

Debridement and Bone Graft Fusion via the Lateral Extracavitary Approach Combined with Lateral and Posterior Screw-Rod Fixation in Treatment of Thoracic Spinal Tuberculosis: A Retrospective Study of 38 Cases

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Research article

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Abstract

Background

Thoracic spinal tuberculosis is still common, and surgical treatment can rapidly relieve pain, correct deformity, reduce bone loss and prevent further damage to neurological function. We have practiced an efficient and safe surgical method.

Methods

From January 2013 to April 2019, 38 patients with thoracic spinal TB were included in our study. Debridement and bone grafting were performed via the lateral extracavitary approach, combined with two different fixation method. Data from these cases were analyzed retrospectively.

Results

The average surgical duration was 297.0 ± 68.4 min, average intraoperative blood loss was 702.6 ± 252.0 ml, postoperative hospital stay was 11.1 ± 3.6 d, and C-reaction protein (CRP) and erythrocyte sedimentation rate (ESR) of all the patients decreased to normal levels at the last follow-up. The average Visual Analog Scale (VAS) score was 7.5 ± 1.6 preoperatively and 0.6 ± 0.8 at the last follow-up, which was significantly reduced compared with that before surgery. The average kyphosis correction was $6.3 \pm 4.7^\circ$ and the angle loss was $1.4 \pm 1.6^\circ$. Neurological functions of all cases were significantly improved According to the American Spinal Injury Association (ASIA) classification. Solid fusion was observed in all cases at the last follow-up. One patient presented sinus tract formation at the incision site and the other two patients had rupture of the parietal pleura intraoperatively. No severe complications such as spinal cord injury or great vessel injury were found in all patients.

Conclusions

Debridement and bone graft fusion via the posterolateral extracavitary approach combined with two fixation methods can both achieve high efficacy in the treatment of thoracic spinal TB. Lateral single screw-rod fixation is more suitable for patients with single-segment lower thoracic lesions and high stability, with less blood loss and shorter surgical duration. Posterior pedicle screw fixation has higher strength, and is more suitable for patients with multi-segment lesions, poor stability and complex conditions.

Background

Tuberculosis (TB) is more common in underdeveloped areas, but with the prevalence of immigration and human immunodeficiency virus (HIV), TB infection also increases in Western world ^[1, 2]. The spine is the most common site of extrapulmonary TB infection ^[3]. The spinal canal of thoracic spine is relatively narrow, which resulting in susceptibility to secondary neurological impairment once the abscess and kyphosis are formed here after TB infection ^[4]. Therefore, anti-TB treatment should be carried out so long

as spinal TB is diagnosed. Most spinal TB can be cured by drug treatment [5, 6]. While early surgical intervention is generally recommended in the cases of poor efficacy, severe vertebral bone destruction, deformity formation, spinal cord compression and neurological impairment. It has long been proposed that surgical treatment can rapidly relieve pain, correct deformity, reduce bone loss and prevent further damage to neurological function [7, 8]. At present, the widely recognized treatment for spinal TB focuses on reconstruction of mechanical structure, thorough removal of lesions and improvement of neurological function, which is suitable for spinal TB at any segment. We advocate that thorough removal of lesions and prevention of recurrence should be the first priority of three surgical focuses. Currently, there are many surgical approaches for thoracic TB. We selected the lateral extracavitary approach for debridement and bone grafting, through which the TB lesions in front of the thoracic spine can be well exposed, followed by fairly thorough debridement. As for the selection of fixation methods, we chose lateral or posterior fixation according to the number of involved segments, the site of lesions, spinal stability and vertebral bone condition, and achieved good results. After screening the patients treated in our group from January 2013 to April 2019, a total of 38 patients were included in this study. The clinical data of these patients will be analyzed below to verify the effectiveness and safety of this approach. For the convenience of analysis, some data will be displayed in different groups according to different fixation methods.

Materials And Methods

Inclusion criteria

According to the following criteria, a total of 38 patients were selected from all TB cases treated in our group from January 2013 to April 2019. (1) The surgery was completed by the same surgeon, and it was the first treatment; (2) diseased vertebrae were located from the superior margin of T1 to the inferior margin of T12, and the efficacy of conservative treatment was poor; (3) local structure was unstable, and estimated to aggravate; (4) patients had or were expected to have neurological impairment.

Basic information

All the patients were treated by debridement and bone grafting via the lateral extracavitary approach (Table 1). Among them, 18 patients received lateral single screw-rod fixation, while the 20 patients underwent posterior screw-rod fixation. There were 19 males and 19 females, aging from 23 to 84 years (average 51.0 ± 14.1 years). The follow-up time was 18–96 months, with an average of 50.8 ± 21.9 months. The involved vertebrae were distributed in T3–T12 (Fig. 1), with involved single segment in 25 patients and involved multiple segments in 13 patients. Preoperative ASIA classification revealed grade B in 2 patients, grade C in 3 patients, grade D in 11 patients, and grade E in 22 patients (Table 2).

Preoperative preparation

Preoperatively, standard anti-TB drug treatment (isoniazid 300 mg/day, rifampicin 450 mg/day, ethambutol 750 mg/day and pyrazinamide 750 mg/day) should be carried out for at least 2–4 weeks, and medical diseases should be actively treated to improve patients' tolerance to surgery.

Operative procedures

The patients with lateral fixation were in the left or right lateral decubitus position according to the condition of lesions. A paraspinous incision was made on the back, with the trapezius/latissimus dorsi separated layer by layer. Through the intermuscular space of the erector spinalis, the ribs connected with the diseased vertebrae and one adjacent upper and lower ribs were exposed. The spaces between the ribs and the anterior parietal pleura were separated carefully to free the ribs. At about 10 cm of the distal end, the ribs were cut off and removed completely. The adjacent ribs were removed in the same way (the number of removed ribs depended on the need of debridement). Afterwards, the intercostal vessels and nerves were ligated and severed. The transverse processes of the diseased and adjacent vertebrae were cut off using an osteotome, so the anterolateral surface of thoracic vertebrae could be reached (Fig. 2). Pus, diseased intervertebral disc and bone were removed completely. If spinal canal stenosis was severe preoperatively, lateral spinal canal decompression could be performed by opening the spinal canal along the intercostal nerves. After thorough debridement, one pedicle screw was inserted into the lateral upper and lower vertebral bodies, respectively, crossing the lesion. After washing, a massive iliac bone, rib or titanium mesh was implanted. Subsequently, the titanium rod was connected, bleeding was stopped thoroughly, 2 g streptomycin was placed locally, and the incision was closed after placing a drainage tube.

The patients with posterior fixation were in the prone position firstly. A posterior-midline incision was laterally made on the back with the diseased vertebrae as the center for exposure till the vertebral plate. The pedicle screw was inserted routinely, and the screw rod on the opposite side of the approach was locked. The incision was closed temporarily, and the patients were changed to the lateral decubitus position. Both ends of the original incision were extended obliquely upward for layer-by-layer exposure. In the same way, the exposure was performed till the anterolateral side thoracic vertebrae, which was followed by careful debridement. If there was spinal canal stenosis, lateral spinal canal decompression could also be carried out. After repairing the bone defect and washing, an autogenous bone or titanium mesh was implanted and connected with the titanium rod on the approach side, which was locked finally. Afterwards, bleeding was stopped thoroughly, 2 g streptomycin was placed locally, and the incision was closed after placing a drainage tube.

Postoperative management

The intraoperatively pathological tissues were sent for pathological examination. In this study, all patients were confirmed as TB by pathological examination. After surgery, all patients received anti-TB drug treatment, routine prevention of general bacterial infection, positive correction of anemia, and body fluid balance on the next day. The character of drainage fluid in the drainage tube were observed, and the drainage tube was withdrawn when there was no extraction. After the general condition was stable and

the incision was normal, the patients were discharged. All the patients were asked to lie in bed for 8 to 12 weeks, and then out-of-bed activities with brace. CRP, ESR and computerized tomography (CT) or X-ray were reviewed at 3, 9, 12 and 24 months after surgery, respectively. Anti-TB drug treatment lasted at least 18 months after surgery.

Evaluation

Surgical duration, intraoperative blood loss and postoperative hospital stay (d) were used to assess the surgical process. Preoperative and postoperative VAS score, and preoperative ESR and CRP were used to assess the postoperative recovery, and ASIA classification to assess neurological function. X-ray and CT were used to assess bone graft fusion and the correction of spinal deformity. The kyphosis angle was measured on the lateral position of the X-ray images: a horizontal line was made at the superior margin of the upper vertebral body and the inferior margin of the lower vertebral body involved in kyphosis formation, and the angle between the two lines was the kyphosis angle. The kyphosis angle was followed up to assess the correction. Additionally, the complications of all patients were recorded.

Statistical analysis

The statistical analysis in this study was performed by SPSS 24.0 statistical software (IBM Corp., Armonk, NY, USA). A paired t-test was applied to compare the changes in indices preoperatively, postoperatively, and during follow-up. A P value of < 0.05 was considered statistically significant.

Results

Perioperative data

The average surgical duration was 297.0 ± 68.4 min, average intraoperative blood loss was 702.6 ± 252.0 ml, postoperative hospital stay was 11.1 ± 3.6 d. The average preoperative CRP and ESR were 18.32 ± 24.1 mol/L and 30.7 ± 23.5 mm/h, respectively. At the last follow-up, CRP and ESR of all patients decreased to normal levels, 1.1 ± 1.2 mol/L and 8.2 ± 4.4 mm/h, respectively. The average VAS score was 7.5 ± 1.6 preoperatively and 0.6 ± 0.8 at the last follow-up, which was significantly reduced compared with that before surgery ($P < 0.05$) (Table 1).

Table 1
Clinical data

	Lateral fixation	Posterior fixation	Total cases
Count	18	20	38
Months of follow-up	56.7 ± 22.6	45.5 ± 20.5	50.8 ± 21.9
Sex (Male/Female)	9/ 9	10/10	19/19
Age(year)	52.3 ± 18.0	49.9 ± 9.8	51.0 ± 14.1
Single/multiple segment	17/1	8/12	25/13
Surgical duration (min)	246.5 ± 23.6	342 ± 63.4	297.0 ± 68.4
Blood loss (ml)	583.3 ± 172.4	810.0 ± 267.3	702.6 ± 252.0
Hospital stay (d)	11.2 ± 3.5	10.9 ± 3.8	11.1 ± 3.6
VAS <i>Pre/Fin</i>	7.3 ± 1.7/0.4 ± 0.8	7.6 ± 1.4/0.7 ± 0.7	7.5 ± 1.6/0.6 ± 0.8
CRP <i>Pre/Fin</i> (mol/L)	15.6 ± 19.7/0.9 ± 0.9	20.7 ± 27.8/1.5 ± 1.4	18.3 ± 24.1/1.1 ± 1.2
ESR <i>Pre/Fin</i> (mm/h)	27.3 ± 20.2/9.1 ± 3.2	33.7 ± 26.2/705 ± 5.2	30.7 ± 23.5/8.2 ± 4.4
<i>Pre</i> = Preoperative, <i>Fin</i> = Final follow-up. Compared VAS, CRP and ESR before and after operation, P < 0.05.			

Complications and neurological function

Two months after surgery, one patient undergoing posterior fixation and debridement via the lateral approach showed sinus tract formation at the incision site, which was confirmed as recurrence of the original lesion and cured after debridement. Nine months after second surgery, two screws at the lower end were withdrawn. While CT confirmed that bony fusion was formed at the bone graft site. In the other patients, the incisions healed at the first stage, and no internal fixture fracture or withdrawal was found. Two patients presented rupture of the parietal pleura during surgery, which were repaired intraoperatively in time. No intraoperative dural tear and large vessel injury, or spinal cord injury, cerebrospinal fluid leakage and intractable intercostal neuralgia occurred in any patients. As for neurological function, a total of 16 patients were lower than grade E before surgery, and at the last follow-up, one patient was upgraded from Grade B to Grade D, while the rest of the patients were upgraded to E (Table 2).

Table 2
ASIA classification

	Lateral fixation		Posterior fixation		Total cases	
	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>
B	0	0	2	0	2	0
C	1	0	2	0	3	0
D	6	0	5	1	11	1
E	11	18	11	19	22	37

Pre= Preoperative, *Post*= Postoperative. A total of 16 patients were lower than grade E before surgery, and at the last follow-up, one patient was upgraded from Grade B to Grade D, while the rest of the patients were upgraded to E.

Follow-up of imaging data

The kyphosis angle was $16.8 \pm 7.9^\circ$ before surgery, $11.6 \pm 5.9^\circ$ after surgery, and 0° in the last follow-up. The average kyphosis correction was $6.3 \pm 4.7^\circ$ and the angle lost was about $1.4 \pm 1.6^\circ$ (Table 3). All the patients showed Intervertebral fusion at the last follow-up (confirmed by CT or X-ray).

Table 3
Correction of spinal deformity

	Lateral fixation	Posterior fixation	Total cases
Preoperative kyphosis angle ($^\circ$)	14.5 ± 8.5	18.8 ± 6.9	16.8 ± 7.9
Postoperative kyphosis angle ($^\circ$)	8.5 ± 4.5	11.9 ± 6.1	10.3 ± 5.6
Final kyphosis angle ($^\circ$)	8.9 ± 5.1	14.0 ± 5.6	11.6 ± 5.9
Kyphosis angle correction ($^\circ$)	6.1 ± 4.8	6.5 ± 4.6	6.3 ± 4.7
Kyphosis angle loss ($^\circ$)	1.1 ± 1.2	1.8 ± 1.8	1.4 ± 1.6

Compared the kyphosis Angle preoperatively and postoperatively, $p < 0.05$.

Comparison between different internal fixation groups

In addition, according to different internal fixation methods, comparison was performed between groups. The main differences are as follows, as shown in all tables. Firstly, in the posterior fixation group, a total of 12 patients had multi-segmental involvement, while in the lateral fixation group, only one patients showed multi-segmental involvement. Secondly, the involved segments were distributed throughout the thoracic spine in the posterior fixation group, while only below T6 in the lateral fixation group. Preoperative kyphosis angle of the posterior fixation group was 18.8 ± 6.9 , which was larger than that of the lateral fixation group (14.5 ± 8.5). The kyphosis correction was $6.5 \pm 4.6^\circ$ in the posterior fixation group and $6.1 \pm 4.8^\circ$ in the lateral fixation group. Moreover, there were four patients in the posterior

fixation group whose preoperative ASIA grade was lower than D, while one patients in the lateral fixation group. Not surprisingly, the surgical duration was significantly shorter and blood loss was significantly less in the lateral fixation group than those in the posterior fixation group.

Discussion

Spinal TB usually involves the thoracic vertebrae, and bone destruction often occurs in the anterior and middle column. Therefore, the anterior spine must be exposed for thorough debridement. The lateral extracavitary approach is widely used in the surgery for ventral lesions of the thoracic spine, including fractures, tumors, infections, etc., with high efficacy^[9]. In the treatment of thoracic TB via this approach according to our practice, the following key points should be paid attention to: the approach should be selected according to preoperative imaging data, and the patients should be in the lateral decubitus position, with the approach upwards. For the lower thoracic vertebrae, the transverse part of the incision should be located about 5 cm laterally to the posterior midline(Fig. 3). If posterior fixation is selected or the lesion is located in the upper thoracic vertebrae(above T6), the transverse part of the incision should be biased to the center to facilitate nailing in the prone position. Then the incision was closed temporarily, and the patients were changed to the lateral decubitus position. Both ends of the original incision were extended obliquely upward for layer-by-layer exposure. After the latissimus dorsi or trapezius are cut open layer by layer and the deep erector spinalis is exposed, separation should be performed with erector spinalis reserved, till the ribs. The ribs need to be dissected carefully from the anterior periosteum using a periosteum stripper, then cut them off respectively and remove completely, during which the parietal pleura should not be damaged. In addition, the transverse process should be cut off simultaneously. Once parietal pleura is fractured, it should be repaired immediately. After ligation of intercostal blood vessels and nerves and disconnection, dissection should be performed carefully along the surface of the thoracic vertebrae, then the anterior column of thoracic spine can be reached through the parietal extrapleural space(Fig. 3). If spinal canal decompression is necessary, the anterior lesions should be cleared roughly for preliminary decompression,which can release the pressure in front of spinal cord and avoid injury of it during opening the spinal canal. Subsequently, the partial vertebral plate and pedicle, and the tissue protruding backwards in the anterior spinal canal should be resected for sufficient decompression(Fig. 4, Fig. 2).

At present, there are multiple surgical approaches for thoracic TB, including anterior approach, posterior approach ,and combined approach, which have their own advantages. The anterior approach needs to enter through the thoracic/abdominal cavity, which was firstly reported by Hodgson et al. ^[10]. It can be used for debridement, precise bone grafting and spinal reconstruction in one stage, with high efficacy. The combined anterior and posterior approach is also widely used, which can achieve 360° spinal reconstruction. Based on thorough debridement and nerve decompression, it has better orthopedic ability and stability. Hirakawa, Liu et al. ^[11, 12] reported that the treatment of thoracic TB via this approach achieved good results. Wang, Guzey, et al. ^[13, 14] reported that the treatment of thoracic TB via the posterior only approach achieved high efficacy. Debridement, bone grafting and internal fixation were

completed in one stage, and the debridement was thorough and the fixation was reliable. They also compared the advantages and disadvantages of the three surgical approaches, and concluded that the posterior approach alone should be the first choice for the treatment of thoracic TB. In addition, Yin ^[15] also reported that the lateral extracavitary approach for the treatment of thoracic TB involving multiple segments achieved high efficacy, which is in line with the approach in our study. Combined with our practical experience and data, it is concluded that the lateral extracavitary approach has the following advantages: (1) it provides wide field of vision, thorough debridement and precise bone grafting. A window can be made by resecting the ribs the transverse processes connected with the diseased vertebrae. If multiple segments are affected, several adjacent ribs can be resected to enlarge the window. Through this window, the anterolateral side of thoracic spine can be reached. Under direct vision, the abscess and necrotic tissues in front of the every affected vertebra can be removed(Fig. 5). Moreover, in the lateral decubitus position, the lesion on the opposite side of the thoracic vertebra can be reached after gradual debridement via this approach, so that debridement is more thorough. After debridement, the amputated rib or ipsilateral iliac bone can be used for structural bone-grafting, or it can be crushed and filled into titanium cage, and then implanted into bone groove. (2) Whether the spinal canal should be opened can be determined according to the demand(Fig. 2). When the anterior lesion is cleared preliminary, if the spinal canal stenosis is confirmed by preoperative imaging data, the spinal canal can be opened laterally at lesion space for decompression. In some cases, the anterior vertebral bone destruction is severe, but the spinal canal is not involved. In some cases, there is no need for decompression, but only debridement(Fig. 2, Fig. 3), the resection range only involves the transverse processes, ribs and Pathological bone. The integrity of the spinal canal can be preserved, meanwhile the remaining support of the spine can be retained as much as possible, then the risk of spinal cord injury can be reduced. The obvious disadvantages of this approach include: large trauma, and need for disconnection of intercostal nerves and blood vessels due to rib resection, resulting in postoperative chest wall paresthesia in some patients. Furthermore, if posterior fixation is selected, the position should be changed during surgery, which also increases the surgical duration and the risk of infection.

The orthopedic ability and stability of posterior fixation are significantly better than those of lateral single screw-rod fixation ^[16]. While, our data showed that lateral single screw-rod fixation could achieve the same orthopedic effect as posterior fixation, and the loss of kyphosis angle was not obvious. The cause is that the choice of internal fixation method was not random during our diagnosis and treatment. In the cases of single screw-rod fixation, the lesions were relatively simple and the stability was not bad. In contrast, posterior fixation was selected for the patients with severer conditions, more bone destruction, more complex lesions and poorer spinal stability after debridement. Additionally, the affected segments of the 18 patients with lateral single screw-rod fixation in our study were all below T6. Because lateral screw-rod fixation is not suitable for the upper thoracic spine (T1-T5). The lateral side of the upper thoracic spine is covered by the scapula, the curvature of the ribs is greater, and the pleura is tenser, which make lateral screw placement more inconvenient. Therefore, for lesions in the upper thoracic spine (above T6), we chose posterior fixation. Combined with practice and data, we preliminarily explored the indications of the two fixation methods. Based on debridement via the posterolateral approach, posterior

fixation should be selected for patients with multi-segment involvement, complex lesions, severe deformity and poor stability(Fig. 6). In the case of single-segment lesions of the lower thoracic spine, good stability and not serious deformity, lateral single screw-rod fixation can be selected(Fig. 7). Their own characteristics are as follows: Posterior fixation has good holding force and supporting capacity, with high strength, high stability and wider application range. Lateral single screw-rod fixation can be completed with debridement and bone grafting in one stage. It is characterized by relatively small trauma, short surgical duration, less blood loss and simple operative procedure, but features weak strength. In addition, Mycobacterium tuberculosis will not form a biofilm on the surface of the internal fixation implant^[17], so it is not improper to directly implant the screw rod or titanium cage into the lesion.

Finally, any surgical method should be selected based on the patients' condition combined with the surgeons' expertise, so as to achieve individualized treatment. Anti-TB drugs are the basis of the treatment of TB. While paying attention to surgical treatment, drug treatment should be given enough attention. The follow-up time of this study is relatively short, and the complications need more long-term observation.

Conclusions

Debridement and bone graft fusion via the posterolateral extracavitary approach combined with two fixation methods can both achieve high efficacy in the treatment of thoracic TB. Lateral single screw-rod fixation is more suitable for patients with single-segment lower thoracic lesions and high stability, with less blood loss and shorter surgical duration. Posterior pedicle screw fixation has higher strength, and is more suitable for patients with multi-segment lesions, poor stability and complex conditions.

Abbreviations

CRP: C-reaction protein, ESR: erythrocyte sedimentation rate, VAS: Visual Analog Scale, ASIA: American Spinal Injury Association, HIV: human immunodeficiency virus, CT: Computerized Tomography, MRI: Magnetic Resonance Imaging

Declarations

Ethics approval and consent to participate

Approval was obtained from the ethics committee of Lanzhou University second Hospital (Project No.2019A-031). The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Consent for publication

Informed consent was obtained from all individual participants included in the study.

Availability of data and materials

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

J Zhou and S Li collected materials, analyzed data and wrote manuscripts.X Gguan participated in data collection.S Lei and Y Wang performed all the patients' surgeries and provided idea.

Acknowledgements

Not applicable

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Figures

Vertebrae involved

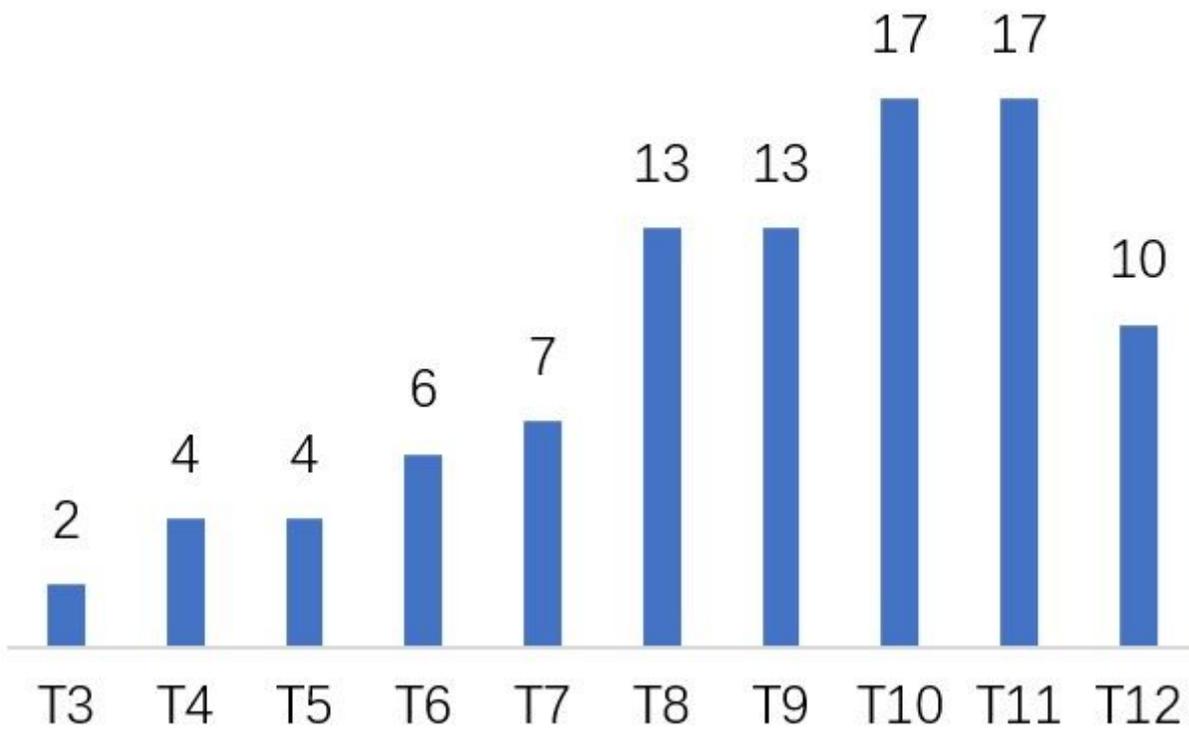


Figure 1

Vertebrae involved.

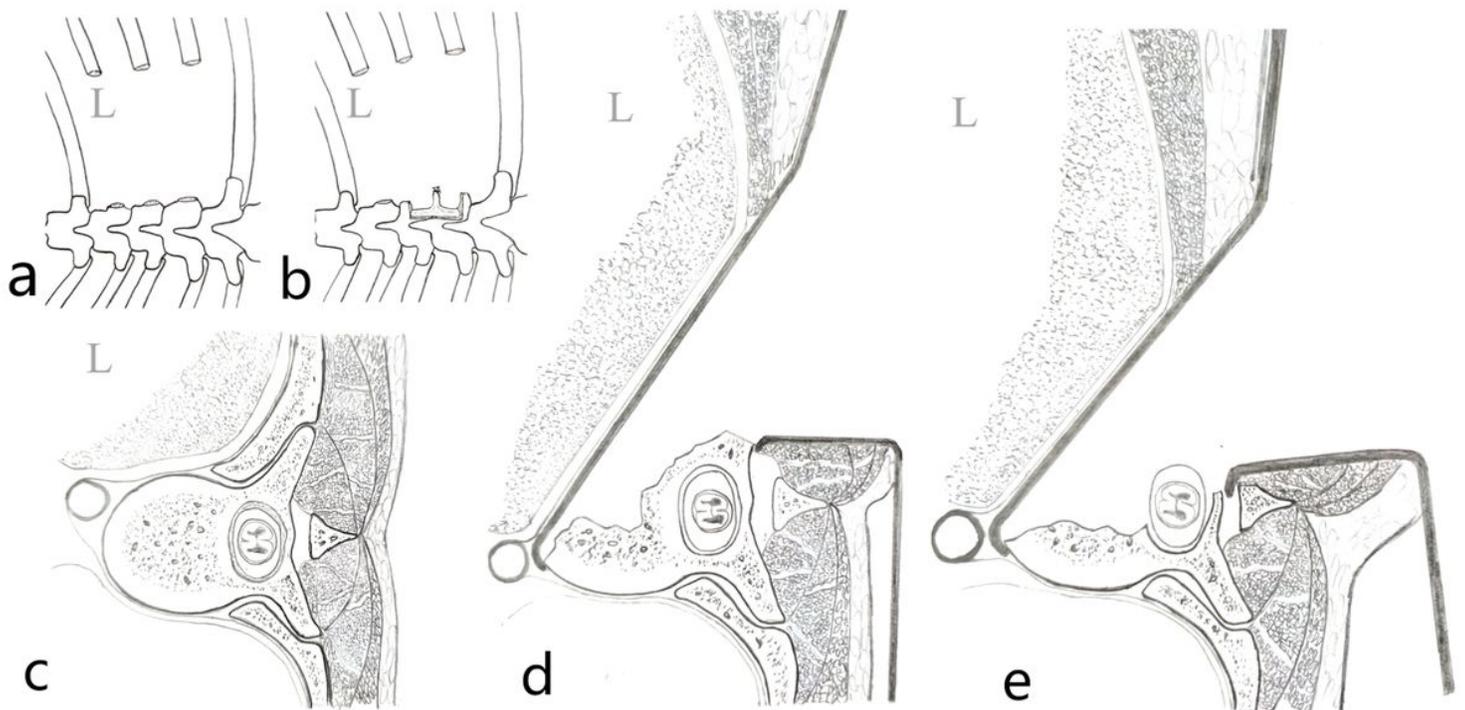


Figure 2

A schematic of the range of excision with the right lateral decubitus for example. (a b) Dorsal view under right decubitus. (c) Sectional anatomy at the level of the 10th thoracic pedicle. (d) The range of excision for debridement without opening the vertebral canal. (e) The range of excision for debridement with lateral decompression of vertebral canal.

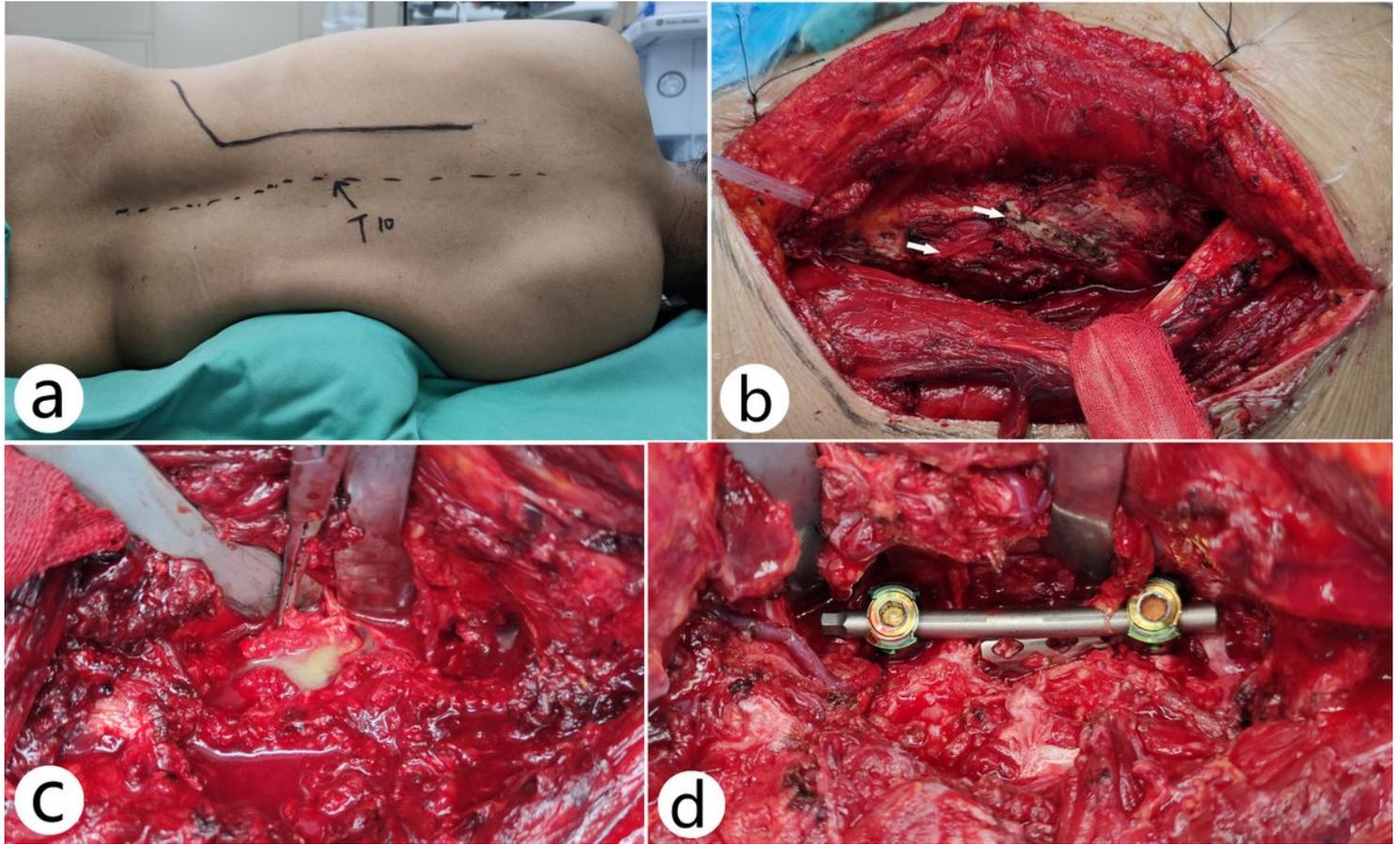


Figure 3

One case was fixed with lateral single screw rod without spinal decompression. (a) The patient is in the right decubitus position with the incision at the solid line. (b) The two white arrows show the ribs attached to the diseased vertebra. The lateral side of the thoracic vertebra is exposed when the ribs and transverse processes are removed while the anterior tissue is pushed forward. (c) The creamy fluid is pus exuding from the intervertebral space. (d) After debridement, titanium cage was placed at the bone defect, and 2 pedicle nails was implanted at the side of two vertebral bodies.

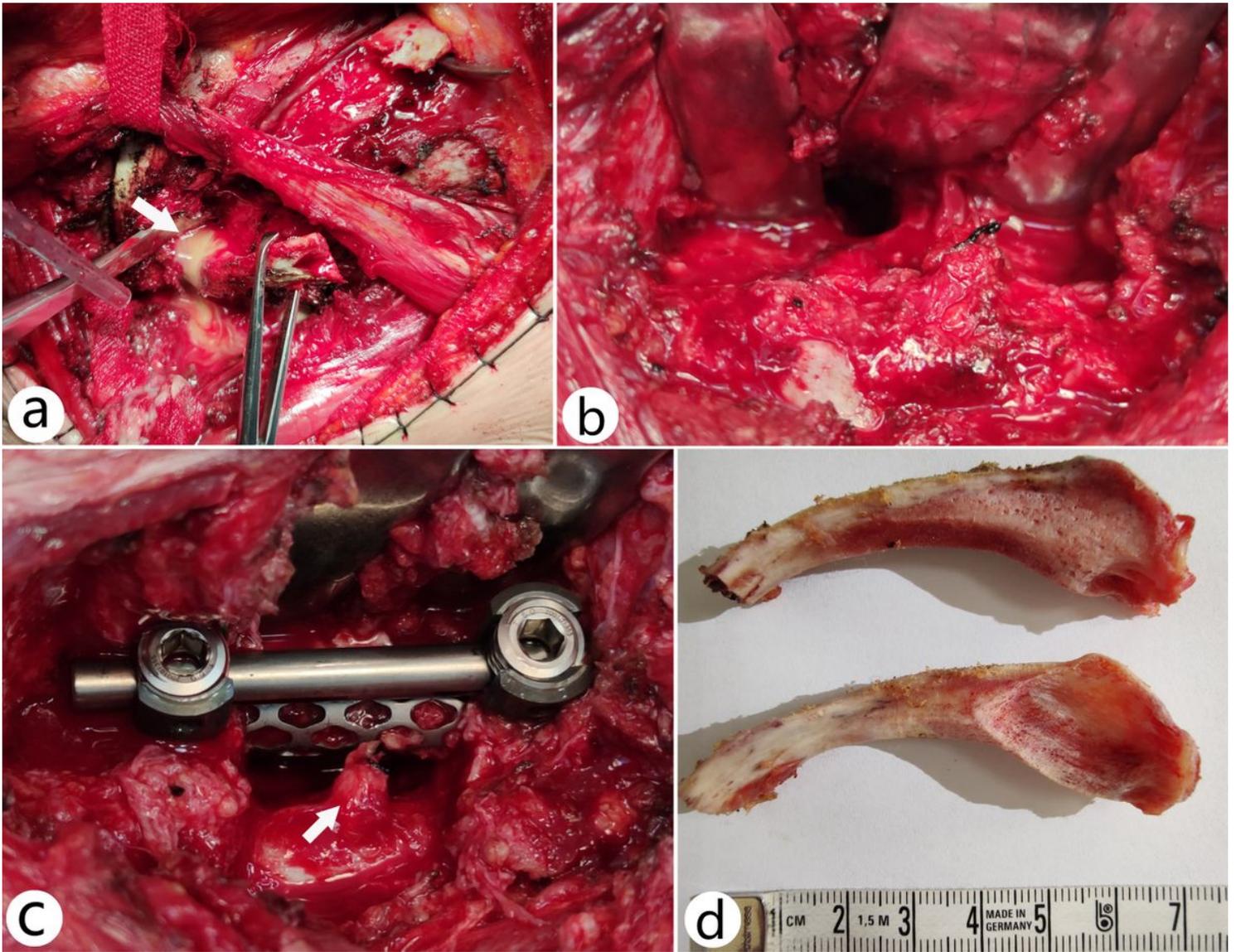


Figure 4

A case of lateral fixation and lateral spinal decompression. The patient was in left lateral decubitus position. (a) The white arrow shows pus emerging from the front of the eighth rib head. (b,c) After adequate debridement and lateral decompression, titanium cage was implanted. The white arrow shows the remains of the eighth intercostal nerve root. (d) On the lower side is the 8th rib, showing a pit on the ventral side caused by tuberculosis.

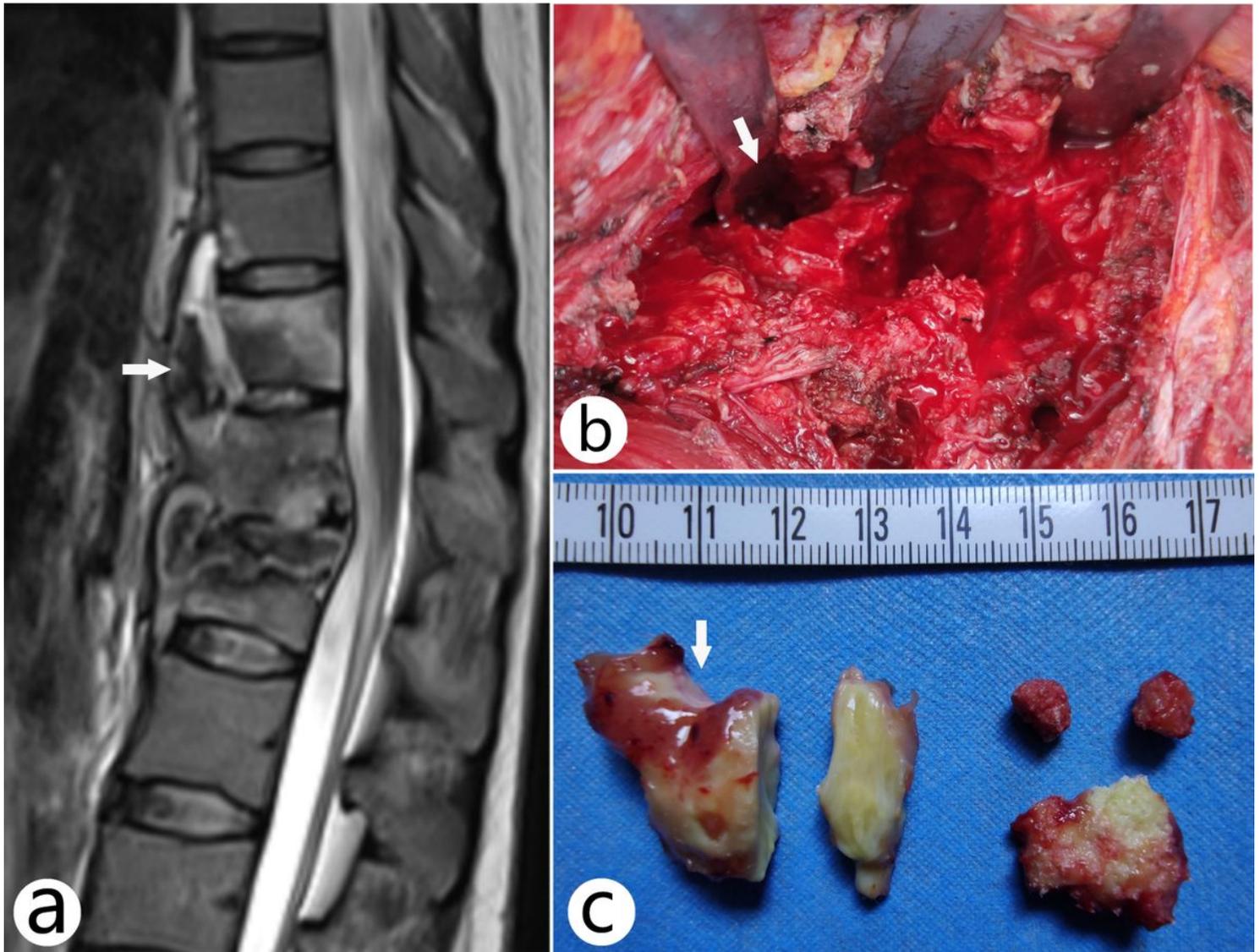


Figure 5

A case with multisegmental involvement. (a) Preoperative MRI showed destruction from T11 to L1, and hyperplastic lesion were formed in front of T11 accompanied by abscess. (b) Patient in left lateral decubitus position. The bone defect shown by the white arrow is in front of T11, and the larger bone defect on the side is caused by clearance of the T12/L1 intervertebral space lesion. (c) The white arrow shows the hyperplastic lesion removed from the front of T11, and its section. The bone mass on the right side is the free sequestrum removed from the T12/L1 intervertebral space.

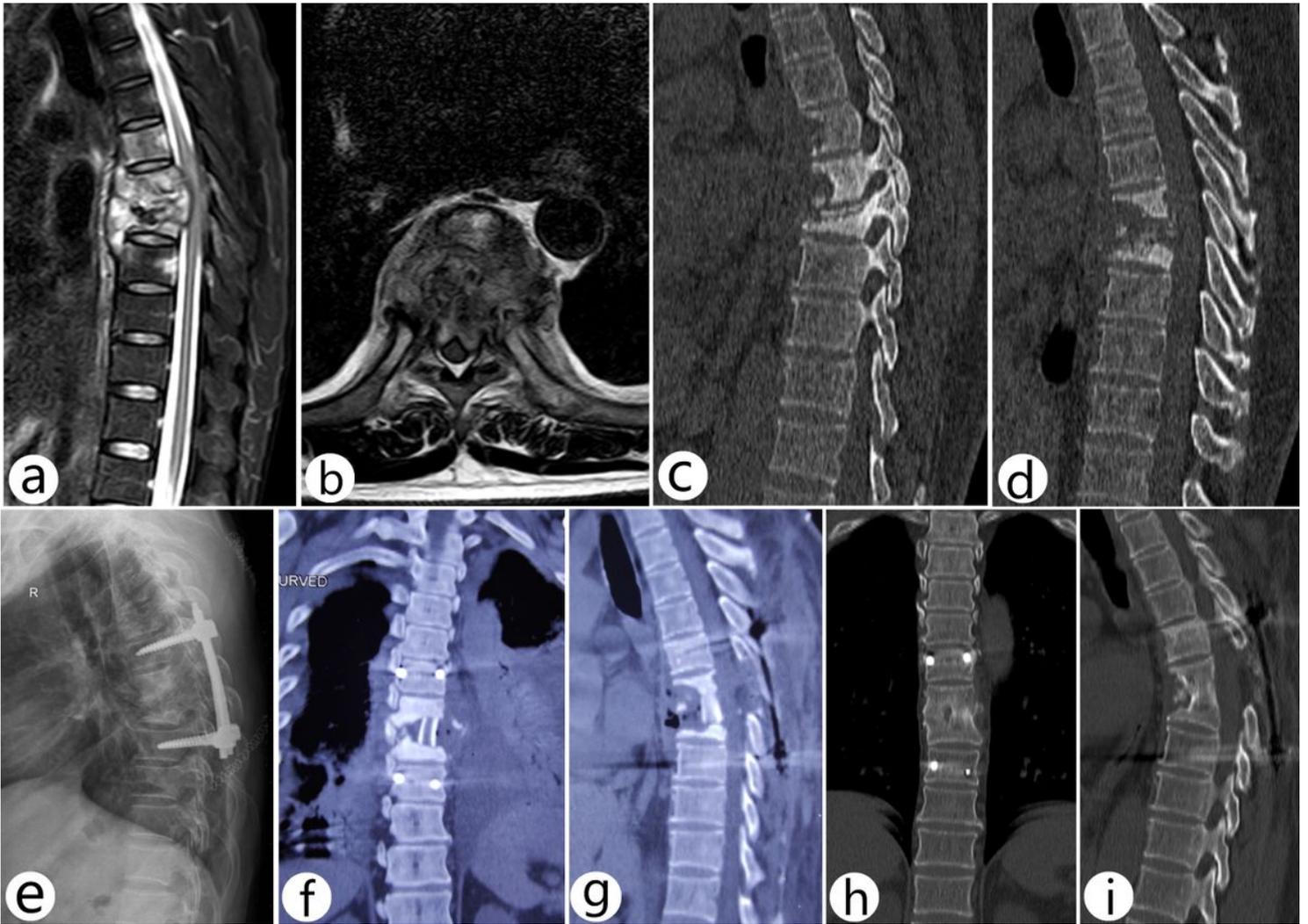


Figure 6

A case of posterior fixation. The patient was a 53-year-old male with back pain for more than half a year and bilateral lower extremity inactivity appeared half a month ago. (a b c d) Preoperative MRI and CT showed that T6, T7 and T8 was destroyed, accompanied by abscess formation, and the spinal cord was compressed to be deformed. (e f g) Debridement and bone graft fusion by lateral extracavitary approach combined with posterior screw-rod fixation was performed. (h i) CT reexamination 2 years after the operation showed perfect bone fusion.



Figure 7

A case of lateral fixation. The male patient, 23 years old, was admitted to hospital with back pain for more than 2 months, accompanied by a gradually enlarged dorsal mass, without any neurological impairment. (a b c d) Preoperative MRI and CT showed bone destruction of T8 and T9, which were concentrated in the middle column, accompanied by a large amount of pus in front and both sides of the thoracic vertebra, almost distributed in the front of the entire thoracic spine, and connected with the dorsal mass. (f g) Debridement, bone grafting and internal fixation were performed by the lateral extracavitary approach in one stage. (h i) CT reexamination one year after the operation showed that the ribs used for structural bone grafting had fused with the surrounding bone. (J k) X-rays two and a half years after surgery.