

How to select the fusion and fixation range of thoracolumbar and lumbar tuberculosis: A retrospective clinical study

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Abstract

Purpose

To investigate the clinical data of thoracolumbar and lumbar spinal tuberculosis with diseased and non-diseased intervertebral surgery, evaluate the clinical efficacy of the two surgical methods, and explore how to choose the fusion of fixation range.

Methods

Among 221 patients with thoracolumbar and lumbar tuberculosis were categorized into two groups. 118 patients were in the diseased intervertebral surgery group (lesion vertebral pedicle fixation, group A) and there were 103 patients in the non-diseased intervertebral surgery group (1 or 2 vertebral fixation groups at the above and below levels of the affected vertebra, group B). Both groups of patients were treated with primary or staging, anterior combined complete lesion removal, bone graft fusion, and internal fixation. By analyzing of clinical data and the clinical efficacy of the two surgical methods in thoracolumbar and lumbar tuberculosis was evaluated.

Results

The mean follow-up duration was 65months (range 50–68 months). There were no significant differences in laboratory examination, VAS scores, and the Cobb angle correction rate and the angle loss, however, significant differences between the two groups in operation time, blood loss, drainage volume, and transfusion, the diseased intervertebral surgery group was significantly better than the non-diseased intervertebral surgery group. Meanwhile, the bone graft was fused entirely at the last follow-up.

Conclusion

Under the conditions of strictly grasping the indications for surgery, intervertebral surgery for thoracolumbar and lumbar tuberculosis is safe, effective, and feasible, and it can effectively restore its physiological curvature and reduce the degeneration of the adjacent vertebral body.

Introduction

Ant-tuberculosis drugs are the foundation and fundamentals for the cure of spinal tuberculosis, but surgery can significantly improve the cure rate of spinal tuberculosis, reduce its recurrence and related complications [1]. After the spinal tuberculosis lesions are removed, it is very important to repair the bone defect with autologous repairing bone and internal fixation to restore the biomechanical stability of the spine [2; 3]. However, there are no clear guidelines or literature reports on the fixation method after the removal of spinal tuberculosis lesions. The vertebral body from thoracic 10 to sacral 1 is a completely

isolated bone structure, and reconstruction of the spine after the removal of tuberculosis lesions in the segment is demanding. How to choose the clinical scope of internal fixation is a controversial issue. The conventional fixation methods to restore spine stability are includes: short-segment fixation, that is, fixation of one normal motor unit in the upper and lower parts of the diseased vertebra; Long segment fixation refers to fixing two or more normal motor units in the upper and lower parts of the diseased vertebra. Besides, partial or total normal intervertebral space or/and posterolateral were fused with diseased intervertebral fusion and fixed range [4; 5]. Although the fixation and fusion methods above can meet the biomechanics requirements of spinal stiffness, they sacrifice the normal motor units of the spine, leading to the degeneration of adjacent segments and the occurrence of chronic lower back pain [6]. It is urgent to consider whether the fixed range can be reduced, and the mechanical strength of the spine can be fully reconstructed. In the treatment of vertebral fractures, the biomechanics of single-segment fixation, short-segment fixation, and long-segment fixation stability have been compared. The single-segment fixation method that fixes only injured vertebrae has been successfully applied in the treatment of thoracic and lumbar spine fractures [7; 8]. This group studies of multiple segmental spinal tuberculosis by the method of continuous multiple single-segment surgeries thoroughly remove the lesions, bone graft fusion, instrument internal fixation is conducted in lesions involving the movement of the motor unit and no normal motor units were involved, is the disease intervertebral surgery (Fig. 1), while the short and long segment surgery are non-disease intervertebral surgery (Fig. 2).

Therefore, a retrospective case-control study was conducted to collect the case data of patients with thoracolumbar and lumbar tuberculosis treated by diseased intervertebral surgery and non-diseased intervertebral surgery in our hospital and to evaluate the clinical efficacy of the two surgical methods in thoracolumbar and lumbar tuberculosis. Therefore, it provides a reference for the rational selection of fusion and fixation range of spinal tuberculosis.

1. Materials And Methods

1.1 General information

A retrospective analysis of 221 cases of thoracolumbar and lumbar spinal tuberculosis treated in our department from January 2001 to December 2010, divided into 118 cases of diseased intervertebral surgery group (pedicle screw fixation group, group A), including abscess formation: 40 cases of psoas major abscess, 17 cases of paravertebral abscess, 4 cases of lumbar triangle, and 4 cases of popliteal; Combined deformities: 6 cases of kyphosis, 4 cases of scoliosis; Frank classification of neurological function: 5 cases of grade B, 16 cases of grade C, 27 cases of grade D, 70 cases of grade E; There were 103 cases in the non-diseased intervertebral surgery group (1 or 2 vertebral fixation groups in the upper and lower vertebral bodies, group B), among which there were 26 cases of psoas abscess, 19 cases of paraspinal abscess, 3 cases of lumbar triangle abscess, and 5 cases of popliteal abscess. There were 13 cases of kyphosis and 3 cases of scoliosis. Frank grade of neurological function: 3 cases of grade B, 10 cases of grade C, 28 cases of grade D, and 60 cases of grade E. The distribution of lesions in the two

groups as shown in Fig. 1, and the general preoperative information of the two groups were shown in Table 1.

Table 1
comparison of general clinical data between groups A and B

Item	Group A(118cases)	Group B(103 cases)	Test value(t/x^2)	P-value
Age	38.84 ± 15.41	40.66 ± 15.61	$t = 0.393$	$P = 0.695$
Male/female	56/62	47/56	$x^2 = 0.489$	$P = 0.446$
Course of disease (months)	16.46 ± 16.79	17.21 ± 20.28	$t = 0.303$	$P = 0.762$
ESR(mm/h)	37.49 ± 23.62	37.58 ± 22.74	$t = 0.303$	$P = 0.976$
CRP(mg/L)	24.72 ± 26.25	26.22 ± 23.13	$t = 0.446$	$P = 0.656$
Cobb angel(°)	17.03 ± 18.95	15.91 ± 12.80	$t = 0.508$	$P = 0.612$
VAS score(points)	6.15 ± 1.74	5.72 ± 1.62	$t = 1.91$	$P = 0.057$

1.2 Preoperative preparations

Patients in both groups were bedridden before surgery, with isoniazid (5 mg/kg/d), rifampicin (10 mg/kg/d), pyrazinamide (20 mg/kg/d), and streptomycin (20 mg/kg/d) for anti-tuberculosis treatment for more than 2 to 3 weeks; blood sedimentation rate decreased to less than 30 mm/h or significantly decreased, and tuberculosis control was effective. The symptoms of systemic tuberculosis were relieved. During the perioperative period, hypoproteinemia should be corrected, and nutrition should be supplemented; hemoglobin should not be less than 100 g/L, ensure normal liver and kidney functions, to ensure that regular anti-tuberculosis drugs can be continued. Combined with other system-related diseases, no obvious surgical contraindications were observed after treatment, and then surgical treatment was performed.

1.3 Surgery group and method

According to the scope of the operation, it is divided into the inter-lesion surgery group and the non-diseased inter-spine surgery group. All patients underwent general anesthesia with posterior instrument internal fixation (fixation between lesions or non-disease intervertebral fixation), primary or staged anterior lesion removal, and intervertebral supports bone graft fusion

1.3.1 Posterior internal fixation instruments:

C-arm fluoroscopy used to locate disease of vertebral, the posterior midline incision is used to expose the diseased vertebra or the upper and lower normal vertebrae layer by layer, and the lateral process is exposed on both sides. The diseased intervertebral is used according to the range of the diseased vertebra. Fixed or non-diseased intervertebral fixation, transpedicular instrument fixation, before the fixation screw is opened according to the size of the convex angle before and after surgery to correct the kyphosis deformity, diseased intervertebral lamina cortex, interlaminar, spinous process vertebral joint fusion.

1.3.2 Anterior lesion remove:

Different anterior surgical approaches were used in different areas of spinal tuberculosis. The thoracolumbar joint or extra peritoneal approach was used in the thoracolumbar segment; Lateral renal incision was used in the upper lumbar spine; the lower lumbar and sacral vertebrae were treated by supine inverted "eight" incision through the peritoneum. According to the preoperative imaging examination, the lesion size was determined, and the degree of spinal cord compression, the distribution range of intraspinal, or paraspinal abscess determined the lesion exposure and resection range. The approach was selected according to the severity of vertebral damage and the size range of abscess. The abscess was exposed layer by layer. First, the thick needle was used to detect the accurate position of the abscess, expand the acupuncture site, draw out the pus with the suction device, open the abscess cavity, and scrape off the abscess moss and case-like substances; to find the bone fistula hole, the diseased vertebral body was found along the orifice of the bone; the vessels of the vertebral segment were ligated, and the damaged bone of the diseased disc and vertebral body was fully exposed and removed; Bone knife or scraping instruments was used to remove the bone from the edge of the lesion to the periphery of the lesion until the "subnormal bone," is grit-like in section, without hardening, dead space, cheese-like material, and granulation tissue, and a fresh bone surface appears. After the lesions were completely removed, the wound was repeatedly washed with normal saline. If the vertebral endplate bone can be preserved during resection of the vertebral body, it should be retained as much as possible to reduce the fixed and fusion segments.

1.3.3 Intervertebral bone grafting:

After the complete removal of the lesion, determine whether there is an accumulated spinal canal according to the preoperative neurological symptoms of the patient and the location or damage of the lesion, as shown in CT and MRI. If there is compression, the dead bones, abscesses, granulomas, and necrotic intervertebral discs protruding from the spinal canal must be completely removed, and the spinal cord, dural sac, and nerve root can be removed, the longitudinal ligament does not need to be opened to prevent tuberculosis necrotic material from entering the spinal canal and contaminating the spinal canal. After removing the sclerotic wall reaction bone as much as possible, the bone bed must be regular, and the remaining part should be shaped into a regular shape that can accommodate the bone graft. Bone graft

1.4. Postoperative treatment and follow-up

After the operation, the changes in vital signs of the two groups of patients were observed. The drainage tube was removed after 48 ~ 72 h with drainage volume less than 20–50 ml, and the drainage tube of the abscess cavity could be extended to 8 ~ 10 days. After 3 weeks of strict bed rest, the patient can go to the ground with braces. During the period of strict bed rest, functional exercise should be paid attention to prevent complications.

After the operation, all patients were treated with 2HRZS/ 2-7hrzs anti-tuberculosis drugs for 2–7 months, and the drugs were adjusted or discontinued according to the review situation. Follow up was done strictly according to the outpatient follow-up card for spinal tuberculosis patients formulated by our department.

1.5. Evaluation index

Perioperative evaluation: Observe the operation time, intraoperative blood loss, postoperative drainage volume, transfusion, and last VAS score in the two groups.

Imaging evaluation: Cobb Angle measurement: the extension line was drawn on the upper normal vertebral body endplate and the lower normal vertebral body endplate adjacent to the diseased vertebra, and the included angle between the two lines was Cobb Angle (defined as the positive thoracolumbar segment, lumbar lordosis, and negative lordosis) [20]. Correction rate=(preoperative kyphosis Cobb Angle - postoperative kyphosis Cobb Angle immediately)/ preoperative kyphosis Cobb Angle × 100%, loss Angle = kyphosis Cobb Angle - postoperative kyphosis Cobb Angle immediately); According to the three-dimensional CT reconstruction, the evaluation of bone graft healing was as follows :(1) to clarify the bone trabecular connection through the bone graft area to form a bone graft bridge;(2) fusion of residual vertebrae and graft bone;(3) bone graft interface gap disappeared.

Laboratory evaluation: changes in ESR and CRP before, 6 months after surgery, and at the last follow-up.

Postoperative neurological recovery: during the follow-up, Frankel graded the recovery of spinal cord nerve function during the preoperative and final follow-up.

Clinical efficacy: during the long-term follow-up, the clinical efficacy of the two groups of patients was evaluated by the Manabí method, which was divided into four grades: excellent, good, moderate, and poor. Excellent: the pain is gone, no motor function is restricted, and regular work and activity are resumed; Good: occasional pain, can do light work; Moderate: some improvement, still feel pain, can't work; Poor: showed nerve root damage, requiring further surgical treatment.

1.6 Statistical processing

SPSS 21.0 statistical software was used for analysis. The measurement data were expressed as mean ± standard deviation ($\bar{x} \pm s$) and the counting data as a percentage (%). T-test was used for measurement data, the chi-square (χ^2) test or non-parametric test was used for counting data, and $P < 0.05$ was considered statistically significant.

2. Results

2.1 Perioperative evaluation Indexes

All patients had complete follow-up data. Patients in group A followed up for 55–82 months, and patients in group B followed up for 50–86 months. There were statistically significant differences between the two groups of patients in terms of surgical time, intraoperative blood loss, postoperative drainage, and whether or not blood transfusion ($P < 0.05$). The diseased intervertebral surgery group was significantly better than the non-diseased intervertebral surgery group. There was no significant difference in the VAS score between the two groups at the last follow-up ($P > .05$), and no considerable pain was found in the two groups at the last follow-up (Table 2).

Table 2
comparison of perioperative evaluation indexes between the two groups ($x \pm s$)

Observation index	Group A(n = 118)	Group B(n = 103)	Test value (t/χ^2)	P-value
Operation time (min)	219.45 ± 17.92	255.35 ± 29.79	$t = 11.04$	$P = 0.000$
Bleeding volume (ml)	714.92 ± 324.22	839.71 ± 355.49	$t = 15.460$	$P = 0.000$
Postoperative drainage(ml)	66.36 ± 17.78	97.09 ± 21.32	$t = 11.68$	$P = 0.000$
Blood transfusion(Yes/No)	18/100	28/75	$\chi^2 = 0.032$	$P = 0.022$
Last follow-up VAS	0.86 ± 1.94	1.03 ± 0.96	$t = 1.201$	$P = 0.231$

2.2 Imaging evaluation indexes

There were no significant differences in the Cobb angle between the two groups of patients before, after, and at the last follow-up ($P > 0.05$). There was also no significant difference in the Cobb angle correction rate and the comparison between the angle loss groups. ($P > 0.05$), which indicates that the diseased intervertebral surgery also has a good effect in correcting kyphosis caused by thoracolumbar and lumbar spinal tuberculosis, and is more conducive to the recovery of the physiology of thoracolumbar and lumbar spine (Table 3)

Table 3
Comparison of Cobb Angle changes in the two groups before, after and at the last follow-up ($x \pm s$)

Item	Cases	Preoperative(°)	Postoperative(°)	Last follow-up(°)	Loss(°)	Correction rate(%)
Group A	118	17.03 ± 18.95	27.80 ± 10.32	26.21 ± 8.77	1.61 ± 1.12	63.24 ± 8.26
Group B	103	15.91 ± 12.80	26.49 ± 7.05	25.39 ± 5.13	1.12 ± 1.06	66.50 ± 10.32
t/χ^2	-	0.508	1.086	0.830	0.612	0.447
P-value	-	0.612	0.279	0.404	0.537	0.716

Spinal tuberculosis bone graft fusion was evaluated by CT three-dimensional reconstruction. The lesion cure rate was >85% at 6 months after surgery, and >95% at 1 year after surgery. The bone graft was completely healed at the last follow-up, and there was no statistical difference between the groups. Significance ($P > 0.05$) (Table 4).

Table 4

Comparison of bone graft healing between two groups of patients

Groups	Cases	6 months after surgery	1 year after surgery	Last follow-up
Group A	118	102(86.44%)	115(97.46%)	118(100%)
Group B	103	92(89.32%)	100(97.09)	103(100%)
χ^2	-	0.425	0.06	-
<i>P</i> -value	-	0.514	0.806	-

2.3 Laboratory test indicators

There were no statistically significant differences in ESR and CRP between the two groups before, 6 months after surgery, and at the last follow-up ($P > 0.05$). ESR and CRP were close to normal at 6 months after surgery and normal at the last follow-up (Table 5).

Table 5

Comparison of ESR and CRP before, after 6 months and the last follow-up of the two groups of patients ($\bar{x} \pm s$)

Groups	Cases	Preoperative		6 months after surgery		Last follow-up	
		ESR(mm/h)	CRP(mg/L)	ESR(mm/h)	CRP(mg/L)	ESR(mm/h)	CRP(mg/L)
Group A	118	37.49 ± 23.62	25.19 ± 22.17	14.69 ± 12.03	2.21 ± 1.11	8.37 ± 5.38	1.99 ± 0.89
Group B	103	37.40 ± 20.83	26.22 ± 23.13	12.53 ± 6.62	2.40 ± 1.34	7.60 ± 4.84	1.86 ± 0.69
<i>t</i>		0.31	-0.245	1.68	-1.16	1.113	1.21
<i>p</i>		0.976	0.807	0.094	0.248	0.267	0.225

Compared with group B, $P > 0.05$, and the difference was not statistically significant

The normal range for ESR: male 0–15 mm/h, female 0–20 mm/h; the normal range for CRP 0–2.87 mg/l

2.4 Postoperative neurological functions recovered

Neurological function at the last follow-up between the two groups of patients was significantly better than before surgery (Table 6)

Table 6

Frankel classification of neurological function at preoperative and final follow-up of the two groups

Groups	Cases	Grades	Preoperative	Last follow-up		
				C	D	E
A	118	B	5	0	2	3
		C	16		3	13
		D	27		3	24
		E	70			70
B	103	B	3	1	0	2
		C	10	0	2	8
		D	28		2	26
		E	62			62

2.5 Clinical efficacy

The Macnab method was used to evaluate the clinical effectiveness of the two groups of patients. The excellent and good rates of the patients in the two groups were 91.25% and 92.23%, respectively, with no significant difference ($P > 0.05$). The excellent and good rates of the last follow-up were 96.6% and 97.09%, respectively, with no significant difference ($P > 0.05$).

Table 7

Comparison of clinical efficacy between the two groups at 1 year and the last follow-up

	Evaluation of clinical efficacy	excellent		good		moderate		poor	U-value
		Cases	%	Cases	%	Cases	%		
1 year after surgery	Group A	90	76.27	18	15.25	10	8.47	0	1.066
	Group B	85	82.52	10	9.71	8	7.77	0	
Last follow-up	Group A	102	86.44	12	10.16	4	3.39	0	0.641
	Group B	92	89.32	8	7.77	3	2.91	0	

Compared with group B, $P > 0.05$, and the difference was not statistically significant

2.6 Complications

Both groups had no severe neurological impairment, such as paraplegia, cauda equine syndrome, root symptoms, cerebrospinal fluid leakage, etc. Group A: psoas abscess occurred in 2 patients with recurrence of tuberculosis, which was cured by reoperation and intensive supervision of anti-tuberculosis chemotherapy. 4 cases of incisional fat liquefaction, 3 cases of incisional infection, dressing change, anti-infective cure; 2 cases underwent a bone graft, and the pedicle screw was loosened and cured again by surgery. Antituberculous drug-related complications were reported in 12 cases. Group B: 2 cases of bone graft fracture, 2 cases of bone graft absorption and pedicle screw loosening, 3 cases of psoas abscess, tuberculosis recurrence, reoperation and intensive supervision of anti-tuberculosis chemotherapy to cure; Fat liquefaction was found in 2 patients, and infection was found in 2 patients. The mean postoperative time of the 5 patients was 2.8 years. Antituberculous drug-related complications were reported in 10 cases. The complication rates of group A and group B were 19.48% (23/118) and 23.30% (26/103) respectively, with no significant difference ($\chi^2 = 1.054$, $P = 0.305$)

3. Discussion

With the progress of basic research and treatment of spinal tuberculosis, the surgical treatment of spinal tuberculosis has significantly increased the cure rate, shortened the course of treatment, reduced complications, and recurrence. Surgical treatment includes complete lesion removal, spinal canal decompression, deformity correction, bone graft fusion, internal fixation, etc. [9]. The thoracolumbar and lumbar spine is the main load-bearing areas of the spine and the main site of spinal tuberculosis. Thoracolumbar and lumbar tuberculosis are prone to spinal instability, deformity, and neurological damage. Therefore, for thoracolumbar and lumbar tuberculosis, bone graft fusion and instrumental internal fixation are particularly crucial for the reconstruction of spinal stability [10; 11], which plays a vital role in improving the overall efficacy of spinal tuberculosis and making patients recover at an early date. However, the selection of bone graft fusion and internal fixation in the reconstruction of spinal tuberculosis has not attracted the attention of scholars, and there is no unified standard. The method adopted by most scholars is to fix multiple standard motor units in addition to the fixation between the pathological motor units. For thoracolumbar or lumbar spinal tuberculosis, long-segment fixation is widespread. Although long segment fusion and fixation can obtain stable fixation, it sacrifices more spinal motor function and reduces the physiological curvature of the thoracolumbar and lumbar spine and also cause adjacent segment disease (ASD). Gotzen et al. [12] first proposed the concept of single-segment fixation under the principle of reducing fusion, fixing segments, and maintaining standard motor units. Since then, many scholars have performed basic [13–15] and clinical [8; 16; 17] studies on the

treatment of spinal fractures with single-segment fixation of injured vertebrae. However, in the surgical treatment of spinal tuberculosis, most authors still use a short segment or long-segment fixation, that is, non-disease intervertebral fixation. Can we further standardize the method of spinal tuberculosis reconstruction surgery and shorten the scope of operation reasonably and effectively? It can achieve the purpose of reliable reconstruction of spine stability and minimize fusion and fixation of standard motor units. Whether diseased intervertebral surgery can meet the requirements of spinal stability and load, scholars at home and abroad have conducted relevant biomechanical studies. Dick et al. [18] found that the stability of single-segment after screw placement in the injured vertebra was enhanced; our team made a model of bone graft reconstruction of the defect of the middle column before the construction of the bovine spine. The study showed that single segment fixation was sufficient to correct the instability of the spine and restore the stability of the spine. The above biomechanical research conclusions provide a strong theoretical basis for our clinical implementation of thoracolumbar or lumbar tuberculosis intervertebral surgery.

For thoracolumbar and lumbar tuberculosis, compared with disease intervertebral operation, short segmental fixation with long-segment fixation, respectively; at the expense of more than two and four normal motor unit, a small fixed segments limited spinal movement function, activity; the longer the fixed segment corresponding adjacent unit vicarious movement, the more concentrated the stress of the adjacent segment, the intervertebral disc pressure increase, thereby accelerating the degeneration of the adjacent segment[19–21]. Increased the probability of ASD. In this study, although there was no significant difference in postoperative symptoms between the two groups, there were 5 cases of postoperative adjacent vertebral degeneration in the non-diseased intervertebral surgery group. The fixed segment was prolonged, the operative time was extended and the intraoperative blood loss was increased; with the addition of fixed segments the internal fixation materials used doubled so that the economic burden of patients also doubled. This study showed that the diseased intervertebral surgery group was significantly better than the non-diseased intervertebral surgery group in terms of operation time, intraoperative blood loss, postoperative drainage volume, and whether blood transfusion is better in the diseased intervertebral surgery group than in the non-diseased intervertebral surgery group, and it can also achieve long-segment fixation with reduced fixed segments Clinical efficacy. The incidence of long-segment fixation prosthesis is increased, and there is a higher risk of fracture and loosening of internal fixation after surgery; it may also cause suspension effect due to stress shielding of internal fixation, which is not conducive to early fusion of bone graft; and the risk of bone graft absorption, displacement, and fracture risk is increased [22; 23]. There is no significant difference between the Cobb angle correction rate and the angle loss between the groups. The diseased intervertebral surgery also has a good effect in correcting kyphosis caused by thoracolumbar and lumbar spinal tuberculosis, and it is more conducive to the physiology of the thoracolumbar and lumbar spine. There was no significant difference in the recovery of curvature between the two groups of patients with bone graft fusion rates. Spine surgery can also achieve the purpose of bone graft fusion and deformity correction. Therefore, for surgical treatment to restore the anatomical structure and motor function of the spine, diseased intervertebral surgery is a more accurate and reasonable method. This operation does not need to

sacrifice the normal exercise unit and retains the spine's motor function to the greatest extent. It has fewer traumas and simple process, reduces the patient's financial burden, and meets the principles of minimally invasive and economical medical treatment.

The internal fixation of the instrument only obtains the instant stability of the spine, the permanent stability reconstruction depends on the fusion of the spine [24]. In this study, all patients underwent bone graft fusion only in the diseased vertebra, and no fusion was required for normal motor units. No anterior or posterior fusion was allowed for normal motor units adjacent to the diseased vertebra. Anterior, middle column support bone grafting is an important part of intervertebral surgery. After the complete removal of the lesion, the intervertebral bone grafting bone surface should be trimmed, and the appropriate length of bone grafting material should be taken for supporting bone grafting; under the condition of unsupported bone grafting, nail and rod stress of the fixation device increased significantly. However, the intervertebral support bone grafting can reduce the load and pressure of the posterior fixation device of the corresponding segment of the spine, which has a protective effect on the internal fixation device. In this study, allogeneic bone containing trilateral cortex dermis of appropriate length was selected for intervertebral bone grafting in all patients. The posterolateral bone graft is allograft, and the posterolateral bone graft fusion can prevent the malformation, screw breakage, rod breakage, and other serious complications caused by the unhealed lesion in the anterior approach and the failure of the bone graft.

Although the diseased intervertebral surgery has achieved satisfactory results in the clinical research of thoracolumbar and lumbar tuberculosis, based on the requirements of thoracolumbar and lumbar biomechanics, we must strictly grasp the indications and contraindications in clinical application. Through the clinical data and surgical operation experience of this study, the surgical indications and contraindications we have summarized are as follows, the indications: (1) non-rigid thoracolumbar and lumbar spinal tuberculosis can be corrected by reduction of posture, manipulation and instruments; (2) the lesion has accumulated one spinal functional unit and there is no pedicle damage or 1/4 less damage in the diseased vertebral body; (3) A solid bone graft bed is required to support the bone graft: after the lesion is removed, the upper and lower endplates of the diseased vertebrae should be intact; (4) the lesion vertebral Cobb was less than 60°. Contraindications: (1) severe osteoporosis; (2) corneous kyphosis requires correction of thoracolumbar or lumbar tuberculosis; (3) posterior column thoracolumbar or lumbar tuberculosis; (4) tuberculosis recurred with continuous multi-segment destruction.

4. Conclusion

In summary, under strict conditions of surgical indications, intervertebral surgery for thoracolumbar and lumbar tuberculosis is safe, effective, and feasible, and it can effectively restore its physiological curvature and reduce the degeneration of adjacent vertebrae; which is worthy of clinical application and promotion. Although the results of this study are satisfactory, there are still some shortcomings. This

study is a retrospective case-control study; case study evidence level is not high, and its single-center research; Long-term follow-up was rare.

Abbreviations

VAS: Visual analog scale; CRP: C-reactive protein; ESR: Erythrocyte sedimentation rate; ASD: Adjacent segment disease; CT: Computed tomography

Declarations

Ethics approval and consent to participate

The present study was approved by the Ethics Committee of the General Hospital of Ning Xia Medical University. Informed consent was obtained from each patient's guardian.

Consent for publication

We have obtained consent to publish from the participants.

Availability of data and materials

The patients' data were collected in the General Hospital of Ning Xia Medical University. The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no conflict of interest.

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Authors' contributions

Jiandang Shi and Zongqiang Yang designed the study. Changhao Liu and Ningkui Niu were involved in the manuscript writing. Jing Tang and Sayed Abdulla Jami collected the clinical data. Zongqiang Yang and Changhao Liu analyzed the data. Huiqiang Ding interpreted the data. Zili Wang revised the draft. All authors read and approved the final manuscript.

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Figures

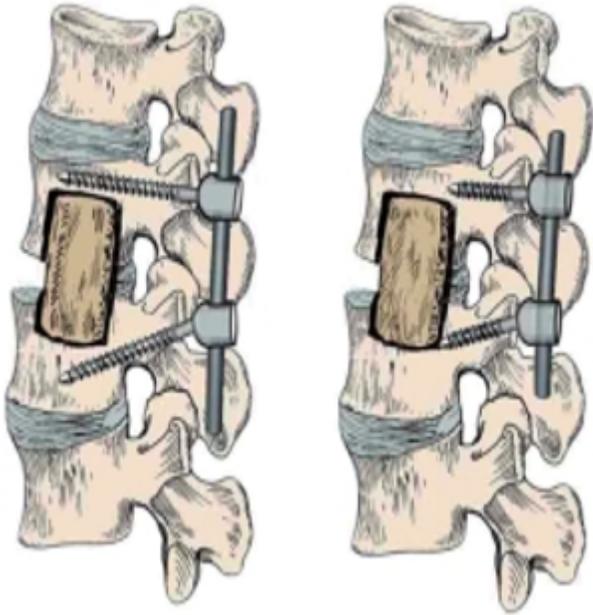


Figure 1

Disease intervertebral surgery

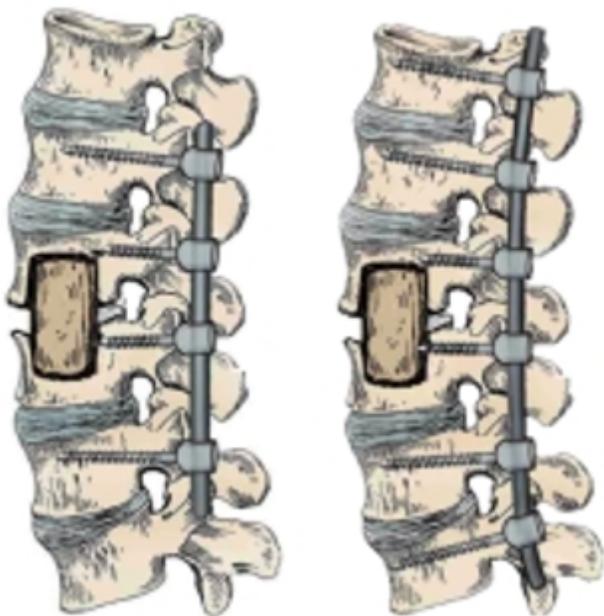


Figure 2

Non-disease intervertebral surgery

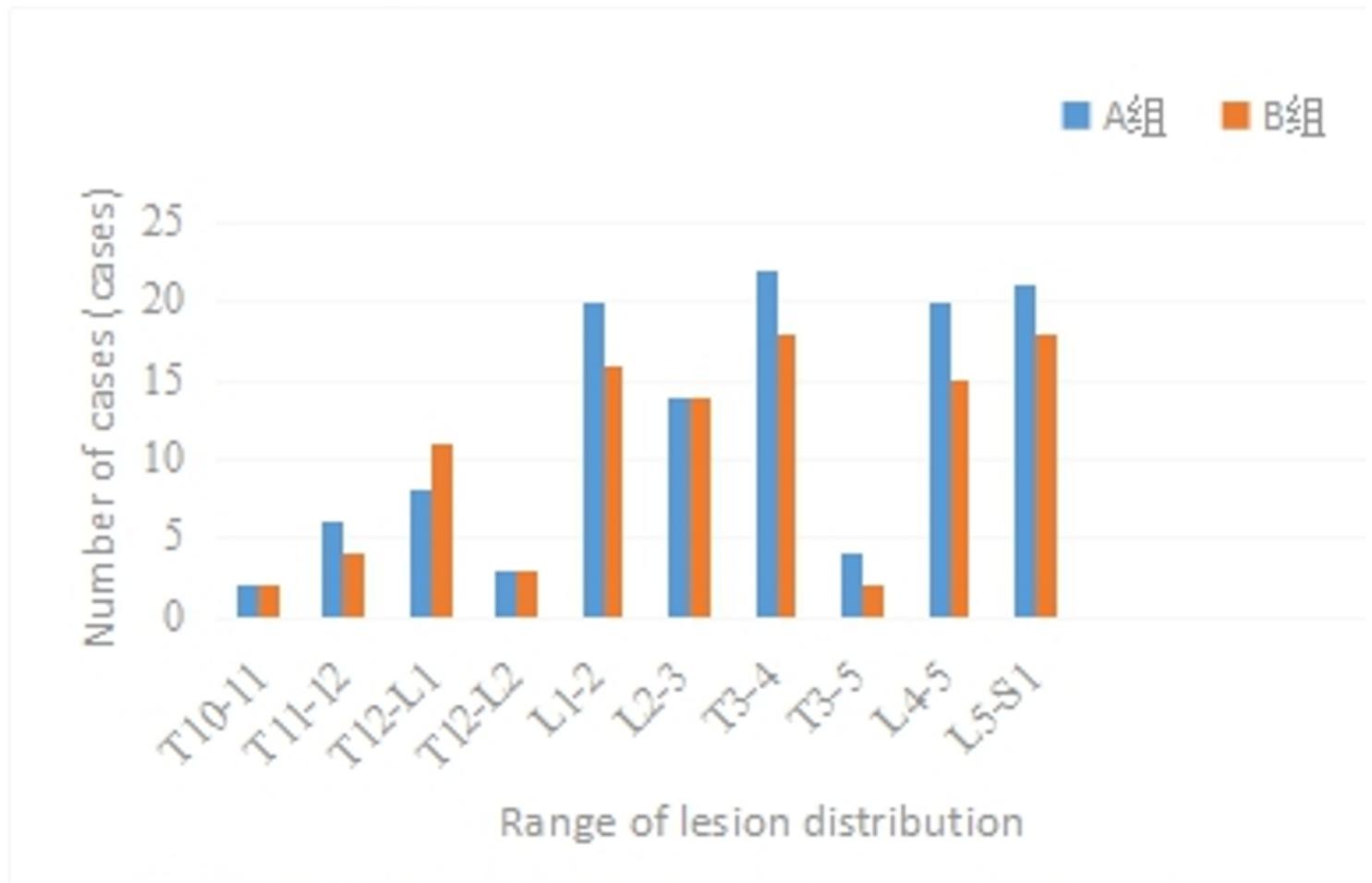


Figure 3

Distribution of spinal tuberculosis lesions in 221 patients.