

Original Article

Clinical efficacy of one-stage anterolateral surgical treatment for lumbosacral spine tuberculosis by bilateral pedicle-screw internal fixation

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Abstract: Objective: To investigate and evaluate the clinical efficacy of one-stage anterolateral surgical treatment for lumbosacral spine tuberculosis by bilateral pedicle-screw internal fixation. Methods: A total of 8 patients with lumbosacral spinal tuberculosis whose lesion location was between L4-5 and L5-S1 and who were admitted and treated in our hospital from October 2014 to December 2015 were selected as the research subjects. After receiving standardized anti-tuberculosis treatment for more than 4 weeks, the patients with lumbosacral spine tuberculosis were treated with the one-stage anterolateral surgery by the bilateral internal fixation. After operation, they also underwent the conventional anti-tuberculosis treatment, then their erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) level, lumbosacral angles, intervertebral altitude and Visual Analogue Scale (VAS) were compared and analyzed and the follow-up visits were carried out to observe their surgical results, clinical functions, complications and recurrences until December 2016. Results: The operation was successful for all patients and the follow-up visits were carried out for 12-24 months with an average of 16 months. Compared with the preoperative condition, the ESR and CRP level were decreased significantly one month after operation (all $P < 0.05$), and returned to normal value after the reexamination at postoperative 6 months. Compared with the preoperative condition, the VAS score were improved obviously 6 month after operation ($P < 0.05$), and patients' persistent low back pain was significantly relieved. In addition, patients' lumbosacral angles were also improved distinctly at postoperative 6 months ($P < 0.05$). The average intervertebral space height was 10.5 mm 6 months after surgery, whose average altitude brace was 2.6 mm compared with the preoperative, with statistically significant difference ($P < 0.05$). Moreover, patients' postoperative bone graft fusion and internal fixation were favorable, all of which achieved satisfying functional recovery results. The average time of bone graft fusion was 7-8 months. And during the follow-up period, there were no complications (such as screw rupture, breakage, and looseness) occurring and no tuberculosis recurrence. Conclusion: The efficacy of one-stage anterolateral surgery by the bilateral internal fixation in the treatment of lumbosacral spine tuberculosis is significant, with advantages of less postoperative complications and lower recurrence rate. Therefore, it is a safe and effective method for treating the lumbosacral spine tuberculosis.

Keywords: Spinal tuberculosis, bone graft, pedicle screw system, internal fixation

Introduction

In recent years, the incidence of bone and joint tuberculosis has shown a clear upward trend. Spinal tuberculosis is often accompanied by varying degrees of neurological dysfunction. Its incidence is up to 50%, and even 10% among them will develop into paraplegia, which is extremely harmful to patients' psychology and life [1, 2]. Spinal tuberculosis is common in bone and joint tuberculosis, especially in the lumbosacral tuberculosis. All the scholars and experts believe that the cure rate of lumbar

tuberculosis can be increased by performing the positive surgical treatments in patients on the basis of standardized anti-tuberculosis drug treatment. But the complicated anatomical structure, special biomechanics, small operating space and other factors of lumbosacral spine have made the surgery become more difficult. And there are many controversies in the surgical approach, lesion debridement, internal fixation choice and other aspects, which have been the hot spots of clinical research for many years [3, 4]. From October 2014 to December 2015, a total of 8 patients with lumbosacral

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spinal tuberculosis were admitted to our hospital to be treated with the one-stage anterolateral surgery by the bilateral internal fixation. The efficacy was significant, and the results were reported as follows.

Materials and methods

Case selection

This study was approved by the local Ethics Committee and all the patients had signed the informed consents. Eight patients with lumbosacral spinal tuberculosis were selected for this study.

Inclusion criteria: Patients' symptoms, imaging and biochemical examinations met the diagnostic criteria of lumbosacral spine tuberculosis and had surgical indications; patients had lesions at L5-S1 without suffering from the psoas abscess, iliac fossa abscess or presacral abscess; patients were able to complete the postoperative follow-up.

Exclusion criteria: Patients had severe heart, lung diseases or chronic liver and kidney diseases; patients had coronary heart diseases, diabetes and other diseases and had poor surgical tolerance; patients' preoperative iliac angiography showed that the internal fixation failed to be achieved because of the low position of iliac vascular; patients had severe mixed infections; patients had pus in lesion parts, necrotic tissues and the nerves in the spinal canal was compressed by sequestra; patients had diseases combined with the immune deficiency and rheumatic immune system diseases.

Treatment methods

Preoperative preparation: After being admitted to the hospital, all the patients were required to strictly follow the doctor's orders, stay in the bed and meanwhile strengthen nutrition. Before operation, patients should receive the standardized anti-tuberculosis treatment with fixed-dose combination of four drugs (hydrazine 0.3 g/time, rifampicin 0.3 g/time, streptomycin 0.75 g/intramuscular injection and ethambutol 0.75 g/time) for 4-5 weeks and strengthen comprehensive nutrition to endure treatment. Patients were asked to take the examinations of hemogram, erythrocyte sedimentation rate (ESR), liver function, renal function and electrolytes before and after operation, and should

be corrected the hypoproteinemia. The operation timing should be chosen when there were significantly alleviated tuberculosis poisoning symptoms and relatively stable tuberculosis, the hemoglobin was more than 100 g/L and the plasma albumin was more than 35 g/L, the blood pressure and blood glucose were controlled within the qualified range after treatment, there were no severe complications and normal functions of liver, lung, heart, kidney, etc.

Operation methods: The general anesthesia with endotracheal intubations was performed in all the patients. After that, they were in the right prone position and the operative side should be elevated to 30-45°. Then, patients underwent the incision which was parallel to the costal margin in the lower abdomen with extraperitoneal approach. During this period, physicians should pay attention to protecting the abdominal organs. The testicular artery, ovarian vein and ureter were retracted, and the adhesions should be separated carefully by using the pre-prepared protective measures. The median sacral artery and iliac vessels were protected by ligation, and the tuberculosis abscess was exposed and cleaned up thoroughly. The hydrogen peroxide was used to wash properly. When the cleaning fluid became clear, a gelatin sponge containing 0.3-0.5 g of isoniazid and 0.8 g of amikacin was placed around the bone graft to infiltrate the graft area, and the silica gel drainage tube was placed. After the lesion removal, L5-S1 intervertebral discs were slotted laterally and opened at the right degree, so as to restore the physiological curvature and lumbosacral angle with proper intervertebral altitude. Then, an appropriate length of the autogenous iliac bone graft was implanted into the opened slot. After the retroperitoneal separation, L4-5 and L5-S1 were exposed, and a secure hemostatic method with gauze packing was applied. Transverse processes at both sides and upper and lower articular processes were exposed with spreader, and their soft tissues and cortex in the screw were removed by rongeur. The depth was detected with a probe and the proper position was determined with a needle. The screw position direction was determined by C-arm X-Ray machine. After that, 2 screws were placed bilateral vertebral plate. Rod clamp was placed between the 2 screws, if necessary, the radian of rod could be changed. Besides, nail heads were put on with pressur-

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Table 1. The prognosis and outcome of lumbosacral spine tuberculosis before and after operation

	ESR (mm/h)	CRP (mg/L)	Intervertebral altitude (mm)	lumbosacral angle (°)
Preoperative	94.1 ± 14.4	97.1 ± 5.8	7.8 ± 0.4	62.4 ± 9.3
Postoperative 1 month	55.3 ± 7.5	48.3 ± 3.9	8.2 ± 0.6	56.3 ± 5.7
Postoperative 6 months	11.7 ± 3.6	7.2 ± 2.8	10.4 ± 0.5	43.3 ± 6.7
P1 (Postoperative 1 month vs. Preoperative)	0.0327	0.001	0.473	0.467
P2 (Postoperative 6 months vs. Preoperative)	0.004	0.0001	0.008	0.041

izer. At last, the wound was sutured.

Postoperative treatment and follow-up: Patients' vital signs, bilateral lower limbs movements and sensory conditions were observed regularly after treatment. After operation, patients were connected to the negative pressure drainage devices at postoperative 48 h and were required to remove the drainage tubes according to the patients' specific drainage situations at postoperative 5-7 days. Moreover, the anti-infective therapy using the antibiotics was prophylactically applied in patients for 3 days and the standardized anti-tuberculosis treatment was lasted for 8-16 months, meanwhile the liver-protecting treatment was performed. During this period, physicians should pay attention to the possible adverse reactions (especially those might bring damages to the liver and kidney) after using the anti-tuberculosis drugs, and regularly take examinations of hemogram, ESR, C reactive protein (CRP), tuberculosis antibody, liver and kidney functions, and lumbar spine X-ray. Patients were required to stay in the bed for nearly 5-6 weeks after operation and their out-of-bed activities should be carried out by using the corset protection measures. All the patients received the routine follow-up for 12-24 months after operation.

Observation indexes

The observation indexes included the surgical results (each patient's operation time, intraoperative blood loss and hospital stays were recorded), clinical functions (the ESR and CRP were used to assess the lesion activity before operation and at 1 and 6 months post-operation; the VAS was applied to respectively evaluate the pain degree before operation and at postoperative 1 and 6 months, in which zero means painless while 10 points means the most painful; the lumbosacral angle was used to assess the activity situation of lumbosacral

vertebrae before and after operation; besides, postoperative complications and recurrences were also observed and recorded.

Statistical analysis

The statistical analysis was performed by using the SPSS19.0 software. The measurement data obeyed the normal distribution and were expressed as mean ± standard deviation ($\bar{x} \pm sd$); the differences before and after the treatment were tested by the paired t-test and the count data were expressed as rate (%). The difference was considered as statistically significant when $P < 0.05$.

Results

General information of patients

A total of 8 patients with lumbosacral spine tuberculosis (4 males and 4 females) were enrolled in this study. And they were aged from 27 to 60 years old with an average of 38.5 years old, and their courses of disease were 5-15 months, with an average of 8.5 months. Their main features were persistent lumbar pain. The examinations of X-ray, computed tomography (CT), and Magnetic Resonance Imaging (MRI) on the lumbosacral spine were performed in all the patients. And the imaging examination showed that the intervertebral altitude was narrowed in all patients' lumbosacral segments (the intervertebral altitude of preoperative patients was $(7.8 + 0.04)$ mm). When the patients were initially admitted to the hospital, their ESR values were 80-105 mm/h and their CRP values were 90-103 mg/L, both of which were higher than the normal (the normal value of ESR is 0-20 mm/h while of CRP is less than 10 mg/L). See **Table 1**.

Surgical results

All the patients completed the operation successfully, and there were no complications

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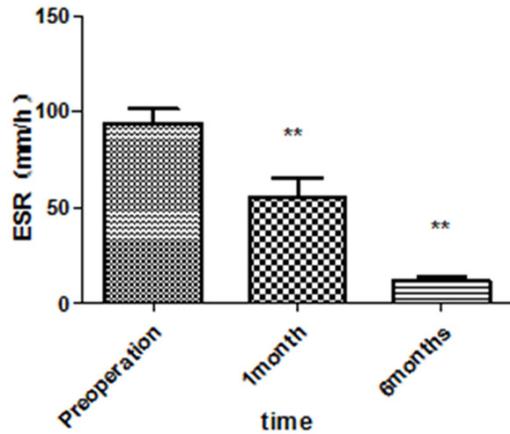


Figure 1. Changes of ESR before and after treatment. Compared with the preoperative condition, **P<0.01.

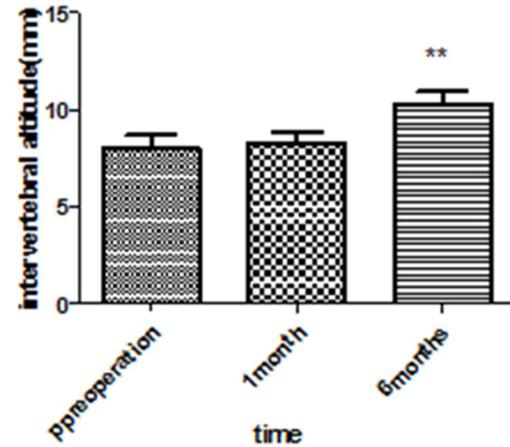


Figure 3. Comparison of intervertebral altitude before and after treatment. Compared with the preoperative condition, **P<0.01.

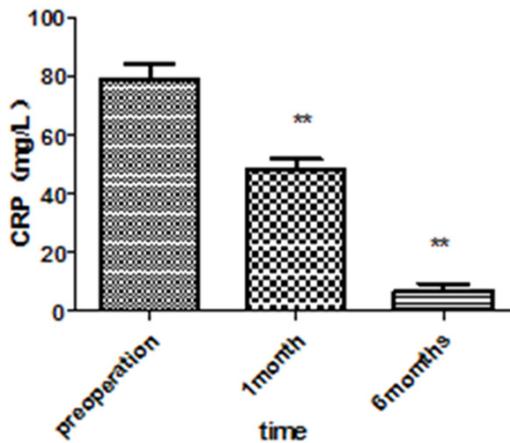


Figure 2. Changes of CRP before and after treatment. Compared with the preoperative condition, **P<0.01.

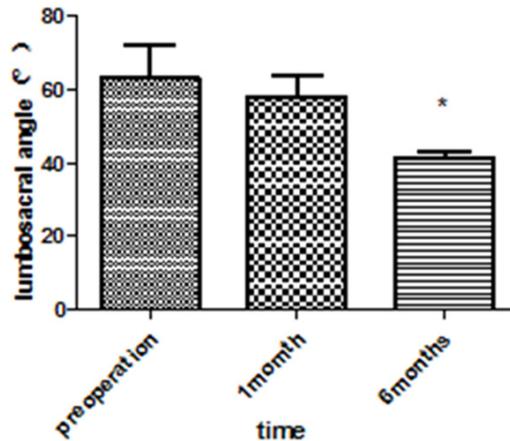


Figure 4. Changes of lumbosacral angle before and after treatment. Compared with the preoperative condition, *P<0.05.

occurring during the operation. The postoperative pathological examination showed that the lesion was confirmed as tuberculosis. The mean operation time was 158.5 ± 30.7 minutes; the average volume of blood loss was 376.7 ± 188.7 ml and the mean length of hospital stay was 18.6 ± 6.2 days.

Evaluations and results of clinical function

After operation, all the patients received follow-up for 10-24 months with an average of 16 months, with follow-up rate of 100%. All the patients' postoperative symptoms of tuberculosis poisoning were relieved. When compared to the preoperative conditions, the ESR and CRP values were decreased significantly at postoperative 1 month ($P=0.0327$, $P=0.001$), and

returned to the normal (**Figures 1 and 2**) at postoperative 6 months. The average intervertebral altitude was 10.5 mm 6 months after surgery, whose average altitude brace was 2.6 mm compared with the preoperative, with statistically significant difference ($P=0.012$, **Figure 3**). In addition, compared with the preoperative conditions, the lumbosacral angles were also improved significantly at postoperative 6 months ($P=0.041$, **Figure 4**). Compared with the preoperative conditions, the VAS scores were improved obviously at postoperative 6 months, and meanwhile, the patients' persistent low back pain symptoms were also relieved distinctly ($P=0.007$, **Figure 5**).

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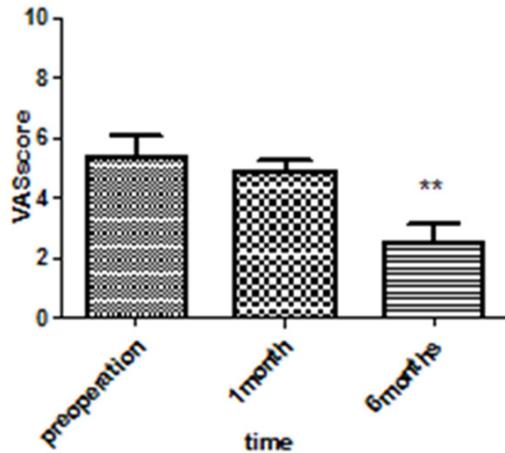


Figure 5. Comparison of VAS scores before and after treatment. Compared with the preoperative condition, ** $P < 0.01$.

Complications of patients

This study adopted the one-stage anterolateral surgery by the bilateral internal fixation to treat the lumbosacral spine tuberculosis, and there were no complications (such as damages of blood vessel, ureter, nerve and abdominal organs) occurring during the operation.

Recurrence

The mean follow-up time was 16 months, and no tuberculosis recurrence was found in all patients. The cure standard of spinal tuberculosis is as follows: one year after operation, there is no recurrence of tuberculosis symptoms; the ESR value remains in the normal range; the imaging should show the bony union of diseased vertebral bodies; patients were able to take some general physical activities. And according to the above standards, it could be concluded that all patients with lumbosacral spine tuberculosis were healed in this study.

Discussion

Lumbosacral spine is the most important part of the human body, which bears great shear force in people's daily life. Once the bone defect caused by the lumbosacral spine lesion occurs, it will seriously affect people's normal life. Therefore, the reconstruction and maintenance of lumbosacral spine stability is essential [1, 3]. The lumbosacral spine tuberculosis is common in the lumbar intervertebral disc tissues. If there is no effective treatment, it will lead to severe damages of vertebral and intervertebral

disc, causing the instability of the spine structure. Severe cases can make the spine protrude backward to oppress the nerves, and thereby generating the neurological symptoms or even paraplegia [5-7]. Studies have shown that the shortcoming of traditional conservative treatment of lumbosacral spine tuberculosis is the high rate of recurrence. But surgery can remove the lesion completely, meanwhile relieve the oppression and correct the spinal deformity to achieve the purpose of restructuring the spinal stability [8-10].

Most of the surgical approaches usually adopt the posterior approach which is simple in anatomy. And the debridement, decompression and internal fixation in the spinal canal can be performed in one operation with short time and less intraoperative blood loss. But the posterior approach is difficult to completely remove the lesion, which can result in the difficulties of lumbosacral spine reconstruction. However, the surgery with anterior approach can properly solve the shortcomings of posterior approach to achieve the firm stability of lumbosacral spine reconstruction [11-14].

The anterior approach usually consists of the transperitoneal approach and the extraperitoneal approach. To some degree, the transperitoneal approach can easily trigger some complications (such as postoperative abdominal distension, intestinal adhesion and urinary retention), so the surgery with the anterior approach usually applies the extraperitoneal approach. The extraperitoneal approach usually adopts the incision which is parallel to the costal margin or the paramedian incision. For patients with iliopsoas abscess, the incision which is parallel to the costal margin is convenient for cleaning the lesion of the vertebral tuberculosis and the iliopsoas abscess, and the efficacy is remarkable. In contrast, the advantage of the paramedian incision is that the abdominal muscles do not have to be cut off and exposed, which is facilitate to extend the incision up and down, but the iliac bone graft is still necessary [15-17].

The advantages of surgery with anterolateral approach include the extraperitoneal approach is not only able to effectively reach the tuberculosis lesion to remove it completely and achieve the prevention and treatment of abdominal tuberculosis contamination, but also able to conduct the bone graft fusion at the same time. In addition, the lumbosacral angle can be main-

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tained and corrected through the iliac bone support and internal fixation, so as to be conducive to the reconstruction of diseased lumbosacral spine. Besides, although the anatomical structure of lumbosacral spine is relatively complex, the related nerves, blood vessels and ureter can be exposed directly through the extraperitoneal approach to conduct the operation under direct vision, so as to avoid the damage to the body. The results of this study were consistent with those reported in other literatures [18-20].

The purpose of spinal tuberculosis treatment is to improve the patient's symptoms and make the bone graft in the spinal lesion region to achieve the bone graft fusion in the early stage. In this study, the one-stage anterolateral surgery by the bilateral internal fixation was applied to treat the lumbar tuberculosis and obtained good clinical results. Compared with the preoperative conditions, both of the ESR and CRP were decreased significantly one month after operation and returned to the normal range at postoperative 6 months. Moreover, the patients' tuberculosis poisoning reactions were reduced obviously, and no recurrence of tuberculosis was found in all patients during the last follow-up. However, patients' pain symptoms, lumbosacral angles and spinal stenosis did not improve 1 month after operation, but improved significantly 6 months after operation. The possible reason was that the premise of the improvement and healing of spinal tuberculosis symptoms was the thorough tuberculosis treatment. Therefore, the surgery is just a means and an important step in the treatment of tuberculosis, and the key for the treatment of spinal tuberculosis lies in conducting the postoperative anti-tuberculosis treatment strictly.

Most of the researchers agree that the spinal tuberculosis surgery must strictly grasp the indications and contraindications. He et al. proposed the surgical indications and operation timing of spine tuberculosis: the spinal tuberculosis with symptoms of spinal cord compression required debridement and decompression as early as possible to prevent the spinal cord injury and irreversible nerve injury; patients could not be cured with the conservative treatments and appeared bone destruction, patients had some small lesions and the symptoms did not relieved after long-term treatment, and patients had obvious kyphosis which affected

the appearance and function should undergo the orthopedic surgery [21].

Studies have pointed out that the one-stage anterolateral surgery by the bilateral internal fixation is suitable for all patients with spinal segment tuberculosis lesions, especially those who receive their initial treatments [22, 23]. For patients with upper cervical spine or lumbosacral tuberculosis, the internal fixation through anterior approach has high risk and cannot be regarded as the preferred choice. And for patients who can complete the lesion debridement and internal fixation by posterior approach in one time, the internal fixation with anterior approach cannot be selected either. All the patients with lumbosacral spine tuberculosis in this study were treated with the one-stage anterolateral surgery by the bilateral internal fixation without other approaches and surgical methods, so more samples are required for this research to take the further comparative study, thereby obtaining more accurate and reliable clinical results.

In conclusion, the lesions in patients who undergo the one-stage anterolateral surgery by the bilateral internal fixation after the standardized and effective anti-tuberculosis treatment can be thoroughly removed, and the bone graft fusion and internal fixation can be conducted reliably and stably. With the high postoperative fusion rate, the surgical complications are decreased significantly. It proves that its application and practice are strongly feasible in clinic.

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Disclosure of conflict of interest

None.

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