

# Wiltse approach TLIF for the treatment of single-segment thoracic spinal tuberculosis with neurological deficits and osteoporosis in the elderly: a retrospective study of 20 cases

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## Research Article

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# Abstract

## Background

This study aimed to explore the clinical efficacy of Wiltse approach transforaminal lumbar interbody fusion (TLIF) in the treatment of single-segment thoracic spinal tuberculosis with neurological deficits (STSTND) in elderly patients with and osteoporosis.

## Methods

This study conducted a retrospective analysis of 20 STSTND patients who underwent Wiltse approach TLIF in our hospital from January 2017 to January 2019. The follow-up time was  $37.15 \pm 7.37$  months (range 24-48 months), and the kyphotic angle was  $35.41 \pm 6.71^\circ$ . According to Frankl spinal cord injury classification assessment of neurological deficits. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are used to assess the activity of tuberculosis (TB). Femoral neck bone mineral density measurement T value (BMD T) is used to assess the degree of osteoporosis.

## Result

20 patients with spinal tuberculosis (STB) were completely cured without tuberculosis recurrence. The postoperative kyphotic angle was  $8.80 \pm 0.79^\circ$ , and there was no significant loss of correction at the last follow-up. In the case of combined osteoporosis, the bone grafts fuse within 6-9 months and the back pain was relieved. The neurological condition of all patients improved after the operation.

## Conclusions

Wiltse approach TLIF treatment plus anti-tuberculosis chemotherapy is adequate for obtaining satisfactory healing of single-segment thoracic tuberculosis with neurological deficits and osteoporosis in the elderly.

## Background

Tuberculosis (TB) has historically been a serious infectious disease in developing countries [1]. Spinal tuberculosis (STB) accounts for 50% of bone and joint tuberculosis and is the most common form of extra pulmonary tuberculosis [2]. Anti-tuberculosis drug chemotherapy is the fundamental means to treat STB, but surgical treatment plays an important part in improving kyphosis, removing abscesses and relieving spinal cord compression [3, 4].

In 1968, Dr. Wiltse and others proposed a new method, which is to perform surgery through the gap between the multifidus muscle and the longissimus muscle. This approach can significantly reduce the dissection and traction of the multifidus muscle during the operation. Injury, to take full advantage of the integrity of the posterior bone structure and ligament complex [5]. Now Wiltse approach transforaminal lumbar interbody fusion (TLIF) surgery has achieved excellent results in intervertebral disc herniation and spinal tuberculosis [6]. However, apart from some case reports in mainstream academic journals, there are limited reports in the literature on the surgical treatment of single-segment thoracic tuberculosis (STSTND) in the elderly with neurological deficits and osteoporosis.

In this study, we reviewed the preoperative and postoperative information and recovery of 20 STSTND patients who underwent the Wiltse approach TLIF in our hospital, aiming to evaluate the effects of this surgical method on the elderly with neurological deficits and osteoporosis.

## Method

### Patient inclusion and exclusion criteria

This study was subject to approval by the Ethics Committee of the First Affiliated Hospital of Guangxi Medical University, and all patients obtained written informed consent. From January 2017 to January 2019, these 20 cases of spinal tuberculosis were handled by the same surgeon in our hospital. Among them, 12 were males and 8 were females. Age 65 to 80 years ( $70.25 \pm 4.19$ ). Diagnosis is based on (1) clinical symptoms and signs; (2) computed tomography (CT) and magnetic resonance imaging (MRI) findings; (3) laboratory test results, including hemoglobin (Hb), erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) concentration, tuberculosis antibody (IgG and IgM), tuberculin test; (4) Effective when using diagnostic anti-tuberculosis treatment for difficult cases; (5) Pathological evidence, such as caseous necrosis under typical tuberculosis microscope It is the gold standard for diagnosis. Exclude patients with the following conditions: (1) age <65 years; (2) femoral neck bone mineral density measurement T value (BMDT) > -2.5 [7]; (3) no neurological deficits; (4) multi-segment disease or multiple lesion centers require anterior long-segment bone fusion; (5) With out-of-range para vertebral or deep muscle abscesses and severe kyphotic deformities (greater than  $50^\circ$ ). According to the Frankel classification to assess nerve damage, grade A is complete loss of movement and sensation below the lesion level; grade B is partial loss of sensation below the lesion level; grade C is motor and sensory preservation below the lesion level, but the patient has no function; grade D is the lesion Movement and sensation below the plane are preserved, and the patient can stand and walk; Grade E is normal function.

### Preoperative Procedure

Chemotherapy was performed shortly after the suspected clinical diagnosis. Anti-tuberculosis treatment with HREZ chemotherapy regimen 2-4 weeks before surgery, including isoniazid (5-10mg/kg/d), rifampicin (5-10mg/kg/d), ethambutol (15mg/ kg/d) and pyrazinamide (25mg/kg/d). When the erythrocyte sedimentation rate, CRP, and body temperature return to normal or decrease significantly, and the anemia and hypoproteinemia are completely corrected, surgical treatment is performed.

### Surgical Technique

Place the patient in the prone position after general anesthesia. The surgical segment is located by X-ray of the C-arm. Mark the distance between the muscle space and the spinous process according to preoperative MRI. Use a posterior midline longitudinal incision to cut the skin, separate the subcutaneous tissue from the surface of the lower back fascia, and then cut the lower back fascia longitudinally to separate the medial multifidus muscle and the lateral longissimus muscle, and enter along the intermuscular space until the outside of the articular process is exposed. Place the half lamina retractor to separate the muscles, and strip the paravertebral muscles to reveal the thoracic lamina and the interlaminar space. After the pedicle screw was implanted on one side of the lamina, the accuracy of the C-arm X-ray was used. Install a temporary pre-curved rod on the lighter side of the lesion to avoid spinal cord injury due to spinal instability during decompression and local debridement. Then select the side that causes clinical symptoms or severe paravertebral abscess to undergo unilateral facetectomy and laminectomy to the edge of the medial pedicle. If necessary, cut off the adjacent ribs 1.0-1.5cm next to the thoracic vertebra, and sacrifice the thoracic nerve root on the side of the lesion for better exposure. The decompression range is generally determined according to the degree of spinal stenosis and the range of paravertebral abscess. Insert a suitable

flushing tube into the paravertebral abscess and flush with proper pressure until no pus is discharged. Then, use a curette to remove the necrotic discs and collapsed vertebrae until healthy bleeding bones. Tighten the rods in turn, and use the compression and extension of the internal fixation device to slowly and carefully correct the kyphosis. If the space created after focal debridement is too large, allograft bones are selected for posterior fusion at the segment where decompression and focal debridement are performed. If necessary, treat the other side in the same way. If the bone graft is loose or there is a bone defect, we will embed relatively large bone particles or pieces into the gap by implementing an impact graft. After that, 1.0g of streptomycin and 0.2g of isoniazid were administered locally. After operation, negative pressure drainage, incision suture, and resection specimens were collected for bacterial culture and pathological diagnosis.

## Postoperative Care

Pull out the drainage tube when the drainage volume is less than 30ml. Ambulation was allowed one week after surgery with a brace. The patient continued oral HREZ anti-tuberculosis chemotherapy for 6 months. Then change to the HRE chemotherapy regimen for 9-12 months. All patients underwent clinical and radiological examinations 1 week, 3 months, 6 months and 12 months after surgery, and then regularly reviewed once a year.

## Follow-up Indicators And Statistical Analysis

For all cases, the following indicators were recorded before operation, after operation, 3 months after operation, and at the last follow-up: (1) kyphotic angle, (2) Frank nerve function grade, (3) ESR and CRP. Using SPSS24.0 software (SPSS, Inc., Chicago, IL, USA), the paired t test was used to perform statistical analysis on the kyphotic angle, ESR and CRP preoperatively, postoperatively, three months of postoperation and final follow-up. The Frank neurological function level preoperatively, postoperatively, three months of postoperation and final follow-up were statistically analyzed by Wilcoxon signed rank test. The significance level is 0.05.

## Result

### Basic condition

Among these 20 cases of spinal tuberculosis, 12 were males and 8 were females, with an average age of  $70.25 \pm 4.19$ , the involved segment of the thoracic spine (Figure 1), the operation time was  $155.00 \pm 52.92$  minutes, the intraoperative blood loss was  $153.75 \pm 41.64$ ml, and the average hospitalization was The time was  $6.80 \pm 1.51$  days, the follow-up time was  $37.15 \pm 7.37$  months, and the osteoporosis T value was  $-4.27 \pm 1.51$  (Table 1). Postoperative complications such as cerebrospinal fluid leakage (1 case), water and electrolyte imbalance (5 cases), superficial infection (1 case), and mild intestinal obstruction (2 cases) occurred. No complications related to bone grafts and devices were observed. The patient's symptoms disappeared after 1 week of anti-inflammatory or symptomatic supportive treatment.

Table 1  
General data of patients.

Gender		Age(years)	Operation time (min)	Blood loss (ml)	Hospitalization time(days)	Follow up (months)	BMD (T)
Male	Female						
12	8	70.25±4.19	155.00±52.92	153.75±41.64	6.80±1.51	37.15±7.37	-4.27±1.81

## Nervous System State

During the follow-up process, all patients' neurological deficits gradually improved. The Frankel classification assessment results from preoperative to the last follow-up were as follows: preoperatively, 1 case was grade A, 3 cases were grade B, 7 cases were grade C, and 10 cases were grade D. At the last follow-up, only 2 patients were grade D, and the remaining 18 patients had neurological function recovery (Figure 2). Statistical analysis showed that there was a significant difference between the Frankel classification before operation and the last follow-up ( $P<0.05$ ).

## Kyphosis, Bone Fusion, Esr And Crp

The Kyphosis angle before operation was  $35.41\pm 6.71^\circ$ ; it was significantly reduced to  $8.80\pm 0.79^\circ$  after the operation ( $P<0.05$ ). At the final follow-up, the kyphotic angle was  $9.99\pm 0.92^\circ$ , and the correction loss was only  $1.18\pm 0.37^\circ$ . Compared with the preoperative measurement value, the kyphotic angle improved significantly at the final follow-up ( $P<0.05$ ).

The average values of preoperative ESR and CRP were  $68.70\pm 16.76$ mm/h and  $25.15\pm 9.60$ mg/L, respectively; all patients returned to normal levels during the final follow-up period. The difference between ESR and CRP before operation and at the last follow-up was statistically significant ( $P<0.05$ ). All patients underwent intervertebral bone transplantation and intertransverse process fusion, and lateral X-ray or CT was used to evaluate the fusion and formation of the bone bridge. All patients achieved bone fusion within  $7.70\pm 1.46$  months after surgery (Table 2).

Table 2  
Clinical details of surgery

Schedule	Kyphosis angle (°)	ESR(mm/h)	CRP(mg/L)	Bony fusion (months)
Pre-operation	$35.41\pm 6.71$	$68.70\pm 16.76$	$25.15\pm 9.60$	$7.70\pm 1.46$
Post-operation	$8.80\pm 0.79$	$19.85\pm 3.50$	$9.09\pm 3.01$	
3month post-operation	$9.23\pm 0.53$	$8.45\pm 1.73$	$4.8\pm 1.95$	
Final follw-up	$9.99\pm 0.92$	$6.45\pm 1.03$	$5.1\pm 1.62$	

## Discussion

Spinal tuberculosis is a common disease, accounting for about 50% of bone and joint tuberculosis [2]. Despite the continuous efforts of the World Health Organization and local health authorities, tuberculosis is still widespread in some developing countries and affects all susceptible people, including the elderly [8].

Anti-tuberculosis treatment, bed rest and supportive treatment are the basis for the treatment of spinal tuberculosis, and are also the main treatment options. If there is no drug treatment, the risk of surgery will increase significantly, and the mortality, risk of infection transmission and recurrence rate will also increase [9]. However, due to the poor health of elderly patients, they often have a variety of chronic diseases and cannot withstand surgical treatment. In most cases, anti-tuberculosis chemotherapy is conservatively treated to avoid surgical risks and related complications. This may lead to aggravation of spinal deformity and nerve damage [10]. At the same time, prolonged bed rest not only affects the quality of life, but also causes serious complications. In addition, the tuberculosis lesion is surrounded by bone, which may result in the ineffective penetration of anti-tuberculosis drugs and poor treatment effects. Therefore, for elderly patients, surgical treatment plays an important role in removing necrotic tissue, removing paravertebral abscess, alleviating nerve compression, and improving spinal deformity.

However, there are many controversies in the surgical treatment of STSTND in the elderly. Anterior surgery has the advantages of directly removing tuberculosis lesions and facilitating bone grafting, but it is not effective in correcting kyphosis and relieving nerve compression [11]. In addition, the sternum, clavicle, ribs, and mediastinal organs interfere with the surgical operation, which makes anterior surgery more difficult. Combined anterior and posterior surgery has a good clinical effect. However, the large amount of operation, long operation time, heavy bleeding, longer postoperative recovery time and more complications often make it difficult to perform in elderly patients [12].

In the past few decades, posterior surgery has made significant progress in the treatment of spinal tuberculosis. The posterior pedicle screw system is popular as a revolutionary technology for correcting spinal deformities and increasing spinal stability. It has been shown to be effective in treating thoracic spine diseases that cause segmental instability and neurological dysfunction [8].

Posterior transforaminal lumbar interbody fusion (TLIF) was originally promoted by Harms et al. [13]. As an improvement of posterior lumbar interbody fusion (PLIF), it overcomes the problem of nerve retraction. However, the traditional TLIF surgical approach requires extensive stripping of the multifidus muscle, which damages the blood supply and innervation of the multifidus muscle, resulting in postoperative degeneration of the multifidus muscle, which manifests as muscle atrophy, fibrosis and fat deposition; at the same time, it takes a long time during the operation. Extensive retraction of the paraspinal muscles, the innermost multifidus muscle, has the largest increase in intramuscular pressure, leading to local blood supply interruption, irreversible ischemic degeneration and necrosis, which seriously affects the physiological function of the multifidus muscle and increases the chronic low back pain after surgery. Incidence rate [14]. In 1968, Dr. Wiltse and others proposed a new method, which is to perform surgery through the gap between the multifidus and the longissimus muscle. This approach can significantly reduce the damage to the multifidus muscle caused by dissection and traction during the operation, and maximize the integrity of the posterior bone structure and ligament complex [5].

In the practice of exploring the application of intermuscular approach, this approach is applied to TLIF surgery for the treatment of spinal tuberculosis in elderly patients with osteoporosis. We believe that the Wiltse approach TLIF surgery has the following advantages. First of all, the Wiltse approach is simple in anatomy. It enters from the natural space between the multifidus and the longissimus muscle without dissection and extensive retraction of the paraspinal muscles, which avoids the denervation of the multifidus muscle and reduces the localization of the multifidus muscle. Ischemic degeneration and necrosis caused by interruption of blood supply. Therefore, the intermuscular approach can retain more of the physiological function of the multifidus muscle, maintain the stability of the spine, reduce the occurrence of chronic low back pain, and help the elderly to recover after surgery. Early

functional exercises can avoid complications caused by long-term bed rest. Secondly, elderly patients are often in poor physical conditions and more serious illnesses. The Wiltse approach TLIF can reduce the length of surgery and the length of anesthesia, reduce surgical bleeding, and reduce the risk of surgery. Third, the posterior internal fixation helps prevent the kyphosis from getting worse, correct the kyphosis, and relieve the pain caused by spinal instability. Finally, the posterior internal fixation of the spine keeps the instrument away from the tuberculosis focus, which is conducive to tuberculosis healing. However, the TTIF of the Wiltse approach has two limitations. First, decompression can increase the risk of spinal cord injury. Secondly, anterolateral debridement is difficult to complete, but with the development of anti-tuberculosis drugs, tuberculosis lesions can spontaneously merge and heal, and the thorough debridement of the lesions is not overemphasized [8].

## Conclusion

One-stage Wiltse approach TLIF is feasible and effective for STSTND. At present, the clinical and imaging results of these patients are very good, but the follow-up time of some patients is relatively short. In any case, this type of surgery still requires a large number of patients for further research and longer follow-up.

## Abbreviations

STSTND: Single-segment thoracic spinal tuberculosis with neurological deficits;

TB: Tuberculosis;

STB: Spinal tuberculosis;

TLIF: Transforaminal lumbar interbody fusion;

ESR: Erythrocyte sedimentation rate;

CRP:C-reactive protein;

BMD T: Bone mineral density measurement T value

CT: Computed tomography

MRI: magnetic resonance imaging.

## Declarations

### Ethics approval and consent to participate

The study has been approved by the Medical Ethics Committee of the First Affiliated Hospital of Guangxi Medical University. Informed written consent from the patient to participate in the study had been obtained.

### Consent to publish

Informed written consent was obtained from the patient for publication of this case report and accompanying images.

### Availability of data and materials

All datasets on which the conclusions of the manuscript rely were presented in the main paper.

### **Competing interests**

The authors declare that they have no competing interests.

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### **Authors' contributions**

HZ participated in the design of this study and performed the statistical analysis. LYF drafted the manuscript. QHY, CLY and SHX carried out the study and collected important background information together with HJG. LSM and HSC collected the clinical data and follow-up details of this study, and QHY and SHX participated in the study design and helped to draft the manuscript. All authors read and approved the final manuscript.

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## Figures

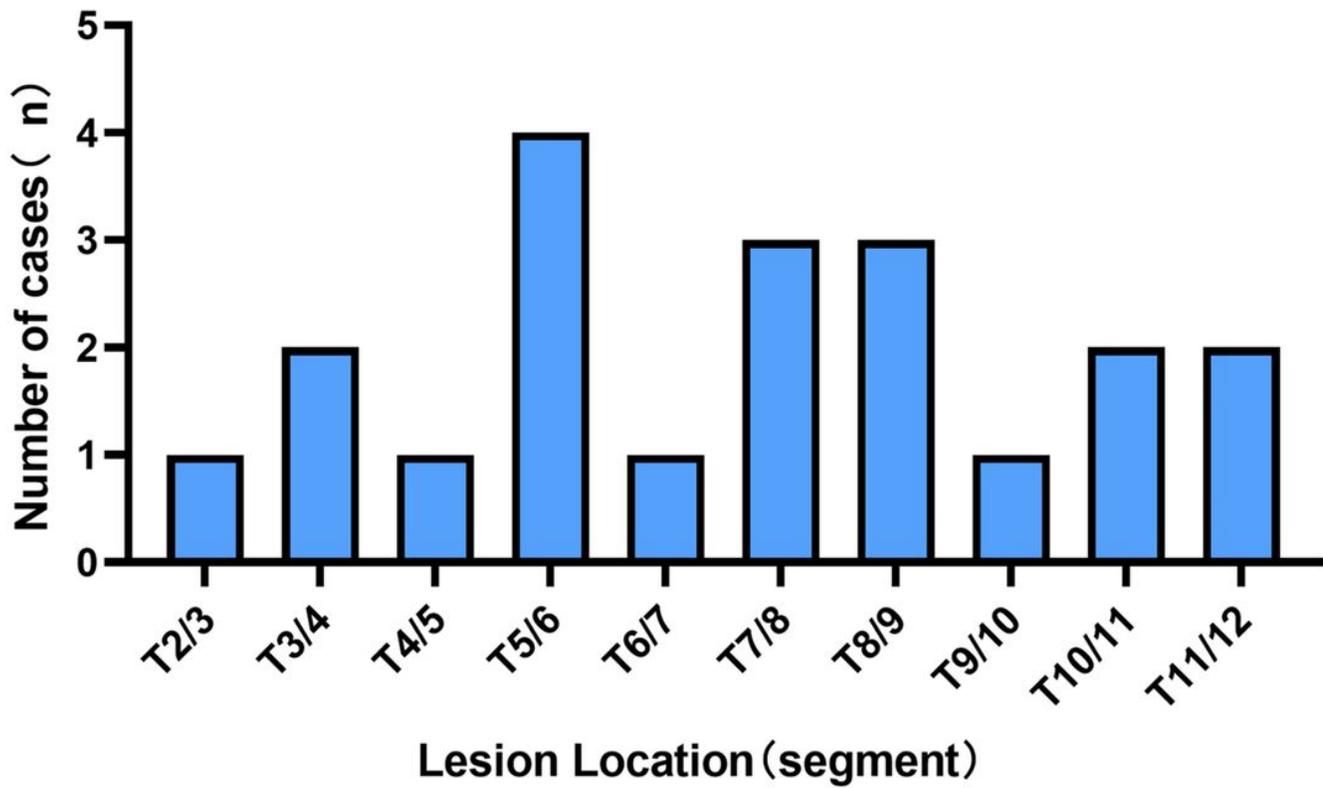
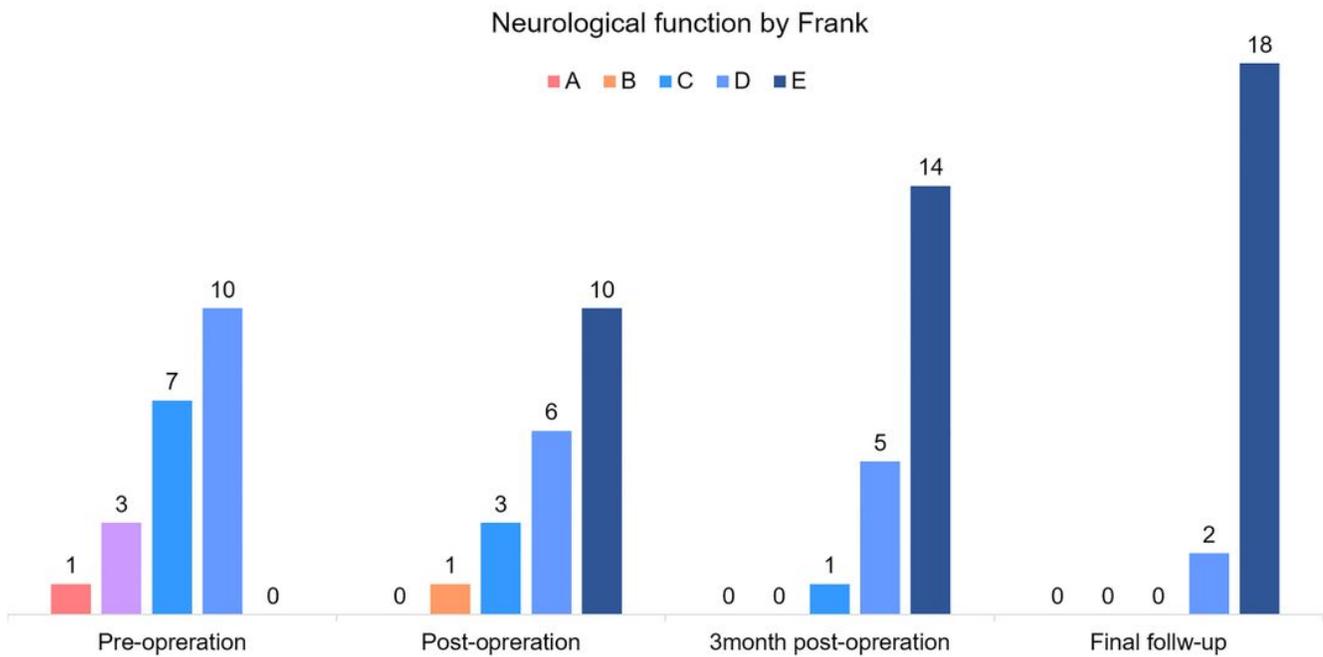


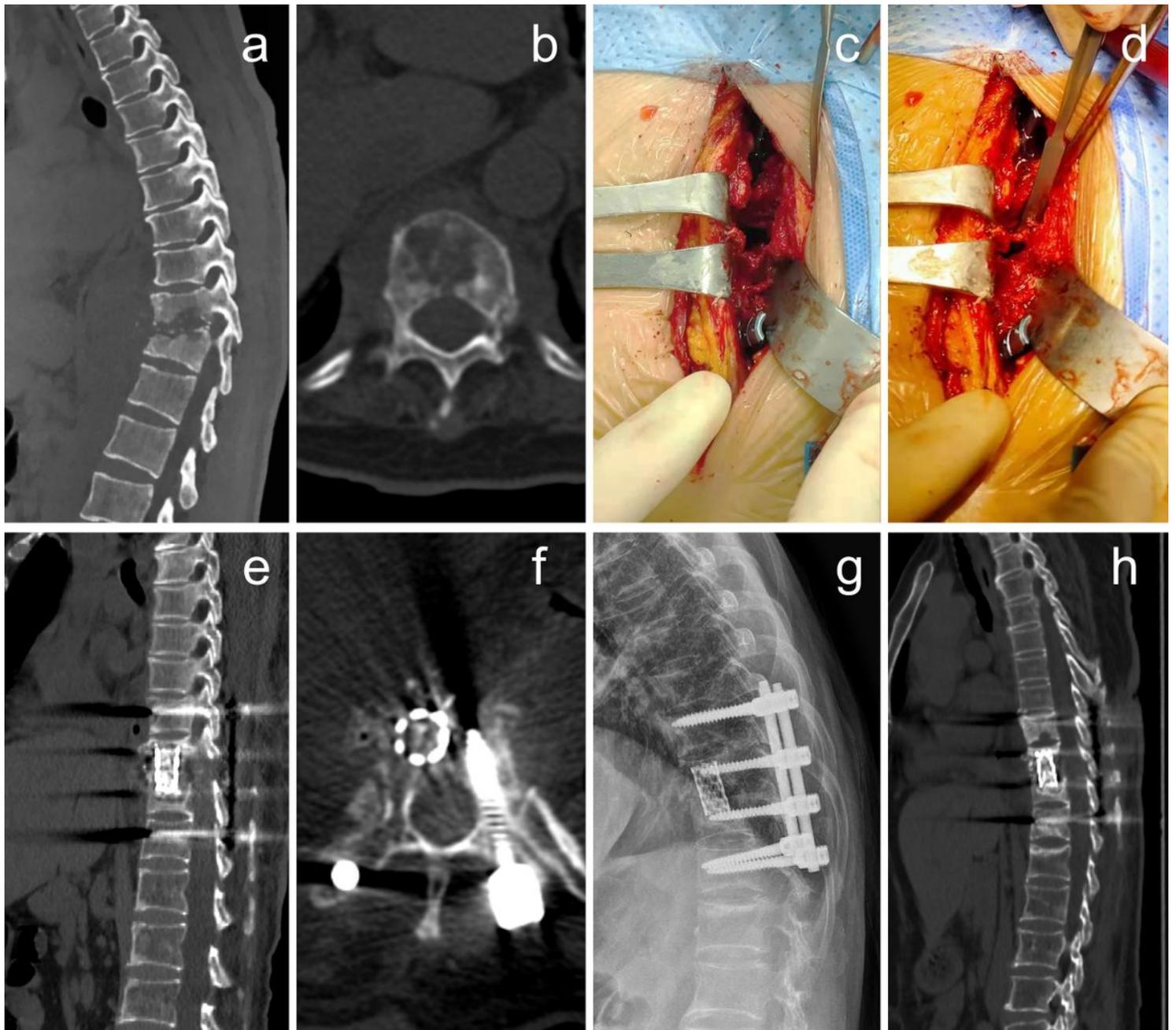
Figure 1

The level of involved thoracic vertebrae.



**Figure 2**

Neurological status of 20 patients.



**Figure 3**

A 75-year-old patient with T9/10 lesions was performed by Wiltse approach TILF. (a and b) The pre-operative imaging data showed T9/10 vertebral bodies' destructions with kyphosis deformity and spinal cord severely compressed. (c and d) Intraoperative photo of Wiltse approach TILF. The postoperative sagittal and coronal CT-scan (e and f) indicated that the kyphosis got obviously improved. X-ray (g) showed good bone fusion and no obvious loss of kyphosis angle in 3 months postoperative. Sagittal CT-scan (h) showed satisfied allograft fusion without relapse of STB at the 9 months of post-operation.