a decrease in appetite and constipation. These physiological changes, combined with prolonged pain, make patients more susceptible to mental health disorders such as depression and anxiety, exacerbating their sense of loneliness and further disrupting both their own and their family's daily lives ^[4].

Beyond the physical and psychological impact, severe OVCF also imposes a significant financial burden on families. Patients often require prolonged treatment, increasing their economic strain. In severe cases, patients may experience a marked decline in self-care abilities, necessitating care from family members or professional caregivers. This places immense pressure on the patient's family and further contributes to the patient's psychological burden, potentially leading to serious emotional distress such as depression and suicidal thoughts. Ultimately, OVCF poses a severe threat to both the physical and mental well-being of patients and their families.

4.3. Treatment of severe OVCF

4.3.1. Conservative treatment

For patients with severe osteoporosis combined with compression vertebral fractures, conservative treatment is a commonly used approach. This method involves the combined application of physiotherapy and medication to relieve pain, improve function, and reduce the risk of recurrent fractures. The expected outcome of conservative treatment is to provide immediate pain control while achieving long-term disease management by promoting bone health and enhancing vertebral stability ^[5]. Pharmacological therapy is an essential component of conservative treatment, aiming to alleviate pain and inflammation while improving bone density and quality. NSAIDs and opioids are widely used for pain management, acting directly on pain receptors and the central nervous system to reduce the patient's perception of pain. Additionally, calcium and vitamin supplementation, along with bed rest, help facilitate gradual fracture healing. However, this treatment approach requires a long recovery period, and after fracture healing, varying degrees of spinal deformity often occur.

4.3.2. Pedicle screw fixation combined with vertebroplasty

Pedicle screw fixation combined with vertebroplasty is a newly emerging minimally invasive treatment in recent years. Considering that most patients are elderly and have poor surgical tolerance, they are often unable to undergo major surgical procedures. Consequently, this type of minimally invasive surgery, characterized by its rapid efficacy and minimal trauma, has gained widespread adoption. The key aspect of this treatment technique involves inserting pedicle screws to stabilize the damaged vertebral body and injecting bone cement into the vertebral canal to reconstruct its structure and strength. The placement of pedicle screws is based on precise surgical planning and positioning, requiring a preoperative evaluation using the patient's medical imaging data to develop a specific surgical plan—this step is critical to the success of the surgery ^[6]. Vertebroplasty involves creating a cavity within the vertebral canal before injecting bone cement, which not only restores spinal height but also enhances the spine's compressive and supportive strength, reducing the risk of refracture and improving spinal stability. Additionally, this procedure effectively alleviates patient discomfort by reconstructing the spinal

structure, relieving compression on the spinal cord and nerve tissues. The surgery significantly lowers the risk of spinal deformity and maximally restores the original spinal morphology. Although pedicle screw fixation combined with vertebroplasty has demonstrated remarkable efficacy in treating severe OVCF, ensuring surgical safety and effectiveness requires thorough preoperative evaluation and postoperative management. Potential intraoperative complications, such as bone cement leakage, pedicle screw loosening or infection, and refracture, must be prevented through meticulous surgical technique, standardized postoperative rehabilitation plans, and anti-osteoporosis treatment. In this study, one patient in the observation group experienced pedicle screw loosening and subsequent refracture due to inadequate postoperative management. This highlights the need for strengthened rehabilitation management in the later stages of treatment. Upon patient discharge, it is essential to provide relevant knowledge education to both patients and their families, guiding them on daily care. This not only accelerates postoperative recovery but also enhances the long-term effectiveness of the surgery.

The results of this study indicate that the overall effective rate of treatment in the observation group, which underwent pedicle screw fixation combined with vertebroplasty, was 97.56%, significantly higher than the 70.73% in the control group ($P < 0.05$). Furthermore, the overall satisfaction rate of patients in the observation group was also significantly higher than that of the control group ($P < 0.05$). These findings suggest that pedicle screw fixation combined with vertebroplasty is highly effective in treating severe OVCF, leading to greater patient satisfaction. Therefore, it is a valuable clinical treatment option for severe OVCF patients and warrants wider application.

Disclosure statement

The authors declare no conflict of interest.

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Clinical Observation on the Effectiveness of Combined Anterior and Posterior Cervical Surgery for Cervical Spinal Stenosis with Cervical Injury

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Abstract: *Objective:* To explore and analyze the clinical effectiveness of combined anterior and posterior cervical surgery for the treatment of cervical spinal stenosis with cervical injury. *Methods:* From March 2023 to June 2024, 40 patients who received treatment for cervical spinal stenosis with cervical injury in our hospital were selected as the study subjects. They were randomly divided into the experimental group and the control group, with 20 patients in each group. The experimental group underwent combined anterior and posterior cervical surgery, while the control group underwent simple anterior cervical decompression surgery. The changes in clinical indicators and improvement in cervical function before and after surgery were compared and analyzed between the two groups. *Results:* Following surgical treatment, the clinical indicators in the experimental group improved more significantly than those in the control group. Additionally, the postoperative cervical function improvement in the experimental group was superior to that in the control group. The differences between the two groups were statistically significant ($P < 0.05$). *Conclusion:* For patients with cervical spinal stenosis and cervical injury, the combined anterior and posterior cervical surgery approach can effectively improve cervical function, demonstrating significant therapeutic effects. This surgical method is worthy of clinical promotion.

Keywords: Combined anterior and posterior cervical surgery; Cervical spinal stenosis; Cervical injury; Clinical effectiveness

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1. Introduction

There are multiple causes of cervical spinal stenosis, including cervical injury and acquired physiological degeneration of the cervical spine. Among these, cervical injury is a primary factor leading to cervical spinal stenosis. For patients with cervical spinal stenosis and cervical injury, the treatment process primarily focuses on local spinal canal decompression while selecting an appropriate surgical approach based on the patient's physical condition, such as anterior cervical surgery or posterior cervical surgery^[1]. If a combined anterior and posterior

cervical surgery approach is used during treatment, it can not only improve cervical function but also alleviate the impact of the disease, helping patients recover their health and return to normal life more quickly. This study selected 40 patients who underwent combined anterior and posterior cervical surgery at our hospital as the research subjects to further investigate and analyze the clinical effectiveness of this surgical approach for cervical spinal stenosis with cervical injury. The specific findings are reported as follows.

2. Clinical information and methods

2.1. Clinical information

A total of 40 cases were selected as research subjects. Through random grouping, the 40 patients were divided into two groups: the experimental group and the control group, with 20 patients in each group. In the experimental group, there were 11 male and 9 female patients, aged between 37 and 66 years, with an average age of 54.21 ± 3.15 years. They underwent combined anterior and posterior cervical spine surgery. In the control group, there were 12 male and 8 female patients, aged between 37 and 66 years, with an average age of 54.31 ± 3.24 years. They underwent anterior cervical decompression surgery alone. There were no significant differences in general clinical characteristics between the two groups ($P > 0.05$), making them comparable.

Inclusion criteria: (1) All patients in this study exhibited clinical manifestations of cervical spinal canal stenosis with cervical spine injury, such as numbness and weakness in both upper limbs and unsteady gait. Based on cervical imaging results after hospital admission, patients with an IOA score of less than 13 were diagnosed with cervical spinal canal stenosis and cervical spine injury. All patients underwent surgery and signed informed consent forms before the procedure. (2) Patients had complete medical records. (3) Patients were conscious and had basic communication abilities.

Exclusion criteria: (1) Patients with osteoporosis or other systemic bone diseases were excluded. (2) Patients with systemic dermatological diseases were excluded. (3) Patients with systemic vascular diseases were excluded. (4) Patients with mental illnesses were excluded. (5) Patients who did not understand the content of this study were excluded^[2].

2.2. Methods

The control group underwent anterior cervical decompression surgery alone. These patients were placed in a prone position and administered general anesthesia. Once anesthesia was effective, an incision was made on the right anterior side of the neck. Through this incision, the anterior part of the cervical vertebrae was exposed. Under C-arm X-ray guidance, the site of cervical spinal stenosis and cervical spine injury was identified. The anterior ligaments at the stenotic and injured sites were incised, and a curette was used to remove the cartilage endplate, nucleus pulposus, and surrounding osteophytes. The patient's head was then positioned to facilitate the implantation of an autologous bone graft at the affected site, which was fixed using a peptide plate.

The experimental group underwent combined anterior and posterior cervical spine surgery. These patients were placed in a supine position and administered general anesthesia. Once anesthesia was effective, an oblique incision was made on the anterior side of the neck, extending from the sternocleidomastoid muscle to the anterior vertebral body. After dissecting the prevertebral fascia, the lesion site identified under C-arm X-ray was exposed. The intervertebral disc and cartilage at the lesion site were removed, and necrotic tissue in the ligament and affected cervical vertebrae was cleared using a rongeur and curette. An autologous iliac bone graft was then

implanted. The patient was then repositioned into a prone position with the assistance of nursing staff. A horizontal incision was made at the midline of the cervical spine to enlarge the posterior approach, exposing the lamina and spinous processes. A micro-drill was used to split the spinous process in half, and after opening the enlarged spinal canal, artificial bone grafting and double-door laminoplasty were performed. Finally, the incision was sutured^[3].

2.3. Observation indicators

The observation and comparison of changes in various surgical treatment indicators and the improvement of cervical spine function before and after treatment in the two patient groups.

- (1) Comparison of clinical observation indicators for surgical treatment in both groups: A statistical comparison was conducted on surgical treatment time, intraoperative blood loss, postoperative spinal cord function scores, and hospital stay duration in both groups. The postoperative spinal cord function was evaluated using the European Myelopathy Score (EMS), with a total score of 20 points. A higher score indicates less spinal cord dysfunction, while a lower score indicates more severe dysfunction.
- (2) Observation indicators for cervical spine function improvement before and after treatment in both groups: This study used the Japanese Orthopedic Association (JOA) Cervical Function Score to assess the improvement in cervical spine function before and after surgical treatment in both groups. The total score is 17 points, where a higher score indicates better improvement in cervical spine function, and a lower score indicates poorer improvement.

2.4. Data processing

SPSS20.0 software was used for data processing. Measurement data were expressed as mean \pm standard deviation (SD) and analyzed using the *t*-test. Count data were expressed as frequencies and percentages and analyzed using the chi-square test. Statistical significance was set at $P < 0.05$.

3. Results

3.1. Comparison of clinical observation indicators for surgical treatment in both groups

A comparison of the clinical observations for surgical treatment in both groups is shown in **Table 1**. According to **Table 1**, the experimental group, which underwent a combined anterior-posterior cervical surgery approach, had shorter surgical treatment times and hospital stays than the control group, which underwent a single anterior cervical decompression surgery. Additionally, the experimental group had less intraoperative blood loss and higher spinal cord function scores. The differences between the two groups were statistically significant ($P < 0.05$). The comparison of clinical observations for surgical treatment in both groups is shown in **Table 1**.

Table 1. Comparison of clinical observation indicators for surgical treatment in both groups

Group	<i>n</i>	Operation time (min)	Intraoperative blood loss (mL)	Hospital stay (days)	Lysholm score
Experimental group	20	63.14 \pm 10.78	80.02 \pm 11.24	7.56 \pm 2.18	15.68 \pm 2.21
Control group	20	86.45 \pm 12.17	135.42 \pm 12.47	13.46 \pm 2.97	7.64 \pm 2.07
<i>t</i>		6.412	14.757	7.161	11.874
<i>P</i>		0.000	0.000	0.000	0.000

3.2. Comparison of cervical spine function improvement before and after treatment in both groups

The comparison of cervical spine function improvement before and after treatment in the two groups is shown in **Table 2**. As seen in **Table 2**, the experimental group, which underwent combined anterior and posterior cervical spine surgery, and the control group, which received only anterior cervical decompression surgery, were compared for cervical spine function improvement before and after treatment. Before treatment, there was no significant difference in JOA scores between the two groups ($P > 0.05$). After treatment, the JOA scores of the experimental group were better than those of the control group, and the difference was statistically significant ($P < 0.05$).

Table 2. Comparison of cervical spine function improvement before and after treatment in both groups

Group	<i>n</i>	JOA score results	
		Before treatment	After treatment
Experimental group	20	5.42 ± 1.34	14.85 ± 2.17
Control group	20	5.74 ± 1.21	7.63 ± 2.31
<i>t</i>		0.792	10.187
<i>P</i>		0.432	0.000

4. Discussion and conclusion

In the clinical field, one of the more common spinal surgical conditions is cervical spinal stenosis with cervical spine injury. This condition primarily affects middle-aged and elderly individuals. Once the disease occurs, patients not only experience significant physical pain but also suffer from disruptions in their daily lives. Surgical treatment is the primary approach for cervical spinal stenosis with cervical spine injury. However, due to variations in patients' physical conditions, the surgical methods used differ, leading to varying treatment outcomes^[4]. Finding a reasonable and effective treatment method to improve cervical spine function in patients with cervical spinal stenosis and injury and ensuring optimal treatment outcomes are key concerns in the clinical field today.

It is well known that the cervical spine is a critical structural component of the human body and is highly susceptible to injury. It is closely connected to the brain and spinal cord, serving as a crucial pathway for transmitting various signals throughout the body and facilitating the transport of nutrients to the brain. Given this, any pathological changes in the cervical spine can directly impact signal transmission and brain nutrition, making cervical spine diseases a significant focus in the clinical field. Cervical spinal stenosis is generally classified into two types: primary spinal stenosis, which is relatively rare in clinical practice, and secondary spinal stenosis, which is more common, such as degenerative osteoarthritis of the spine. In patients with cervical spinal stenosis, early clinical manifestations include significant pain, numbness, and weakness in the upper limbs, typically beginning with arm discomfort characterized by soreness and numbness. As the disease progresses, symptoms may extend to the lower limbs, affecting one side of the body with noticeable clinical signs such as shoulder pain and fingertip numbness, or affecting all four limbs simultaneously. In the mid-to-late stages of disease progression, patients may experience severe motor impairments, specifically presenting with pyramidal tract symptoms, including unsteady gait, a sensation of a heavy head and light feet while walking, and weakness in the legs, making walking difficult. In severe cases, patients may develop quadriplegia and become completely immobile^[5]. In the final stages of the

disease, patients may exhibit clinical symptoms such as urinary incontinence and urinary retention. Patients with spinal stenosis have a higher likelihood of developing cervical spine-related conditions, and the cervical spine is particularly prone to injury, which can lead to neurological disorders. Even minor injuries can result in severe neurological issues. This risk is especially pronounced in older patients, who may suffer nerve damage if they make sudden or excessive movements.

With the advancement of the times, continuous improvements in medical technology, and the emergence of various modern medical devices, favorable conditions have been provided for the treatment of cervical spinal canal stenosis with cervical spine injury, promoting higher examination and diagnosis rates. As a relatively common spinal disease in clinical practice, cervical spinal canal stenosis with cervical spine injury is primarily treated through surgical intervention. However, the treatment effects and prognosis vary depending on the surgical approach. The reason for this variation lies in the necessity of assessing the patient's physical condition and determining the most suitable surgical plan based on actual circumstances.

In recent years, surgical treatment plans for cervical spinal canal stenosis with cervical spine injury have been continuously optimized, significantly improving safety. However, due to the complex structure of the cervical spine and the relatively high surgical risks, selecting an appropriate surgical approach is crucial. In treating patients with cervical spinal canal stenosis with cervical spine injury, CT and MRI results can be used to determine the most suitable surgical approach. During the procedure, the exact location of the cervical spine damage should be identified, and decompression should be performed precisely at the site of compression. The focus of treatment is to directly address the compressive factors and enhance cervical spine stability through bone grafting. Based on different surgical approaches, procedures can generally be classified into anterior and posterior approaches, with different surgical methods corresponding to varying degrees of cervical spine injury. The choice of approach should be based on the patient's specific condition.

In this study, the experimental group, which underwent a combined anterior-posterior cervical surgery approach, showed more significant improvement in cervical spine function and had higher JOA scores compared to the control group, which underwent only anterior cervical decompression surgery. Additionally, the experimental group exhibited better outcomes in terms of surgical duration, intraoperative blood loss, and postoperative hospital stay, with significant differences between the two groups ($P < 0.05$). The use of the combined anterior-posterior cervical surgery approach helps minimize potential weaknesses in traditional surgical treatments, effectively reducing anterior and posterior cervical pressure and facilitating cervical spine function recovery. In contrast, a single anterior cervical decompression surgery may compromise the stability of cervical spine segments. In specific treatments, the combined anterior-posterior approach improves the patient's cervical spine condition, thereby enhancing the stability of the anterior column structure of the cervical spine^[6]. Moreover, patients undergoing the combined anterior-posterior cervical surgery approach experience a reduction in surgical frequency and the number of procedures required, preventing repeated surgeries that could lead to further cervical spine damage. This approach also shortens treatment duration, ensuring effective treatment while alleviating the financial burden on patients and reducing medical costs.

According to the study results, the clinical indicators in the experimental group showed greater improvements than in the control group, and postoperative cervical spine function recovery was also superior in the experimental group. The differences between the two groups were statistically significant ($P < 0.05$). Therefore, the application of the combined anterior-posterior cervical surgery approach in the clinical treatment of cervical spinal canal stenosis with cervical spine injury not only enhances cervical spine function but also controls intraoperative blood

loss, continuously improves cervical spine function scores, ensures postoperative recovery, shortens hospital stays, and facilitates a quicker return to normal life. This approach demonstrates significant therapeutic value and effectiveness, making it worthy of promotion in clinical practice.

Disclosure statement

The authors declare no conflict of interest.

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Retrospective Analysis and Literature Review of a Case of Spinal Epidural Lipomatosis

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Abstract: Spinal epidural lipomatosis (SEL) refers to the pathological overgrowth and accumulation of fat tissue within the spinal canal, forming an intraspinal space-occupying lesion. It is often associated with other spinal surgical conditions. This study retrospectively analyzes the clinical data of a patient diagnosed with SEL at Wuhan Hospital of Traditional Chinese Medicine on April 18, 2024, and reviews relevant literature. The study focuses on the etiology, clinical manifestations, diagnosis, and treatment of SEL to provide insights for clinical practice.

Keywords: Spinal epidural lipomatosis; Steroid hormones; Spinal stenosis; Spinal decompression surgery

Online publication: March 6, 2025

1. Introduction

Epidural fat (EF) refers to the adipose tissue filling the epidural space within the spinal canal. The dura mater, nerve roots, blood vessels, lymphatic vessels, and filum terminale within the spinal canal are all surrounded by EF, allowing for mutual sliding between these structures, thereby providing lubrication and stress-buffering protection^[1]. EF contains mesenchymal stem cells (MSC), and extracellular vesicles derived from EF-MSC can improve neurological recovery after spinal cord injury by reducing the expression of inflammatory cytokines. Spinal epidural lipomatosis (SEL) is characterized by pathological hyperplasia and excessive accumulation of fat tissue within the spinal canal, leading to compression of the dural sac, spinal cord, cauda equina, and nerve roots, resulting in corresponding clinical symptoms. SEL is relatively rare in clinical practice and is often misdiagnosed or overlooked due to its similarity to common intraspinal space-occupying conditions such as lumbar disc herniation or ligamentum flavum hypertrophy. The authors retrospectively analyzed the clinical data of a patient with SEL treated at Wuhan Hospital of Traditional Chinese Medicine to provide references for clinical diagnosis and treatment.

2. Case presentation

The patient is a 56-year-old male who was admitted to the hospital due to “low back pain accompanied by soreness, numbness, and weakness in both lower extremities for 5 years, with symptoms worsening over the past month.” The patient developed soreness and pain in the lower back without an obvious cause 5 years ago, accompanied by soreness, numbness, pain, and weakness in both lower limbs, as well as restricted mobility. He was diagnosed at an external hospital with “cervical spondylotic myelopathy” and “lumbar disc herniation.” He underwent conservative treatments, cervical open-door surgery, and lumbar minimally invasive surgery, which initially relieved his symptoms. However, he continued to experience intermittent episodes, with symptoms worsening after exertion and slightly alleviated with rest. One month ago, his symptoms progressively worsened without an apparent cause, leading to difficulty walking and intermittent claudication, with no significant relief after rest. Seeking systematic treatment, he visited Wuhan Traditional Chinese Medicine Hospital on April 18, 2024, and was admitted to the Orthopedics and Traumatology Department, Hankou Third Ward, with the outpatient diagnosis of “lumbar disc herniation.”

The patient has a history of hypertension for over 10 years, managed with long-term oral felodipine tablets, but blood pressure control was poor at admission. The patient also has a history of diabetes mellitus, managed with oral metformin tablets and subcutaneous insulin injections, but blood sugar control was also poor upon admission. The patient denied history of other underlying diseases. The patient underwent cervical single-door laminoplasty in 2019 and minimally invasive lumbar surgery in 2023 at an external hospital, but relevant surgical data was lost. There was no history of trauma, blood transfusion, or drug allergies. Physical examination revealed that the patient was in good general condition, with a height of 175 cm, weight of 100 kg, and BMI of 32.6 kg/m². The lumbar physiological curvature was flattened, with mild scoliosis. There was mild tenderness adjacent to L4/5 and L5/S1, no percussion pain in the lumbar region, positive deep tenderness in the right buttock, no significant tenderness in the bilateral sacroiliac joints, tenderness along the sciatic nerve trunk in both lower extremities (right: +, left: +), straight leg raising test (right: 50°, left: 60°), positive Bragard’s test (right: +, left: +), negative bilateral “4” test, negative bilateral piriformis muscle stretch test, Grade 5-muscle strength in both lower extremities, Grade 5 muscle strength in both upper extremities, normal and symmetrical muscle tone in all extremities, normal and symmetrical knee and Achilles tendon reflexes, negative Babinski sign, normal skin temperature in both lower extremities, palpable dorsalis pedis arteries, and adequate peripheral circulation.

MRI of the lumbar spine indicated degenerative changes, with L2, L3, and L5 vertebral bodies showing posterior spondylolisthesis (Grade I). There was degeneration of the L2/3–L5/S1 intervertebral discs, bulging and herniation of the T12/L1 disc (central type), bulging and mild herniation of the L2/3 disc (central type), bulging of the L3/4 disc, and bulging and herniation of the L4/5 and L5/S1 discs (left lateral type), resulting in narrowing of the left lateral recess. Stenosis of the spinal canal was observed at the L4/5 level. Synovial cysts were considered adjacent to the right facet joints of L4/5 and the left facet joints of L5/S1. There was edema in the subcutaneous soft tissue of the waist, and inflammation of the interspinous ligaments from L2/3 to L5/S1. After departmental discussion, the patient’s condition was communicated with the patient and family. Surgical treatment was recommended, and both the patient and family requested surgery. The patient’s general condition was stable in the perioperative period, with well-controlled blood pressure and blood glucose. Preoperative examinations showed no significant contraindications to surgery. Thus, the following procedure was performed: posterior lumbar discectomy for herniated disc + spinal canal decompression + interbody fusion with cage

implantation + pedicle screw fixation.

The surgical procedure is as follows: After successful general anesthesia, the patient was placed in the prone position, and routine disinfection and draping were performed. A midline longitudinal incision of approximately 12 cm was made with the lower edge of the L3 spinous process as the center. A micro radiofrequency tungsten needle electrode was used to incise the skin, superficial fascia, and lumbar dorsal fascia. The bilateral erector spinae muscles were dissected and stripped laterally along the L2–L5 spinous processes to expose the bilateral laminae, facet joints, and parts of the transverse processes of L2–L5.

Using C-arm X-ray fluoroscopy for confirmation, two guide pins were inserted bilaterally at L4 with an approximately 15-degree angle to the sagittal plane and parallel to the transverse plane. Similarly, two guide pins were inserted bilaterally at L5 with the same angulation. The positioning was confirmed to be satisfactory via C-arm fluoroscopy. A total of four 6.5×50 mm universal pedicle screws were inserted bilaterally at L4 and L5.

After confirming positioning via C-arm fluoroscopy, an ultrasonic bone scalpel was used to remove part of the left L4 lamina, the inferior articular process, and parts of the superior articular process and lamina of L5, exposing the ligamentum flavum and dura mater. A large amount of adipose tissue was observed in the spinal canal. The L4–L5 segment dura mater was visibly compressed, appearing white with reduced pulsation. The left L5 nerve root was found to be congested and edematous.

The left nerve root canal was expanded, and the nerve root was carefully mobilized medially. Bipolar coagulation was used for hemostasis, and the herniated nucleus pulposus was removed entirely, ensuring clearance within the intervertebral space. The nerve root canal was checked and found to be unobstructed and decompressed. Bone grafting was performed in the L4/5 intervertebral space, and a suitable cage (2.2×1.3 cm) was implanted. C-arm fluoroscopy confirmed good cage positioning.

An ultrasonic bone scalpel was then used to remove the middle and lower parts of the right L2 lamina and part of the right L3 lamina while preserving the L2 and L3 isthmus. After removing the lamina, hypertrophic ligamentum flavum, adipose tissue, and significant compression on the dura mater were observed. The hypertrophic ligamentum flavum and adipose tissue were meticulously removed, revealing a pulsating and expanded dura mater.

Two connecting rods were installed on the pedicle screws, and four locking nuts were sequentially tightened. C-arm X-ray fluoroscopy confirmed satisfactory internal fixation positioning. A final instrument and gauze count was performed. The surgical field was thoroughly irrigated with a large amount of normal saline, and hemostasis was achieved using absorbable hemostatic fleece. A drainage tube was placed in the incision, and the wound was closed layer by layer.

The surgery was completed successfully, with approximately 650 ml of intraoperative blood loss. 400 ml of autologous blood was reinfused intraoperatively. The patient remained hemodynamically stable and was safely transferred back to the ward. Vital signs were monitored postoperatively. The patient received anti-inflammatory, analgesic, infection prevention, gastric protection, neurotrophic support, and fluid replacement therapy. The preoperative MRI images (**Figure 1**) and postoperative lumbar X-rays (**Figure 2**) are as follows:

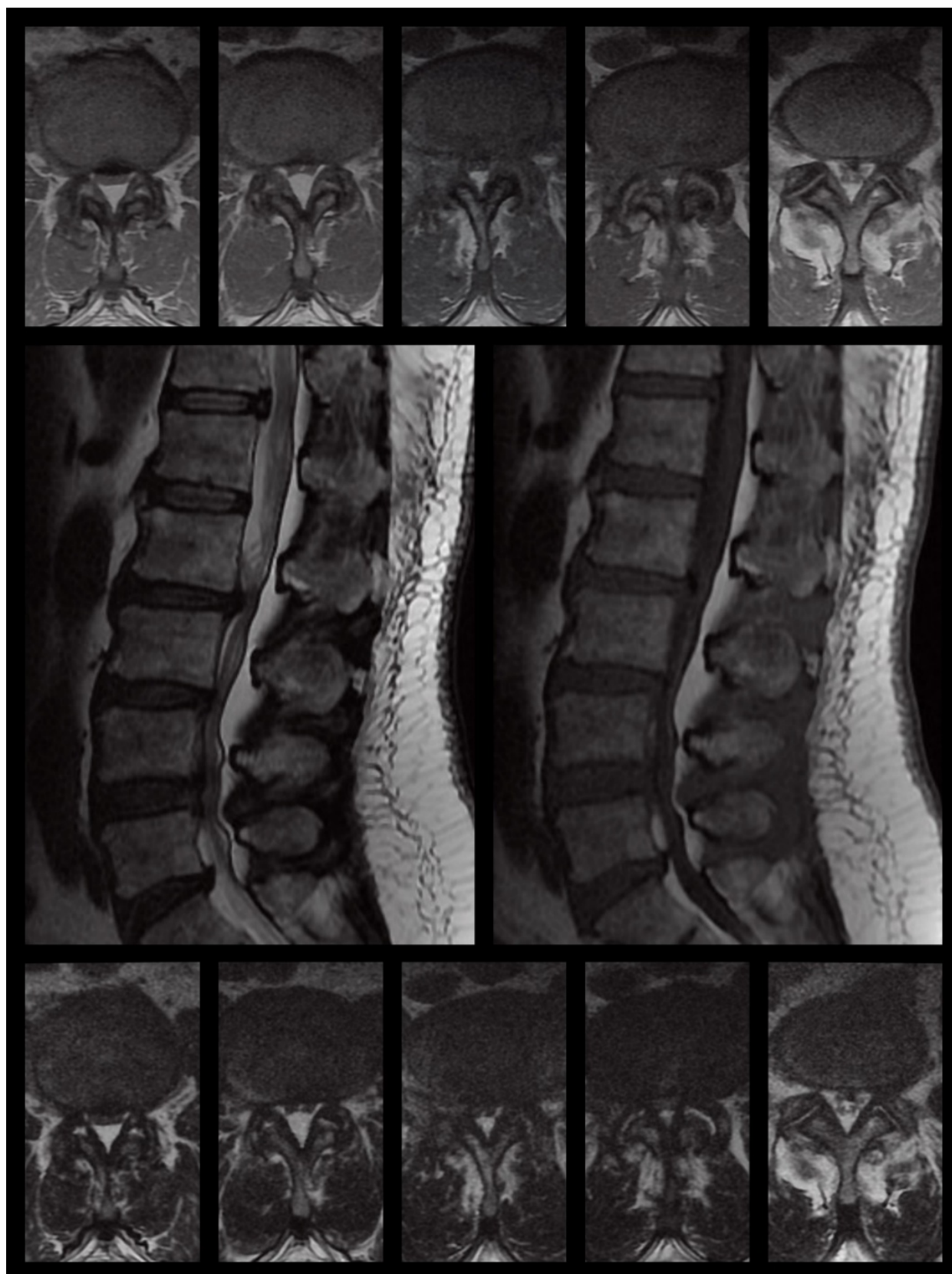


Figure 1. Preoperative MRI images

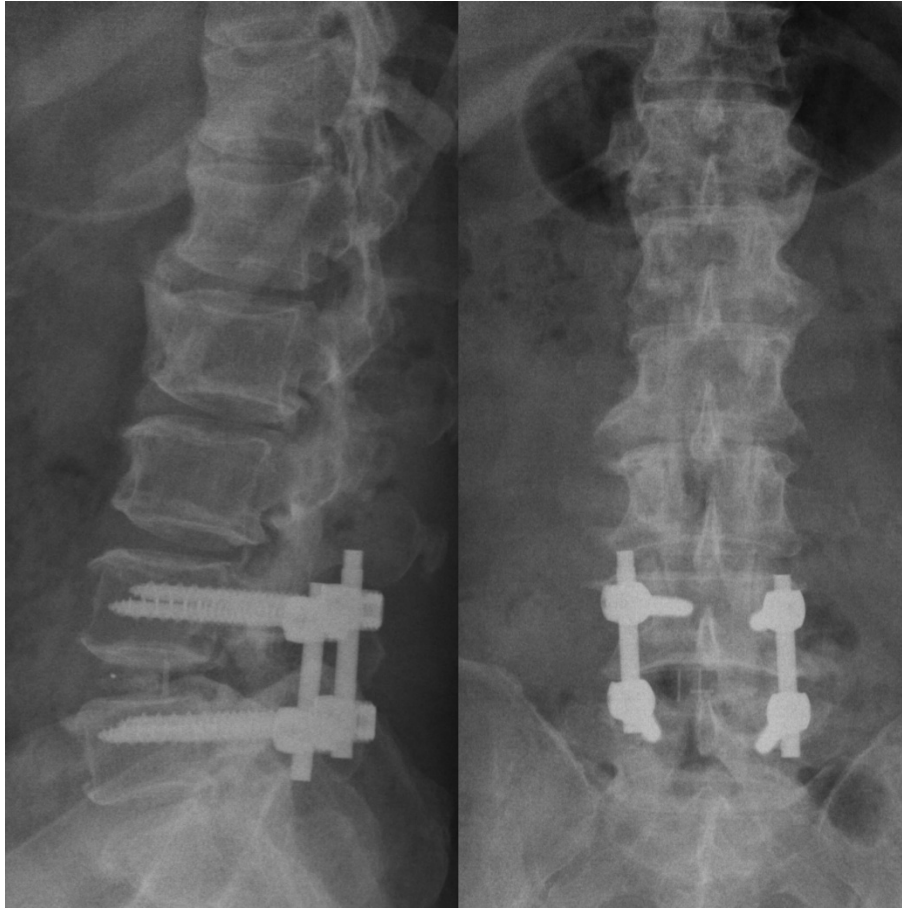


Figure 2. Postoperative lumbar X-rays

3. Literature review

3.1. Etiology of SEL

Spinal epidural lipomatosis (SEL) refers to a space-occupying lesion within the spinal canal caused by the pathological proliferation and excessive accumulation of EF. It is characterized by the compression of spinal canal contents such as the dural sac, spinal cord, cauda equina, and nerve roots, leading to varying degrees of lower back pain, unilateral or bilateral limb soreness, numbness, swelling pain, cauda equina syndrome, intermittent claudication, and other neurological compression symptoms.

The exact pathogenesis of SEL remains unclear. The prevailing view is that excessive corticosteroid hormones, whether due to exogenous corticosteroid use or increased endogenous cortisol, are the primary causes of SEL ^[2]. Increased endogenous cortisol is usually secondary to conditions such as Cushing's syndrome, hypothyroidism, hyperprolactinemia, and diabetes. Non-steroid-related SEL is considered idiopathic epidural lipomatosis and is often associated with obesity, metabolic syndrome, and chronic inflammation. Ishihara *et al.* ^[3] conducted a statistical evaluation of the correlation between SEL and metabolic syndrome or metabolic-related diseases, finding that the degree of EF accumulation was significantly associated with BMI, abdominal circumference, and visceral fat area, suggesting a relationship between EF deposition and metabolic diseases. Greenish *et al.* ^[4] reported the first case of acute SEL following spinal surgery and suggested that SEL should be considered a postoperative complication of spinal surgery. Currently, various hypotheses exist regarding the

etiology and pathogenesis of SEL, and further research is needed to supplement and clarify these aspects.

3.2. Clinical manifestations and diagnosis of SEL

SEL has a higher incidence in males and most commonly occurs in the thoracolumbar region and at the S1 level, with the L5/S1 segment being particularly affected. It is rarely observed in the cervical region or below the S2 level. A small number of asymptomatic SEL cases have also been reported. Salna *et al.* [5] described a case of a patient who experienced three days of right upper and lower limb weakness, initially evaluated for a stroke but ultimately diagnosed with SEL. This case was the first to suggest that SEL could present with stroke-like prodromal symptoms, highlighting the need for careful clinical diagnosis and differential diagnosis.

MRI can clearly visualize excessive epidural fat within the spinal canal. Fat tissue appears as a high signal intensity on both T1WI and T2WI sequences and as a low signal intensity on fat suppression sequence images. Combined sagittal and axial imaging can accurately display the distribution and morphology of excess fat within the spinal canal, as well as the degree of compression on the dural sac and spinal cord. Ge *et al.* [6] noted that the distribution of EF varies across spinal segments, and using a fixed MRI threshold to diagnose SEL at different spinal locations may be inaccurate.

3.3. Treatment of SEL

For patients with a lower grade of EF accumulation, mild and stable clinical symptoms, or asymptomatic cases, conservative treatment is recommended. This primarily involves treating the underlying condition, reducing or discontinuing exogenous corticosteroids, encouraging weight loss, optimizing pain management, and utilizing physical therapy. Surgery is considered only when conservative treatment proves ineffective. The primary surgical approach for SEL is decompression surgery, which includes laminectomy and epidural fat resection [7]. In pediatric SEL patients, laminoplasty is the preferred option to prevent future spinal deformities [8]. Minimally invasive procedures, such as unilateral biportal endoscopic decompression, have also been applied in SEL treatment, achieving decompression effects and improving clinical symptoms.

4. Discussion and conclusion

Reviewing this case, the patient was overweight, with a BMI of 32.6 kg/m², and had a history of “cervical spondylotic myelopathy” and “lumbar disc herniation.” The spine was in a state of chronic inflammation, and the patient also had a long history of diabetes, indicating an underlying metabolic disorder. Additionally, the patient had undergone spinal surgery in the past. Although the surgical records were lost, standard spinal surgery typically involves the use of a certain amount of corticosteroids for anti-inflammatory treatment. Combining these factors with the content discussed above, the etiology of SEL in this case closely aligns with what has been reported in related literature.

From an imaging perspective, the patient’s DuS/EF was ≤ 0.33 , and EF/SpiC was $\geq 75\%$, meeting the criteria for SEL grade III. Axial images showed that the patient’s dural sac was compressed into an oval or star-shaped deformation. Since the radiologists at our hospital had not previously encountered such cases, the initial imaging report did not describe the increased fat content. However, after discussing this case with the radiology department, subsequent imaging reports for some patients included descriptions of epidural fat accumulation in the spinal canal. This case also contributed to the experience and knowledge base of our hospital’s radiology

department.

Due to the patient's concurrent lumbar disc herniation and progressively worsening symptoms, the department decided on surgical treatment. The procedure included posterior lumbar discectomy, spinal canal decompression, cage-assisted interbody fusion, and pedicle screw fixation. Intraoperatively, the hypertrophic adipose tissue was resected. However, this case had certain limitations. Since the patient sought treatment in a different city, postoperative MRI follow-up was not feasible. Follow-up was conducted via telephone, where the patient reported normal walking ability and expressed high satisfaction with the surgical outcome. In conclusion, SEL is a relatively rare clinical condition, and further research is needed to deepen our understanding. Clinicians should enhance their knowledge and awareness of this disease to avoid missed or incorrect diagnoses.

Disclosure statement

The authors declare no conflict of interest.

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Analysis of Surgical Techniques and Therapeutic Effects for Hyperextension Tibial Plateau Fractures

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Abstract: *Objective:* To explore the surgical techniques and clinical efficacy of plate fixation for hyperextension tibial plateau fractures. *Methods:* A retrospective analysis was conducted on 20 patients with hyperextension tibial plateau fractures who underwent surgery in our hospital from January 2018 to October 2022. The operation time, hospital stay, preoperative and postoperative posterior tibial slope angles, knee function score (HSS), and postoperative complications were recorded. *Results:* All patients were effectively followed up for at least 6 months, with an average follow-up of 14.6 months. The average operation time was 153 minutes, and the average hospital stay was 18.7 days. The average preoperative posterior tibial slope angle improved from -3.7° to 7.3° postoperatively ($P < 0.05$), with a statistically significant difference. At the last follow-up, the HSS score was 81.2. One case of incision infection was reported, with no other serious complications. *Conclusion:* Hyperextension tibial plateau fractures present a significant clinical challenge. Strong fixation with a plate, restoration of the posterior tibial slope angle, and maintenance of knee joint stability provide an effective treatment approach for hyperextension tibial plateau fractures.

Keywords: Hyperextension tibial plateau fractures; Surgical efficacy analysis; Plate fixation

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1. Introduction

Tibial plateau fractures pose a significant challenge in clinical treatment, and hyperextension tibial plateau fractures represent a unique subtype. The primary injury mechanism involves an external force applied to the anterior tibial plateau while the knee is in an extended position, with the foot serving as the fulcrum. This results in a distinct fracture pattern characterized by anterior compression and posterior opening, often accompanied by severe soft tissue injuries and complications, making it a current research focus^[1]. Without timely intervention, fracture healing may be compromised, leading to difficulties in restoring knee joint function. This study retrospectively analyzed 20 cases of hyperextension tibial plateau fractures treated with plate fixation, all of which achieved favorable outcomes. The findings are reported below.

2. Materials and methods

2.1. Baseline data

This study retrospectively analyzed 20 patients with hyperextension tibial plateau fractures who underwent surgical treatment in our department from January 2018 to October 2022. There were 10 males and 10 females, aged between 29 and 64 years old, with an average age of 53.3 years old. Injury mechanisms included 12 car accidents, five falls from heights, and three heavy object injuries. Among them, five cases were complicated with fibular head fractures, one case with femoral condyle fracture, one case with popliteal artery injury, four cases with ligament and posterolateral complex injuries around the knee joint, and two cases with patellar fractures. There were 10 cases involving bilateral platform fractures, eight cases of lateral platform fractures, and two cases of medial platform fractures.

Inclusion criteria: Patients diagnosed with hyperextension tibial plateau fractures based on medical history and imaging examination. Exclusion criteria: (1) Conventional flexion-type tibial plateau fractures; (2) Old tibial plateau fractures; (3) Incomplete clinical data or loss to follow-up.

2.2. Surgical method

The position of the fracture was carefully analyzed based on preoperative radiographs, CT, and MRI. The procedure was performed under general anesthesia with a tourniquet. For fractures involving only the medial condyle, a direct medial incision was used, and after protecting the pes anserinus tendons, reduction was performed, followed by fixation with a plate or a plate-assisted screw. For isolated lateral tibial plateau fractures, an anterolateral proximal tibial incision was made, and the knee was flexed. The lateral joint capsule was incised, a meniscal retractor was inserted, and the lateral meniscus was suspended. Under direct visualization, the fracture fragments were exposed, and the posterior tilt of the articular surface was reduced first using a pry or push technique to correct anterior tilt. The depressed articular surface fracture was then reduced, and an allogeneic bone graft was implanted. Temporary fixation was achieved with Kirschner wires, and a rafting plate was placed laterally for fixation.

For fractures involving both condyles, a dual-incision approach was used. The lateral incision was routinely made through an anterolateral proximal tibial approach, while the medial incision was chosen based on the location of the medial tibial plateau fracture—either a posteromedial or slightly medial approach. The distance between the two incisions was maintained at a minimum of 7 cm. Under direct visualization through the dual incisions, mutual assistance was provided during the reduction process. The simpler fracture side was reduced first to restore the lower limb alignment, correct the anterior tilt of the tibial plateau, and elevate the collapsed articular surface. After bone grafting, Kirschner wires were used to maintain reduction, and both medial and lateral rafting plates were applied for fixation. Intraoperative fluoroscopy was performed to assess the alignment of the proximal tibia, the restoration of the plateau line, and the correction of joint surface collapse. A lateral fluoroscopic view was used to evaluate the restoration of the tibial posterior slope. Additionally, the surgeon conducted lateral stress and hyperextension tests on the knee joint to determine postoperative stability.

2.3. Postoperative treatment

Postoperatively, the patient was elevated, and ice therapy was applied for swelling reduction and pain relief. Dressing changes were reinforced. If no ligament repair around the knee joint was required, the patient was encouraged to begin knee flexion exercises within one week. If ligament repair had been performed, the

functional exercise period was extended to three weeks. The patient was encouraged to walk with crutches. Radiographic follow-up was conducted at three months postoperatively, and if fracture healing was confirmed, the patient was encouraged to begin weight-bearing walking.

2.4. Evaluation indicators

The operative time and follow-up data were recorded. Standard radiographs were used to assess the restoration of the tibial posterior slope. The knee function was evaluated based on the Hospital for Special Surgery (HSS) score, with assessments conducted at three months and at the final follow-up.

2.5. Statistical analysis

Data were processed using SPSS21.0 statistical software and analyzed using an independent samples *t*-test. A *P*-value less than 0.05 was considered statistically significant.

3. Results

3.1. Postoperative outcomes

All cases were followed up for at least 6–23 months, with an average of 14.6 months. The operation time ranged from 95 to 460 minutes, with the longest duration being 460 minutes. Due to injury to the popliteal artery, after fracture fixation during surgery, the patient was repositioned in the prone position to repair the damaged popliteal artery. Concurrent repair of peri-knee ligament injuries was performed in four cases. Additionally, fixation of patellar fractures was conducted in two cases, femoral condylar fracture in one case, and fibular head fracture in one case. The average operation time was 153 minutes. The hospital stay ranged from 8 to 32 days, with an average of 18.7 days. No early postoperative complications, such as incision infection, skin necrosis, or nerve injury, were observed. During follow-up, no late complications, such as internal fixation failure, were reported.

3.2. Radiology assessment

The primary evaluation focused on the restoration of the tibial posterior tilt angle. The preoperative angle of -3.7° was corrected to 7.3° postoperatively ($P < 0.05$, statistically significant). At the final follow-up, the angle was measured at 6.8° .

3.3. Functional assessment

The HSS knee scoring system was used for functional evaluation. The average score was 75.6 at three months postoperatively and 81.2 at the final follow-up.

4. Discussion

4.1. Characteristics of hyperextension tibial plateau fractures

Due to its unique injury mechanism, hyperextension tibial plateau fractures have a relatively low clinical incidence. The definition of knee joint hyperextension injury was first proposed by Nagel *et al.* in 1977 ^[2]. This injury was referred to as a “dashboard injury” of the knee joint. Its characteristics include an anteriorly directed force leading to anterior fracture compression and posterior fracture opening. In severe cases, the

proximal tibia, along with the femur, may shift forward as a whole, resulting in more severe soft tissue tension injuries to the posterior structures. For patients with hyperextension tibial plateau fractures, both soft tissues and neurovascular structures are affected. Therefore, during surgical treatment, special attention must be given to protecting vital structures such as nerves and blood vessels, significantly increasing the complexity of the surgical procedure^[3]. In this case series, one instance of popliteal artery injury and various ligament injuries around the knee joint were observed, all of which were repaired during the initial surgery. Therefore, for the treatment of such patients, the focus should be placed not only on the assessment and management of the fracture but also on the repair of soft tissues to prevent severe postoperative complications.

4.2. Selection of surgical approach

The fundamental principle in selecting a surgical approach is to ensure adequate exposure of the tibial plateau fracture^[4]. This allows for direct visualization during reduction, and in combination with the stability of fracture fragment fixation, knee joint reconstruction can be completed to ensure its overall stability^[5]. However, it should be noted that during the reconstruction phase, the procedure must be performed with the assistance of screws and plates^[6]. It has been observed that the rational selection of a surgical approach significantly affects the quality of tibial plateau fixation and the prognosis^[7]. Currently, for complex bicondylar hyperextension tibial plateau fractures, some researchers^[8] have adopted a single anterior approach with broad exposure of the anterior plateau, achieving favorable clinical outcomes. However, an additional incision is often required for supplementary fixation of the posteromedial aspect. In clinical practice, the dual-incision approach, exposing both the medial and lateral sides, is more commonly used. This technique is relatively straightforward, ensures sufficient width of the skin flap between the two incisions, and allows for proper reduction of both condyles, enhancing fixation effectiveness and reducing the risk of surgical complications^[9]. In this case series, a dual-incision approach was used in 10 cases of complex bicondylar fractures, with no postoperative complications such as incision necrosis or infection.

4.3. Reduction techniques

Reduction is the most challenging aspect of hyperextension tibial plateau fractures and the key to surgical success. In the reduction of complex bicondylar hyperextension tibial plateau fractures, not only must lower limb alignment be corrected to address varus and valgus deformities, but the anterior tilt of the tibial plateau must also be adjusted to a posterior tilt to ensure sagittal plane stability. It was reported by Kang *et al.*^[7] that hyperextension tibial plateau fractures were reduced under fluoroscopic guidance using limited open assistance and traction, with satisfactory postoperative outcomes. Wang and Zhang^[10] reported that excellent results were achieved in 15 patients through reduction methods that utilized the patient's own leg gravity, arthroscopic assistance, or leverage techniques. In our technique, bilateral incisions were used for exposure, and the knee joint was flexed with padding placed underneath. When posterior displacement of the lateral tibial plateau was involved, bilateral incisions were extended to the posterior aspect. The method described by Chu *et al.*^[11] was employed to expose the posterolateral structures, allowing for continuous exposure to the posterolateral region, where an acetabular retractor was inserted and maintained in place using leverage. Anteriorly, a row of Kirschner wires was inserted beneath the articular surface. With one assistant providing traction to maintain varus and valgus alignment, another assistant applied cranial traction to the Kirschner wires to maintain the posterior tilt of the plateau. Once successful reduction was achieved, temporary fixation was performed with

Kirschner wires, followed by bone grafting and final fixation with medial and lateral plates to complete the surgery.

5. Conclusion

Hyperextension tibial plateau fractures present significant clinical challenges. Precise preoperative incision design, protection and repair of soft tissues, proficient intraoperative reduction techniques, and strong plate fixation are essential to ensuring favorable postoperative outcomes.

Disclosure statement

The author declares no conflict of interest.

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Topics covered but not limited to:

- Architectural design
- Architectural technology, including new technologies and energy saving technologies
- Architectural practice
- Urban planning
- Impacts of architecture on environment

Journal of Clinical and Nursing Research (JCNR) is an international, peer reviewed and open access journal that seeks to promote the development and exchange of knowledge which is directly relevant to all clinical and nursing research and practice. Articles which explore the meaning, prevention, treatment, outcome and impact of a high standard clinical and nursing practice and discipline are encouraged to be submitted as original article, review, case report, short communication and letters.

Topics covered by not limited to:

- Development of clinical and nursing research, evaluation, evidence-based practice and scientific enquiry
- Patients and family experiences of health care
- Clinical and nursing research to enhance patient safety and reduce harm to patients
- Ethics
- Clinical and Nursing history
- Medicine



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Topics covered but not limited to:

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