

Comparative study of a single posterior approach and combined posterior-anterior approach for patients with lower lumbar tuberculosis

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Research article

Keywords: Spinal tuberculosis, Lumbar, Posterior, Combined, Posterior-anterior

Posted Date: August 13th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-48386/v1>

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Abstract

Background

To compare the surgical effect of a single posterior approach with a combined posterior-anterior approach for patients with lower lumbar tuberculosis (TB).

Method:

119 cases of lower lumbar TB were conducted from January 2008 to December 2016 using two procedures. Out of 119 cases, 73 patients were operated with a single posterior approach (group A), whereas, 46 patients were operated using the combined posterior-anterior approach (group B). The evaluative items were compared between two groups, including operation time, blood loss, surgical complication rate, cure rate, Visual Analog Scale (VAS) score, Japanese Orthopaedic Association (JOA) score, kyphosis Cobb's angle, and time of abscess disappearance. Furthermore, the period between bone graft fusion and the patients' return to regular activity were compared between the two groups to evaluate the therapeutic effects.

Results

No significant differences of gender, age, BMI, illness duration, and preoperative indexes of VAS, JOA, ESR, CRP, and kyphosis Cobb's angle were found between the two groups of patients, who were followed-up for 24–60 months. Although the operation time and blood loss rate were less in group A as compared to group B, no remarkable differences in VAS, JOA, ESR, CRP and kyphosis Cobb's angle were found. Furthermore, the rate of surgical complications, cure rate, and time of bone graft fusion did not show appreciable differences between the two groups. However, the time of abscess disappearance and time return to regular activity were less in group B as opposed to patients of group A.

Conclusion

Both single posterior approach and combined posterior-anterior approach are effective for the treatment of lower lumbar TB with a high cure rate and low surgical complication rate. Additionally, single posterior approach is less traumatic than the combined posterior-anterior approach, but with a much slower lesion healing and activity recovery.

Background

Spinal tuberculosis (TB) is a serous infection of the spine caused by *Mycobacterium TB* (MTB), which affects the lumbar portion of adult patients, followed by thoracic and cervical spine. MTB in the spine damages the disc, the lower endplate in the upper adjacent vertebra and the upper endplate in a lower

vertebra in adult patients. Moreover, it has a disastrous consequence on the body's weight-bearing function, which causes back pain, spinal instability, severe kyphosis, and even paralysis [1]. Most spinal TB (STB) lesion involves only one functional spinal unit (FSU); however, multiple FSUs was also observed among patients in some rural areas. Typically, TB lesion has little effect on spinal stability at an early stage of STB; therefore, it can be cured following anti-TB chemotherapy and other conservative treatment, such as bed rest, plaster vest immobilization, and nutritional support [2]. However, the lesions become prominent during the late stages of STB, during which an appropriate surgical intervention is needed.

Anti-TB chemotherapy is the basis for surgical intervention and plays a decisive role in the healing of STB [3]. The principle of anti-TB chemotherapy for STB follows the same principle of PTB, which is a early, regular, full course, full dose, and combined. Due to inadequate blood supply and low drug concentration in the focal of STB, the duration of anti-TB chemotherapy exposure is usually longer than that of pulmonary TB (12–18 months) [4]. The accepted indications for STB are (1) apparent cold abscess (2) sequestrum or cavity formation in the vertebral body (3) sinus formation for a prolonged period ; (4) neurological impairment (5) spinal instability or severe kyphosis. Before the operation, TB toxic symptoms should be significantly alleviated, like body temperature should be dropped to normal, average erythrocyte sedimentation rate (ESR) should be lower than 40 mm/h; following which, 2–4 weeks of regular quadruple anti-TB chemotherapy is recommended.

Although the surgical approaches for lumbar STB surgery are varied, identification of one approach out of single anterior, a single posterior, and combined posterior-anterior approaches, respectively, is controversial. The purpose of this study is to compare the treatment effects of a single posterior approach with a combined posterior-anterior approach for patients with lower lumbar TB.

Methods

From January 2008 to December 2016, 119 patients diagnosed with lumbar STB were enrolled in this retrospective study that included 71 males and 48 females, respectively. STB diagnosis was confirmed by pathological examination and MTB culture results. The mean age of patients was 49.3 ± 9.6 years (range, 21-70 year) and mean illness duration was 8.0 ± 3.3 months (range: 3-20 months). Patients were divided into two groups according to the different surgical methods. Group A consisted of 73 cases of patients who accepted the procedure of a single posterior approach, while those who accepted the procedure of the combined posterior-anterior approach belonged to group B (46 cases). The ethics review committee of Shaanxi Provincial People's Hospital approved this study, and informed consent was obtained from all patients before undergoing the technique. Data in group A and B are shown in Table 1. No significant differences in gender, age, body mass index (BMI) and illness duration were found between group A and B. (Table 1).

Preoperative preparation

Anti-TB chemotherapy was given at least two weeks before surgery as outlined: isoniazid (300 mg/d, Intravenous drip), rifampicin (450 mg/d, oral), ethambutol (750 mg/d, oral) and pyrazinamide (750 mg/d,

oral). When the hemoglobin and albumin levels were lower than 90g/L and 30g/L, respectively, blood transfusion and albumin supplement were used.

Surgical methods

1. The procedure of a single posterior approach: A median longitudinal incision was made, followed by a detachment of multifidus muscle. When the lamina and facet joints were identified, pedicle screws were placed into the vertebral body using X-ray monitoring. Pedicle screws were used in the affected vertebrae, provided they were not severely damaged (or noticeable collapsed) but shorter than the usual length. The proximal screws and distal screws were aimed close to the upper endplate and lower endplate in the affected vertebrae, respectively. Total laminectomies were used for facilitating intervertebral debridement and paravertebral abscess drainage. Sometimes, facet joints or pedicles were removed for extensive debridement and kyphosis correction. Fixation of normal FSU was minimally used under the premise of stability ensuring. Necrotic discs, sequestrants, and granulated tissue were cleared as complete as possible. Paraspinal sticky pus was rinsed and drained by the catheter. Allograft iliac interbody fusion was used. Wound drainage was placed before incision closure. (Figure-1).
2. The procedure of the combined posterior-anterior approach: The procedure was performed in one-stage. Posterior pedicle screw fixation was performed at first, and the detailed steps were like a single posterior approach without canal decompression. Anterior debridement and interbody fusion were performed subsequently. An oblique incision was made in the lower abdomen region after the adoption of lateral position. Abdominal oblique and transverse muscles were detached until a good view of the retroperitoneal cavity was achieved. Under the protection of peritoneum and anterior viscera, the front part of the psoas major was gently detached to reach the anterolateral part of the vertebral body. The contralateral paravertebral abscess was rinsed and drained by catheter, following which, the complete clearance of abscess, necrotic discs, dead bone and allograft interbody fusion were performed. Wound drainage was placed below the incision that was made layer by layer. (Figure-2).

Postoperative care

Antibiotics were given prophylactically for 24-48h. The wound drainage catheter was removed when the drainage volume was less than 20ml. Bed rest was recommended within the first 6-8 weeks; however, minor out-of-bed activities under the protection of thoracolumbar brace were allowed after the removal of drainage. Regular quadruple anti-TB chemotherapy was continued for 18 months. During the anti-TB treatment, liver function was monitored and protected prophylactically.

Follow-ups and Evaluative indexes

Patients were followed up regularly, i.e., once every month for the first three month after the operation, once every three months during postoperative care of 3-12 months, once during the six month of postoperative care (1-2 years), and once a year from the second year. Evaluative indexes such as

operation time, blood loss, surgical complication rate, cure rate, Visual Analog Scale (VAS) score, Japanese Orthopaedic Association (JOA) score, kyphosis Cobb's angle, time of abscess disappearance, time return to regular activity and time of bone graft fusion were compared between the two groups to evaluate their therapeutic effects.

Statistics

SPSS version 22.0 (SPSS Inc., Chicago, IL) statistical software was used for data analysis. An independent sample t-test or Chi-square test was used for comparison of indexes between the two different groups. A P-value of less than 0.05 is considered to be significant.

Result

Surgical technique evaluation

Patients were followed for 24-60 months (mean was 29.0 months). The mean operation time and blood loss in group A were 166.0 ± 12.7 min (range, 150 -180 min) and 717.8 ± 90.6 ml (range, 600-1000 ml), respectively. The mean operation time and blood loss in group B were 256.3 ± 18.3 min (range, 220-300 min) and 772.8 ± 89.9 ml (range, 600-1000 ml), respectively, which were significantly more than the corresponding indexes in group A. (Table 2). The surgical complication rate of group A and group B were 9.59% (7/73) and 13.0 % (6/46), respectively. The cure rate of group A and group B were 93.2% (68/73) and 97.8% (45/46), respectively. No significant differences in surgical complication rate and cure rate were observed between the two groups ($P > 0.05$). (Table 2).

Laboratory evaluation

Mean preoperative ESR and CRP were 59.8 ± 9.1 mm/h and 56.2 ± 19.4 mg/L in group A, respectively. Mean postoperative ESR and CRP were 62.9 ± 12.9 mm/h and 61.7 ± 27.9 mg/L in group B, respectively. No significant differences in the preoperative ESR and CRP were found between the two different groups. All ESR and CRP values returned to normal in all patients within eight months. During the follow-up time of postoperative care (12th month), the ESR and CRP were 11.6 ± 2.6 mm/h and 3.9 ± 0.7 mg/L in group A, whereas, the ESR and CRP were 11.0 ± 1.9 mm/h and 4.0 ± 0.8 mg/L in group B, respectively. No significant differences between ESR and CRP were observed in both groups. (Table 3).

Functional evaluation

Mean preoperative VAS and JOA were 4.8 ± 1.2 and 18.8 ± 1.8 in group A, respectively. Mean preoperative VAS and JOA were 5.1 ± 0.7 and 18.3 ± 1.9 in group B, respectively. Mean postoperative (12th month) VAS and JOA were 1.7 ± 0.6 and 24.3 ± 1.4 in group A, respectively. Mean postoperative (12th month) VAS and JOA were 1.6 ± 0.7 and 24.7 ± 1.7 in group B, respectively. Both VAS and JOA in group A and group B significantly improved after operation; however, the difference in both preoperative and postoperative 12th month VAS and JOA between the two different groups were not significant (Table 2). Mean time return to

regular activity in group A and group B was 9.3 ± 2.1 months and 6.9 ± 0.9 months, respectively. The difference in time return to regular activity was significant ($P<0.05$) (Table 2).

Radiological evaluation

Mean preoperative and postoperative (12th month) kyphosis Cobb's angle in group A were $24.7^\circ\pm 7.8^\circ$ and $9.0^\circ\pm 3.0^\circ$. Mean preoperative and postoperative (12th month) kyphosis Cobb's angle in group B was $23.9^\circ\pm 8.4^\circ$ and $8.3^\circ\pm 2.6^\circ$. Both kyphosis Cobb's angles significantly reduced after the operation. No significant difference in preoperative and postoperative kyphosis Cobb's angles were found between the two different groups (Table 3). The mean time of abscess disappearance was 5.9 ± 1.2 months in group A, which was significantly longer than that of group B (5.0 ± 0.9 months). The mean time of bone graft fusion in group A was 6.7 ± 0.8 months, and mean time of bone graft fusion in group B was 6.4 ± 0.7 months. No significant difference in the time of bone graft fusion existed between the two different groups. (Table 2).

Discussion

Lumbar is the only bony structure in the human body that connects the thorax to the pelvis and plays a crucial role in various physical activities as it bears most of the bodyweight. With the aid of discs' elastic function, lumbar can effectively buffer shock transmitted from the lower limbs, which prevents neural tissue injury in the spinal canal from sudden trauma. Inconspicuous manifestations can delay the diagnosis of lower lumbar TB; therefore, an effective surgery can shorten the duration of anti-TB drug treatment, fasten the patients' rehabilitation and reduce the occurrence of anti-TB drug resistance [5].

In this respect, most patients with lower lumbar TB can also be cured *via* regular anti-TB drug chemotherapy; however, surgical intervention is mandatory in critical cases. Several surgical approaches are implemented for the treatment of lower lumbar TB, such as, single anterior approach for STB which was first reported by Hodgson in Hong Kong in the 1960s [6]. Radical lesion debridement and anterior spine column construction are easily obtainable using a single anterior approach. With the introduction of pedicle screw fixation, many scholars reported stability to be an essential part of STB healing.

Wang et al. [7] reported that STB patients who underwent only posterior instrumentation and posterolateral fusion without anterior debridement could obtain lesion healing and solid bony fusion without TB recurrence during a mean follow-up of 68.8 months. Zhang et al. [8] suggested that spinal stability should be prioritized as TB lesion could not be radically eliminated at the microbiological level. Qian et al. [9] compared the clinical outcomes between the patients who underwent the procedure of radical debridement, bone graft, instrumentation, and the patients who underwent the procedure of isolated posterior instrumentation without debridement. No significant differences of VAS, kyphotic angle and neurological function improvement were observed between the two groups.

Despite such evidence, most experts deemed that radical debridement played a decisive role in the treatment of STB. Jin et al. [10] studied 289 patients who underwent complete debridement, interbody

fusion anterior, or posterior fixation. They reported that debridement should not only include pus, caseous necrotic tissue and pathological granular tissue but also include the sclerotic bone and bony bridges adjacent to the lesions because these tissues possibly prevented anti-TB drugs from entering the unhealthy bony tissues. Wang et al. [11] found that except for kyphotic deformity correction, single anterior debridement, interbody fusion, and fixation were useful for some cases of STB. Huang et al. [12] found that one-stage surgical management of anterior lesion removal, bone grafting, posterior instrumentation and fusion were effective for children with STB. Liang et al. [13] found that chemotherapy for an average duration of 4.5 months was effective for STB patients who underwent a combined posterior and anterior approach of posterior infixation (including fixation of the affected vertebrae) including anterior debridement and interbody fusion. Nevertheless, some experts consider such an approach as time-consuming [14, 15].

Postoperative debridement was first reported by a Chinese orthopedic pioneer Fang Xianzhi in the 1950s [16]. Yusof et al. [17] reported that the proportion of posterior column involvement in spinal TB was highly underestimated, and therefore, lots of patients were suitable for posterior surgery. Zhou et al. [18] reported that one-stage posterior surgery coordinated with continuous local chemotherapy and postural drainage were useful for lumbar STB. Pang et al. [19] indicated that the clinical results of one-stage posterior transforaminal lumbar debridement, 360° interbody fusion, and posterior instrumentation were favorable for STB in lower lumbar and lumbosacral junction. Few studies also compared the clinical results of a single posterior approach with a combined posterior-anterior approach for the patients of lumbar STB. Wang et al. [20] compared the clinical results of lumbar STB utilizing a single posterior approach with a combined posterior and anterior approach.

Although both approaches provided excellent clinical results for thoracic and lumbar STB, a single posterior approach demanded the less operation time (blood loss), hospitalization duration and obtained superior kyphotic deformity correction. According to results, the single posterior approach provided a reasonable ESR, CRP, VAS, JOA score and kyphosis Cobb's correction but at the expense of prolonged abscess disappearance and time return to regular activity as opposed combined posterior-anterior approach (less operation time and blood loss). No significant differences in surgical complication and cure rate between the single posterior approach and combined posterior-anterior approach were found during the follow-up period of patients. So, we believe that a single posterior approach might be suitable for most cases of lower lumbar STB; however, for the patients with big iliopsoas abscess, the combined posterior-anterior approach might be appropriate due to fast recovery.

Conclusion

Both single posterior approach and combined posterior-anterior approach are effective for the treatment of lower lumbar TB with a high cure rate and low surgical complication rate. Additionally, single posterior approach is less traumatic than the combined posterior-anterior approach, but with a much slower lesion healing and activity recovery.

Abbreviations

Tuberculosis: TB; Mycobacterium TB:MTB; Spinal TB:STB; Functional Spinal Unit:FSU; Erythrocyte Sedimentation Rate:ESR; Body Mass Index:BMI; Visual Analog Scale:VAS; Japanese Orthopaedic Association:JOA

Declarations

Ethics approval and consent to participate

This retrospective study protocol was approved by the Ethics Committee of the Shaanxi Provincial People's Hospital. Each author certifies that all investigations were conducted in conformity with ethical principles. Written informed consent was obtained from all participants.

Consent for publication

All patients signed informed consent forms to publish their personal details in this article.

Availability of data and Materials

The datasets supporting the conclusions of this article are included within the article. The raw data can be requested from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

The work was supported by China Xi'an Science and Technology Projects (2017115SF/YX009(3)). No benefit in any form has been or will be received from a commercial party related directly or indirectly to the subject of this manuscript.

Authors' contributions

WL and YC contributed to the study design and drafting of the manuscript. LG, YZ, DD, YF and JL participated in recruitment, data collection and analysis. All authors read and approved the final manuscript.

Acknowledgements

Not applicable.

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Tables

Table 1: Basic clinical data of patients

	Group A (N=73)	Group B (N=46)	<i>P</i> Value
Gender (male/female)	43/30	28/18	0.850
Age (years)	50.5±8.8	47.5±10.7	0.108
Disease duration (months)	8.4±3.0	7.4±3.7	0.111
BMI (kg/m ²)	22.9±3.1	23.7±3.0	0.145

Table 2: Evaluation indexes Comparison between Group A and Group B

Evaluation indexes	Group A (N=73)	Group B (N=46)	P Value
Operation time (min)	166.0±12.7	256.3±18.3 [□]	0.000
Blood loss (ml)	717.8±90.6	772.8±89.9 [□]	0.000
Time of abscess disappearance (months)	5.9±1.2	5.0±0.9 [□]	0.000
Time return to normal activity	9.3±2.1	6.9±0.9 [□]	0.000
Time of bone graft fusion (months)	6.7±0.8	6.4±0.7	0.086
Rate of surgical complications (%)	9.59% (7/73)	13.0 % (6/46)	0.599
Cure rate (%)	93.2% (68/73)	97.8% (45/46)	0.856

Data are presented as n (%) or mean ± standard deviation (range)

□: $P < 0.05$, the difference between Group A and Group B was significant

Table 3: Evaluation indexes Comparison between Group A and Group B

Schedule	Group A		Group B	
	Pre-op	Post-op 12 th M	Pre-op	Post-op 12 th M
ESR (mm/h)	59.8±9.1	11.6±2.6*	62.9±12.9	11.0±1.9*
CRP (mg/L)	56.2±19.4	3.9±0.7*	61.7±27.9	4.0±0.8*
VAS	4.8±1.2	1.7±0.6*	5.1±0.7	1.6±0.7*
JOA	18.8±1.8	24.3±1.4*	18.3±1.9	24.7±1.7*
Kyphosis angle (°)	24.7±7.8	9.0±3.0*	23.9°±8.4°	8.3±2.6*

Pre-op: pre-operation, Post-op: post-operation.

□: $P < 0.05$, compared with pre-op indexes

Figures

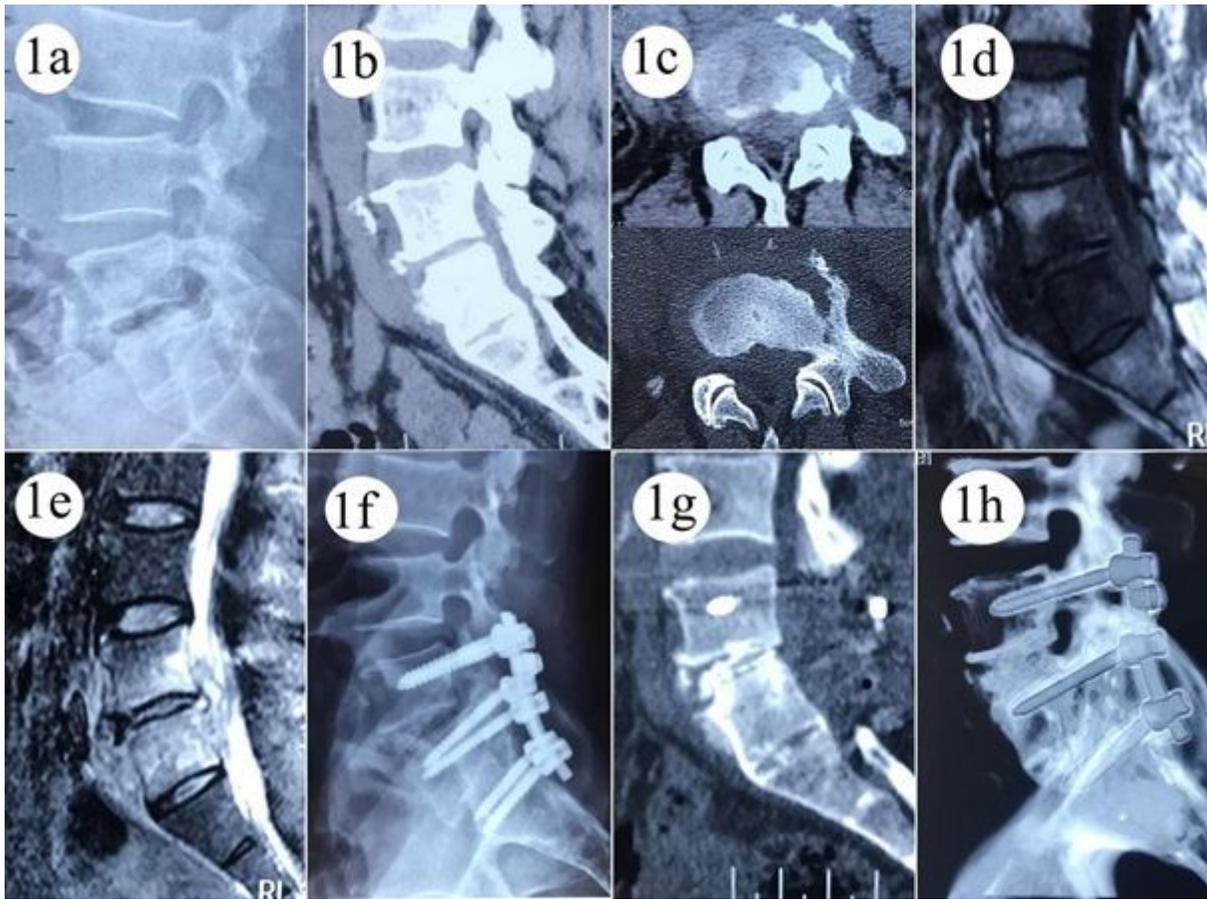


Figure 1

56-year-old male patient with L4-5 spinal TB complained of moderate back pain and pain in the lower limb for three months, following which he received single posterior debridement, interbody fusion and pedicle fixation. (1a-1c): Preoperative X-ray and CT images showed the narrowing of intervertebral space and vertebral destruction (1d-1e): Preoperative MRI images showed L4, L5 vertebral body, L4-5 disc low signal in T1WI with high signal in T1W2, prevertebral and canal abscess pus (1f): Postoperative X-ray image seven days after the operation showed the position of pedicle screw fixation (1g-1h): Postoperative CT images 24 months after the operation indicated that solid interbody fusion was obtained.

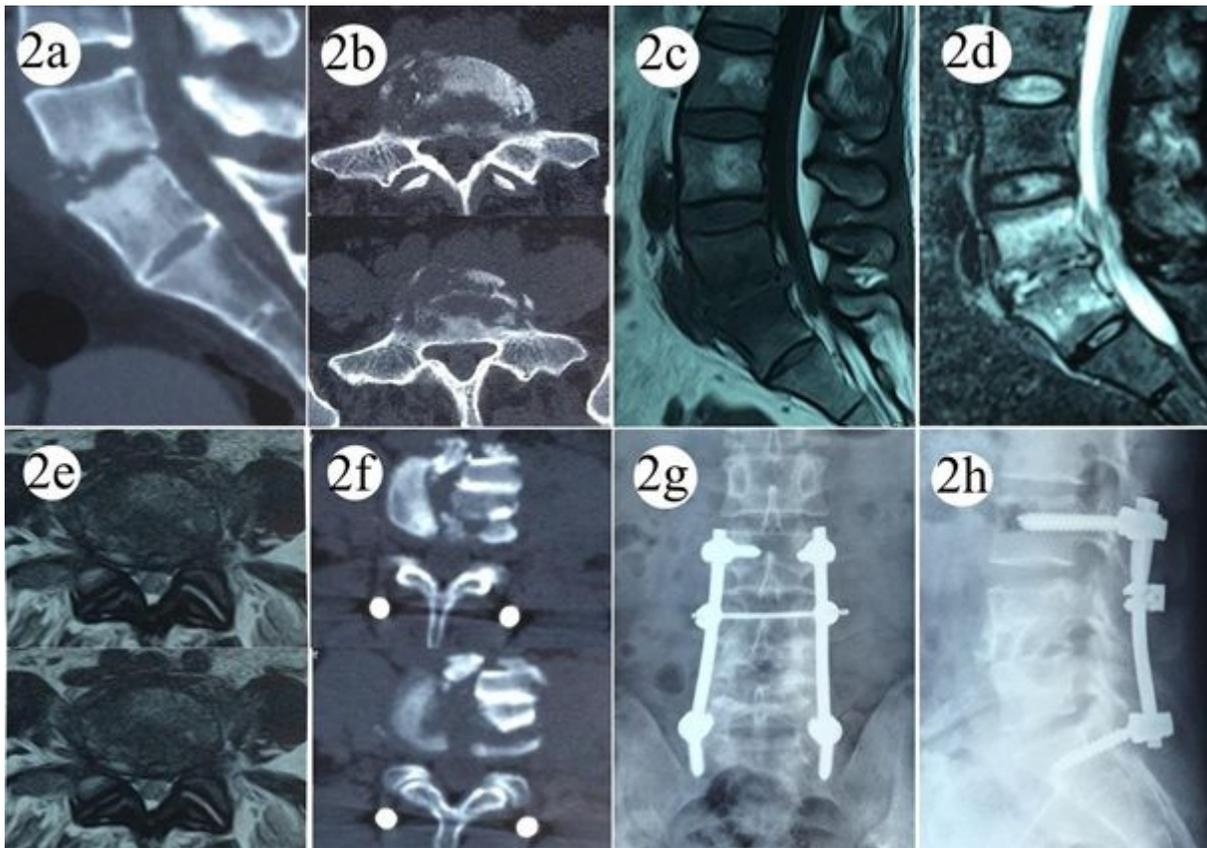


Figure 2

40-year-old female patient with L4-5 spinal TB, who complained moderate low back pain for eight months and received combined posterior pedicle fixation and anterior debridement along with interbody fusion in one stage. (2a–2b): Preoperative images showed vertebral destruction and intervertebral space narrowing (2c–2e): Preoperative MRI images showed L4, L5 vertebral body, L4-5 disc low signal in T1WI with high signal in T1W2, and prevertebral abscess pus (2f): Postoperative image seven days after the operation showed allogeneic iliac from an anterior approach in the intervertebral space (2g–2h): Postoperative X-ray images 24 months after the operation indicated that interbody fusion was achieved.