Clinical Analysis of Improved Lateral Approach Lesion Clearance, Autologous Iliac Bone Interbody Fusion, and Posterior Internal Fixation for Lumbar Tuberculosis

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Abstract: Objective: To explore the clinical efficacy of improved lateral approach lesion clearance, autologous iliac bone interbody fusion, and posterior internal fixation for treating lumbar tuberculosis. Methods: Thirty lumbar tuberculosis patients enrolled from January 2022 to June 2023 were selected and divided into two groups based on the surgical method. The control group (15 cases) underwent traditional posterior open lesion clearance and conventional lumbar posterior reconstruction surgery. The observation group (15 cases) received improved lateral approach lesion clearance, autologous iliac bone interbody fusion, and posterior internal fixation. Comparisons were made on surgical conditions, time to ambulation after surgery, complication rates, laboratory test results, ASIA scores, VAS scores, ODI index, and cure rates. Results: The observation group had superior surgical outcomes compared to the control group, with shorter time to ambulation after surgery ($P < 0.05$). The complication rate in the observation group was lower than in the control group ($P < 0.05$). Laboratory test results post-surgery were better in the observation group ($P < 0.05$). ASIA scores were higher in the observation group ($P < 0.05$). There were no significant differences in VAS scores and ODI index between the two groups ($P > 0.05$). The cure rate was higher in the observation group ($P < 0.05$).Conclusion: Improved lateral approach lesion clearance, autologous iliac bone interbody fusion, and posterior internal fixation for lumbar tuberculosis resulted in a smooth surgical process, faster recovery, and better safety. This method improved laboratory results, neurological function, and cure rates.
***Keywords*:** improved lateral approach lesion clearance; autologous iliac bone interbody fusion; posterior internal fixation; lumbar tuberculosis; surgical treatment

1. Introduction

Tuberculosis is common in clinical practice in China, and spinal tuberculosis is a prevalent form of bone and joint tuberculosis, with a high incidence due to weak disease prevention awareness among the public. This disease causes severe lower back pain and deformities, affecting the patient's mobility and daily life[1]. Surgical treatment is a common method for lumbar tuberculosis, which can reduce the disability rate of patients. However, surgery may cause damage to blood vessels and organs, leading to severe complications. Microinvasive surgical techniques have developed rapidly and achieved better results compared to traditional methods, reducing patient damage. Lateral approach interbody fusion is a widely used minimally invasive surgery for lumbar tuberculosis with a lower complication rate[2]. The application of endoscopic technology in lateral approach interbody fusion can create more exposure space and provide adequate illumination, enhancing the safety and effectiveness of minimally invasive lateral approach lesion clearance and reconstruction for lumbar tuberculosis. However, clinical research on this surgical method for lumbar tuberculosis is limited. Therefore, this article provides an in-depth study to explore the value of this surgical approach for lumbar tuberculosis and offers data support.

2. Materials and Methods

2.1 General Information

Thirty lumbar tuberculosis patients enrolled from January 2022 to June 2023 were selected and divided into two groups based on the surgical method. The control group (15 cases) included 8 males and 7 females, aged 27-71 years (48.65 ± 2.01 years). The observation group (15 cases) included 9 males and 6 females, aged 28-70 years (48.56 ± 2.11 years). There were no significant differences between the groups ($P > 0.05$), making them comparable. All patients provided informed consent, and the study was ethically approved.

Inclusion Criteria: ① Final diagnosis of thoracolumbar tuberculosis based on patient history, clinical presentation, imaging and laboratory tests, and postoperative histopathology or pus culture. ② Vertebral body destruction predominantly

anterior or severe, with continuous disease involvement ≤3 vertebrae. ③ First-time surgical treatment. ④ Underwent primary anterior lesion clearance with iliac bone grafting and internal fixation. ⑤ Follow-up duration of at least 1.5 years. ⑥ Meeting all of the above five criteria.

Exclusion Criteria: ① Other infections, such as brucellosis or pyogenic spondylitis. ② Recurrence of tuberculosis. ③ Severe thoracolumbar kyphotic deformity or other conditions affecting clinical efficacy, such as tumors, vertebral slippage, or spinal stenosis. ④ Active tuberculosis at other sites, such as active pulmonary tuberculosis or renal tuberculosis, which might affect clinical cure time. ⑤ Other serious illnesses affecting the ability to tolerate surgery. ⑥ Pregnant women, children, and other ineligible individuals.

2.2 Methods

All patients received routine four-drug anti-tuberculosis treatment for 2 weeks before surgery. Surgery was performed after patients' nutritional status improved and liver and kidney functions normalized.

Control Group: Traditional Posterior Surgery: Under general anesthesia, the patient was placed in the prone position. A posterior midline incision was made to clear the lesion from the posterior to the anterior edge of the vertebral body, followed by pedicle screw fixation. The skin and fascia were incised along the spinous processes and laminae to expose the affected vertebral segments and facet joints. Based on imaging results, pedicle screws were placed in the segments requiring fixation, and the lesion was cleared. For patients with less severe vertebral body destruction mainly at the intervertebral disc, partial removal of the facet joint was performed on the side with more severe disease, with lesion clearance through the foramen. For patients with severe bone destruction, removal of the facet joints, pedicles, part or all of the lamina, or the opposite lamina was performed. Pus and necrotic tissue were cleared laterally through the spinal column, followed by anterior reconstruction using iliac bone grafts and posterior rod-screw fixation.

Observation Group: Minimally Invasive Lateral Surgery with Endoscopic Assistance: Under general anesthesia, the approach was from the side with more severe bone destruction and abscesses. The patient was placed in a lateral position with a soft pillow under the waist and the hip joint slightly flexed, secured with elastic bands. After routine disinfection and draping, a C-arm fluoroscope was used to locate the affected segment. A skin incision approximately 4 cm long was made at the lateral midline of the vertebral body projection of the affected segment. The skin and subcutaneous fascia were incised, and the external oblique, internal oblique, and transverse abdominal muscles were separated. The peritoneum and retroperitoneal fat were retracted forward to expose the anterior surface of the psoas major muscle. After fluoroscopic localization, the working channel was gradually expanded and placed. Using an endoscope (KARL STORZ, 28731BWA), pus and necrotic tissue in the lesion area were cleared until normal vertebral bone was exposed. Anterior reconstruction was performed using iliac bone grafts filled with titanium mesh or artificial vertebrae, followed by lateral rod-screw or plate fixation.

Postoperatively, all patients began limb exercises in bed 3 days after surgery. Imaging was reviewed to assess spinal correction and internal fixation. Drains were removed 7 days post-surgery if no drainage was present, and patients were allowed to ambulate with a brace. Antibiotic treatment was administered for 5-7 days, and anti-tuberculosis therapy was continued for 12-18 months according to the preoperative plan.

2.3 Observation Indicators

The following indicators were recorded and monitored:

Surgical Indicators: Duration of surgery, intraoperative blood loss, and incision length. The time for patients to begin ambulating post-surgery was observed, and the stages of any complications were meticulously recorded.

Postoperative Follow-Up: Routine follow-up included rechecking blood routine, liver and kidney function, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) levels.

Functional and Pain Assessment: ASIA scores, Visual Analog Scale (VAS) scores for lumbar and leg pain, and Oswestry Disability Index (ODI) were calculated.

Imaging Studies: Immediately post-surgery, all patients underwent lumbar spine X-rays in the anteroposterior and lateral views, as well as CT 3D reconstructions to observe the positions of pedicle screws, facet joint screws, and intervertebral fusion devices. Follow-up imaging included lumbar spine X-rays in the anteroposterior, lateral, flexion, and extension views, and MRI at 1, 3, 6, 12, 24, and 36 months.

Fusion Assessment: Bone fusion rates were evaluated according to the methods of Coe JD and Vaccaro AR, including checking for any displacement or subsidence. Measurements of lumbar curvature and fusion intervertebral height were taken to assess abscess clearance.

Cure Criteria: Cure of spinal tuberculosis was defined as follows: ① Systematic anti-tuberculosis medication for more

than 6 months post-surgery, with stable overall condition, normal body temperature, no neurological symptoms, and normal diet. ② Multiple follow-up tests showing ESR within normal range. ③ Imaging showing successful bone graft fusion with no abnormal findings. ④ Restoration of normal daily activities, performing non-strenuous work for 3-6 months, with no symptoms of tuberculosis infection, abscesses, or sinus formation.

2.4 Statistical Analysis

All data were analyzed statistically. Measurement data were presented as mean ± standard deviation ($\bar{x} \pm s$), while count data were expressed as n (%). Comparisons between groups were performed using t-tests and χ^2 tests, with a significance level set at $P < 0.05$. Statistical analyses were conducted using SPSS version 24.0 software.

3. Results

3.1 Surgical Indicators and Time to Ambulation

In the observation group, the surgical time was longer compared to the control group, but intraoperative blood loss, incision length, and time to ambulation were shorter in the observation group ($P < 0.05$), as shown in Table 1.

Table 1. Surgical Indicators and Time to Ambulation ($\bar{x} \pm s$)

Group	Number of Cases	Surgical Time (min)	Intraoperative Blood Loss (ml)	Incision Length (cm)	Time to Ambulation (d)
Control Group	15	182.91±20.15	428.78±95.21	12.27±0.64	35.61±2.64
Observation Group	15	220.21±20.61	314.38±84.16	11.80±0.52	30.61±2.01
t	-	5.012	3.487	2.207	5.836
p	-	0.000	0.002	0.036	0.000

3.2 Laboratory Test Results

Postoperative laboratory test results in the observation group were superior to those in the control group ($P < 0.05$), as shown in Table 2.

Table 2. Laboratory Test Results ($\bar{x} \pm s$)

Group	Control Group (15 cases)	Observation Group (15 cases)	T	P
WBC ($\times 10^9$/L)	10.35±1.35	7.03±0.57	8.775	0.000
ALT (U/L)	39.61±2.51	45.52±2.61	6.321	0.000
Scr (μmol/L)	90.54±2.14	95.35±2.05	6.286	0.000
ESR (mm/h)	33.56±5.51	18.55±5.24	7.645	0.000
CRP (mg/L)	15.67±1.51	11.51±1.61	7.299	0.000

3.3 Scores: ASIA, VAS, and ODI

The ASIA score of the observation group was higher than that of the control group ($P < 0.05$). The VAS score and ODI index did not show significant differences compared to the control group ($P > 0.05$), as shown in Table 3.

Table 3. Scores ($\bar{x} \pm s$, points)

Group	Number of Cases	ASIA		VAS	ODI
		Sensory Score	Motor Score		
Control Group	15	126.64±10.32	31.53±4.22	1.69±0.51	15.71±2.24
Observation Group	15	157.69±10.25	46.69±4.17	1.51±0.31	15.42±2.60
t	-	8.268	9.897	1.168	0.327
p	-	0.000	0.000	0.253	0.746

3.4 Cure Rate and Complication Incidence

The incidence of complications in the observation group was lower than that in the control group, and the cure rate was higher in the observation group ($P < 0.05$), as shown in Table 4.

Table 4. Cure Rate and Complication Incidence (n/%)

Group	Number of Cases	Anterior Thigh Numbness	Surgical Site Infection	Tuberculosis Recurrence	Total Incidence	Cure Rate
Control Group	15	2(13.33)	1(6.67)	1(6.67)	4(26.67)	11(73.33)
Observation Group	15	0(0.00)	0(0.00)	0(0.00)	0(0.00)	15(100.00)
χ^2	-	-	-	-	4.615	4.615
P	-	-	-	-	0.032	0.032

4. Discussion

Tuberculosis is highly prevalent in China, with the country ranking second globally in the number of tuberculosis cases. Among these, bone and joint tuberculosis is a common extrapulmonary manifestation, with spinal tuberculosis accounting for one-third to one-half of bone and joint tuberculosis cases [3]. The granulomatous tissue from tuberculosis protrudes and compresses the spinal cord, affecting spinal nerve function and leading to a high incidence of paraplegia in patients. To address this, hospitals strive to find more effective surgical treatments that not only improve clinical cure rates but also enhance surgical safety. In recent years, minimally invasive surgery has advanced rapidly, and its application in spinal tuberculosis has also grown. In this context, the lateral approach for lumbar interbody fusion surgery has emerged. During this procedure, a smaller incision is made on the patient's surface, and intervertebral disc removal and interbody fusion are performed through an expanded channel. However, this surgery may cause damage to blood vessels and sympathetic nerves [4-5]. Therefore, hospitals focus on researching further improvements to enhance surgical safety.In this study, the observation group, using endoscope-assisted minimally invasive lateral approach for lesion removal and reconstruction, showed better outcomes than the control group. Although there was no significant difference in VAS and ODI scores between the two groups, the observation group had superior results in terms of surgical indicators, time to mobilization, laboratory test results, complication rates, and cure rates. The longer surgical time in the observation group may be due to the increased complexity of the procedure and the use of endoscopy. The advantages observed in other indicators may be attributed to the reduced surgical trauma and higher visualization.

In summary, the modified lateral approach for lesion removal, combined with autogenous iliac bone interbody fusion and posterior fixation, demonstrates good surgical outcomes for lumbar tuberculosis. It facilitates faster postoperative recovery and is relatively safe and effective, making it a valuable approach for application.

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