RESEARCH ARTICLE

Single Posterior Surgery Versus Combined Posterior–Anterior Surgery for Lumbar Tuberculosis Patients

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Objective: Posterior approach of debridement, interbody graft, and instrumentation, and combined posterior–anterior approach of posterior instrumentation and anterior debridement and interbody graft are two essential surgeries for the surgical treatment of spinal tuberculosis (TB), and, until now, which one should be chosen is still controversial. This study aimed to compare the therapeutic efficacy between the single posterior surgery and combined posterior–anterior surgery for lumbar tuberculosis (LTB) patients to elucidate the role of debridement and the effects that result from posterior structure resection.

Methods: One hundred and nineteen LTB patients managed with single posterior debridement, interbody graft, and instrumentation surgery (Group P, 73 cases), or combined posterior–anterior surgery of posterior instrumentation and anterior debridement and interbody graft (Group P-A, 46 cases) from January 2008 to December 2016 were retrospectively analyzed. Different indexes were compared between the two groups to evaluate the curative effect and explore the role of debridement and the effects that result from posterior structure resection: operation time, blood loss, visual analog scale (VAS), Japanese Orthopaedic Association (JOA), Erythrocyte Sedimentation Rate (ESR), C-reactive Protein (CRP), surgical complication type and rate, spinopelvic sagittal parameters (local kyphosis [LK], pelvic incidence [PI] and pelvic tilt [PT], lumbar lordosis [LL], and sacral slope [SS]), drainage retention duration, hospital stay, time of abscess disappearance, time of activity recovery, and time of bone graft fusion by *t*-test or χ^2 test.

Results: The follow-up period ranged from 24 to 60 months. No significant variations were detected between the two groups for age, sex ratio, BMI, disease duration, indication, and the preoperative values of VAS, JOA, ESR, CRP, and LK ($p > 0.05$). The VAS, JOA, ESR, and CRP significantly improved in both groups after the operation ($p < 0.05$), along with the LK and LL ($p < 0.05$). Meanwhile, the SS, PI, and PT showed minor improvement after the operation ($p > 0.05$). Compared to the P-A group, the P group had shorter operation time and less blood loss and hospital stay ($p < 0.05$). However, both groups presented similar VAS, JOA, ESR, CRP, and LK improvements ($p > 0.05$). Additionally, the surgical complication type and rate, postoperative spinopelvic sagittal parameters, and bone graft fusion time did not differ between the two groups ($p > 0.05$). On the other hand, the patients in the P-A group had a shorter time of abscess disappearance and activity recovery ($p < 0.05$) but a similar time of drainage retention ($p > 0.05$) compared to the P group.

Conclusion: Both single posterior and combined posterior–anterior surgeries presented a good therapeutic effect for LTB patients with a low surgical complication rate and good quality of LK correction and LL reconstruction and maintenance. Moreover, single posterior surgery was less traumatic than combined posterior–anterior surgery but with slower TB lesion healing and activity recovery. Compared to debridement, stability seems to be more vital for STB healing, posterior structure resection does not affect the effect of spinopelvic realignment.

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Introduction

Spinal tuberculosis (TB) is a severe infection of the body trunk caused by specific bacteria called *Mycobacterium tuberculosis* (MTB), which frequently affects the lumbar portion of an adult's spine. The lumbar plays a dominant role in weight-bearing function because it connects the thoracic vertebrae to the pelvis. When the lumbar is damaged by MTB infection, various bad symptoms might occur, such as low back pain, unsymmetric radicular pain, and lower limb weakness.[1] Most lumbar TB (LTB) lesions involve one to two functional spinal units (FSU) and can be cured by regular anti-TB drug therapy and some other non-surgical methods, such as rest in bed, plaster vest immobilization, and nutrient supplementation.[2] However, if the TB lesion becomes worse and spinal stability is badly damaged, non-surgical methods might not work.

Surgery is essential for treating spinal TB (STB) patients with apparent cold abscess, neurological impairment, sinus formation, large pieces of sequestrum, spinal instability, or severe kyphotic deformity. Before the operation, 2–4 weeks of standard anti-TB drug treatment is recommended to alleviate the toxic TB symptoms and reduce the possibility of TB dissemination. The goals of surgical STB treatment are: to clear the infectious lesion, decompress the neural tissue, and reconstruct the spine stability.[3] Single posterior surgery is the leading approach for most thoracic and lumbar spinal disorders and is particularly suitable for STB patients with a lesion located at the posterior part of the vertebral column. Moreover, most focal in the anterior column can be cleared with the single posterior approach by laminectomy or transforaminal posterior approach by partial resection of the facet joint.[4] Many studies[5,6] have reported that single posterior surgery leads to good therapeutic outcomes for STB patients.

However, some authors believe that combined posterior–anterior surgery is more suitable for STB treatment because it is more beneficial for radical debridement and safer for fixation.[7] Shen et al.[8] believe that combined posterior–anterior approach surgery of anterior debridement and interbody fusion with posterior pedicle instrumentation is a standard or golden procedure for spinal TB because it is almost suitable for every case, even some complicated ones. However, the combined posterior–anterior approach is too aggressive for the surgical treatment of infectious spinal disease because it is time-consuming, causes more bleeding, and interferes with adjacent tissues and organs.[9] Hence, experts still have a controversy regarding how to properly treat thoracic and lumbar TB.[10]

One of the key steps in the surgical treatment of STB was radical removal of the infectious lesion; however, some experts believed that the infectious focal could not be cleared completely in the cellular level, and they reported that lots of spinal TB patients had received good clinical results though with an incomplete or nondebridement.[11] So, in their opinion, the role of debridement was overstated in the past. Single posterior debridement, interbody graft and instrumentation surgery is a good procedure for most thoracic and lumbar TB cases, however, before carrying out the debridement, the posterior structure should be resected in advance in most instances, and thus would damage the existing stability and potentially lead to some changes of spinal-pelvic parameters.[12] Therefore, this retrospective study aimed to: (i) discuss the role of debridement and its effects on the clinical results in posterior surgery (P) or combined posterior–anterior surgery (P-A) groups; (ii) explore the role of posterior structure resection and their effects on kyphotic correction and spinopelvic parameters changes in the posterior approach surgery.

Methods

From January 2008 to December 2016, 178 consecutive patients who underwent single posterior approach of debridement, interbody graft, and instrumentation surgery (P group) or combined posterior–anterior approach of posterior instrumentation and anterior debridement and interbody graft surgery (P-A group) after being diagnosed with LTB were retrospectively reviewed. Case inclusion criteria were: (i) LTB Cases; (ii) underwent single posterior approach of debridement, interbody graft and instrumentation, or combined posterior–anterior approach of posterior instrumentation and anterior debridement and interbody graft; (iii) vertebral collapse or local instability; (iv) vertebral cavities or sequestrums; (v) complete follow-up data. Case exclusion criteria were: (i) active lung tuberculosis; (ii) lumbar or abdomen surgery history; (iii) contraindication to surgery; (iv) follow-up period <12 years. According to the inclusion and exclusion criteria, 119 patients (71 males and 48 females) were finally analyzed (Figure 1). The average age was 49.3 ± 9.6 years (range: 21–70 years), and the average disease duration was 8.0 ± 3.3 months (range: 3–20 months). This study followed the Helsinki Declaration and was approved by the Ethics Review Committee of Shaanxi Provincial People's Hospital (No. 20210313–01). Informed consent was acquired from every patient. The P and P-A group data are shown in Table 1. The main approach deciding factors (main differences of indication), such as the main lesion location, lesioned segments, paravertebral abscess size, and ratio of neurological deficit, were compared to identify the differences between the two groups (Table 2).

Preoperative Preparation

Standard anti-TB drug treatment was used 2–4 weeks before the operation: Isoniazid (H, 300 mg/day, ivgtt), Rifampicin (R, 450 mg/day, *per os*), Ethambutol (E, 750 mg/day, *per os*),

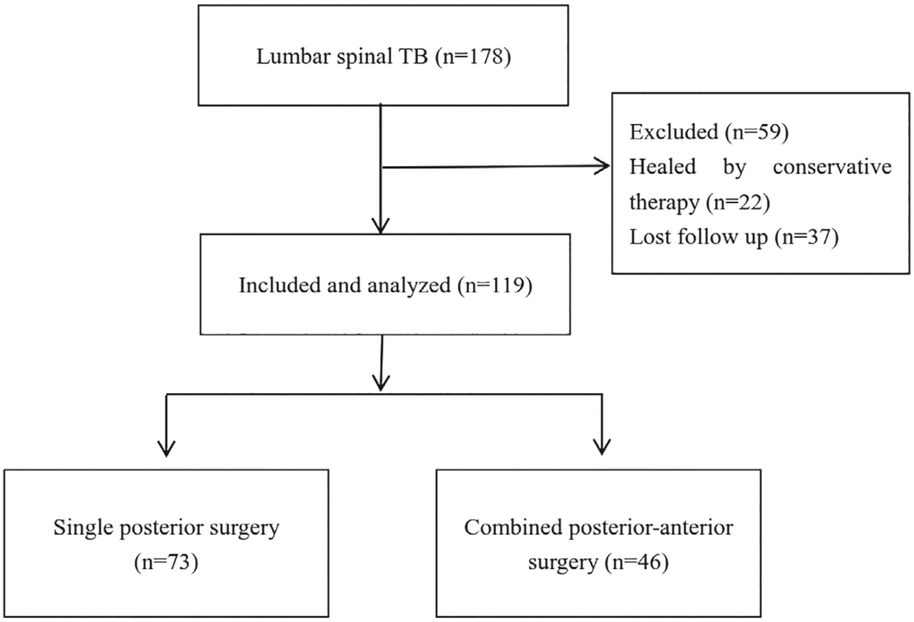

FIGURE 1 Flow chart for patients enrolled

TABLE 1 Basic clinical data of patients

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

Note: *$p < 0.05$, the difference between Group P and Group P-A was significant.

TABLE 2 Indication difference between Group P and Group P-A

Evaluation indexes	Group P ($N = 73$)	Group P-A ($N = 46$)	p Value
Main lesion location (An/Po)	68/5	46/0	0.106
Lesioned segments (n)	1.4 ± 0.5	1.5 ± 0.7	0.330
Paravertebral abscess size (mm)	6.4 ± 4.3	19.2 ± 7.4*	0.000
Ratio of neurological deficit (%)	14/73 (19.2%)	6/46 (13.0%)	0.459

Note: *$p < 0.05$, the difference between Group P and Group P-A was significant.

and Pyrazinamide (Z, 750 mg/day, *per os*). Hemoglobin and albumin values were corrected by blood transfusion and albumin supplement if their levels were lower than 90 and 30 g/L, respectively.

Surgical Methods

Single Posterior Surgery

The median longitudinal incision was adopted, then a multifidus muscle was detached subperiosteally. Pedicle screws were implanted into the normal vertebral body under X-ray guidance when the whole lamina and bilateral facet joints were exposed well. The affected vertebras were also placed with pedicle screws when the affected vertebras were not severely damaged (or not significantly collapsed). Total laminectomies were performed to facilitate intervertebral debridement and prevertebral abscess drainage. Occasionally, partial or total zygapophysial joints or vertebral pedicles were resected for extended debridement and forceful kyphotic correction. The normal FSUs were fixed as little as possible after the guarantee of lumbar stability. Necrotic discs, granulated tissue, and sequestrum were cleared as complete as possible through a posterior paramedian or transforaminal approach. The prevertebral abscess was washed and drained using a catheter. Then, autologous iliac interbody fusion was performed, the drainage tube was put beside the wound, and the incision was closed layer by layer (Figures 2 and 3).

Combined Posterior–Anterior Surgery

The operation was carried out in one stage. First, the pedicle screw placement was implanted, and the detailed process was similar to the single posterior surgery but without canal decompression. Then, focal clearance and interbody fusion were carried out through the anterior approach. The oblique incision was used in the lower abdomen after the lateral position was placed well. External oblique abdominal muscle, internal oblique abdominis, and transversus abdominis muscles were detached until a good view of the retroperitoneal cavity was obtained. To protect the peritoneum and abdominal viscera, the anterior part of the psoas major was gently separated to reach the anterolateral side of the vertebral body. The contralateral prevertebral abscess was washed and sucked using a catheter, then the necrotic discs, tuberculous granulation tissue, and sequestrum were cleared, and the autogenous ilium interbody fusion was implemented. The wound drainage tube was placed beside the incision, and the incision was finally sutured (Figure 4).

Postoperative Care

Cefazolin or cefuroxime (2 g, ivgtt) were prophylactically given 30 min before and within 24 h after the operation (2 g, q12h, ivgtt). If the patients had a fever over 38°C with a distinct elevation of infectious indexes, a higher-level antibiotic, such as Moxifloxacin or Linezolid, was used alone or combined according to the specific condition. The drainage tube was removed if the drainage volume was continuously <20 ml. Rest in bed was suggested for the first postoperative 6–8 weeks, but small amounts of weight-bearing activities protected by thoracolumbosacral bracing were allowed after the drainage removal. Regular anti-TB drug therapy was given for at least 12 months (HRZE 6 months, HRE 6–12 months). The hepatic function was regularly tested and prophylactically protected during the anti-TB drug treatment.

Follow-Ups and Evaluative Indexes

Patients were asked to follow up once every month within the first three postoperative months; once every 3 months within the postoperative 3–12 months; once every 6 months within the postoperative 1–2 years; and once a year from the second postoperative year. The following indicators were compared between the two groups to evaluate their treatment outcomes: operation time, blood loss, drainage retention, hospital stay, visual analog scale (VAS), Japanese Orthopaedic Association (JOA), Erythrocyte Sedimentation Rate (ESR), C-reactive Protein (CRP), surgical complication type and rate, local kyphosis (LK), spinopelvic sagittal parameter [pelvic incidence (PI), pelvic tilt (PT), lumbar lordosis (LL), sacral slope (SS)], time of abscess disappearance, time of backing to normal activity, and time of bone graft fusion were compared between the two groups to evaluate their treatment outcomes.

Statistics

Statistical comparisons were conducted using SPSS version 22.0 statistical software (IBM, USA). Continuous variables were denoted as mean ± standard deviation ($\overline{x} \pm s$) and categorical variables were described as sum and percentage (n, %). The independent sample t-test or χ^2 test was used to compare the indicators between the two groups. A $p < 0.05$ was considered statistically significant.

Results

The P and P-A groups did not differ regarding age, sex ratio, BMI, and disease duration (Table 1). No differences of decision-making indications (lesion location, segments, abscess size, and neurological deficit condition) were detected between the two groups ($p > 0.05$), except the huge paravertebral abscess size ($p < 0.05$; Table 2). All patients had 24–60 follow-up months, with a mean of 28.0 ± 6.5 months. The mean bone graft fusion time did not differ between the two groups (P group: 6.7 ± 0.8 months; and P-A group: 6.4 ± 0.7 months; Table 3).

Symptom Relief and Neurological Recovery Evaluation

The VAS and JOA scores did not differ between the P and P-A groups before operation ($p > 0.05$). Both VAS and JOA

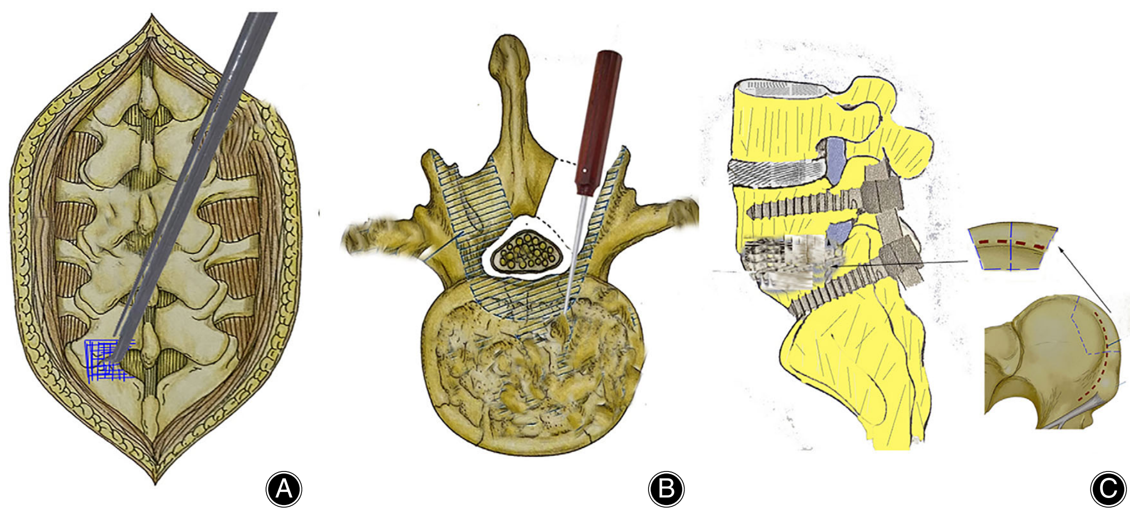

FIGURE 2 (A) Partial or total laminectomy according to the specific location and range of lesion; (B) Debridement through single posterior approach. (C) Posterior interbody fusion and pedicle screw fixation

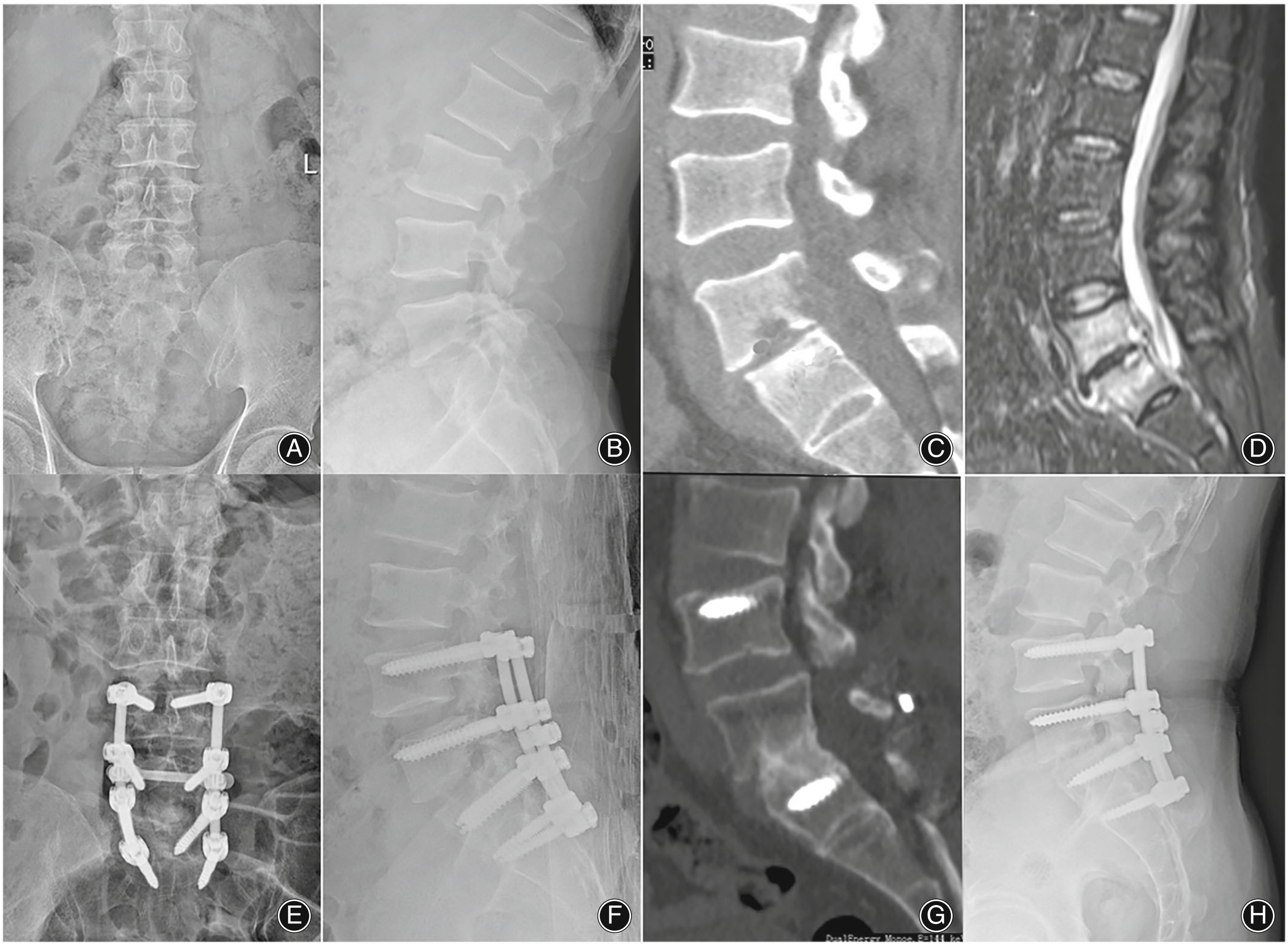

FIGURE 3 A 51-year-old female with L5-S1 lumbar TB complained of moderate low back pain for 6 months and intermittent radiating leg aches for 2 months. She received the single posterior debridement, interbody graft, and instrumentation surgery. (A, B) Preoperative X-ray of A-P and lateral images show mild destruction of the lower endplate of the L5 vertebrae and mild narrow L5-S1 intervertebral interval. (C) Preoperative CT image shows mild osteolytic destruction in the lower endplate and posterior margin of the L5 vertebrae and narrow L5-S1 intervertebral interval. (D) Preoperative MRI image shows the high signal intensity of L5 and S1 vertebrae and the variable signal intensity of L5-S1 intervertebral space in fat suppression sequence. (E, F) X-ray images 7 days after the operation show a good position of pedicle screw fixation. (G) CT image 12 months after the operation confirmed that the bone bridge was obtained. (H) X-ray image 24 months after the operation indicates that lumbar lordosis and height of intervertebral space were not significantly lost

values dramatically improved in the P and P-A groups after the operation ($p < 0.05$). At the 12th postoperative month, the VAS and JOA score differences between the two groups were not significant. Meanwhile, the mean activity recovery time in the P group (9.3 ± 2.1 months) was distinctly longer than in the P-A group (6.9 ± 0.9 months) ($p < 0.05$; Table 4).

Traumatic Evaluation

Patients in the P-A group had longer operation time, more blood loss, and more extended hospital stay compared to the P group ($p < 0.05$). However, the drainage retention time did not differ between the two groups ($p > 0.05$; Tables 3).

Infection Control Evaluation

The ESR and CRP did not differ between the P and P-A groups before operation ($p > 0.05$). Within the first 12 postoperative months, the ESR and CRP values descended to normal in the P and P-A groups. At the 12th postoperative month, the ESR value in the P and P-A groups was 11.6 ± 2.6 mm/h and 11.0 ± 1.9 mm/h, and the CRP value was 3.9 ± 0.7 mg/L and 4.0 ± 0.8 mg/L, respectively. The ESR and CRP differences between the two groups were not

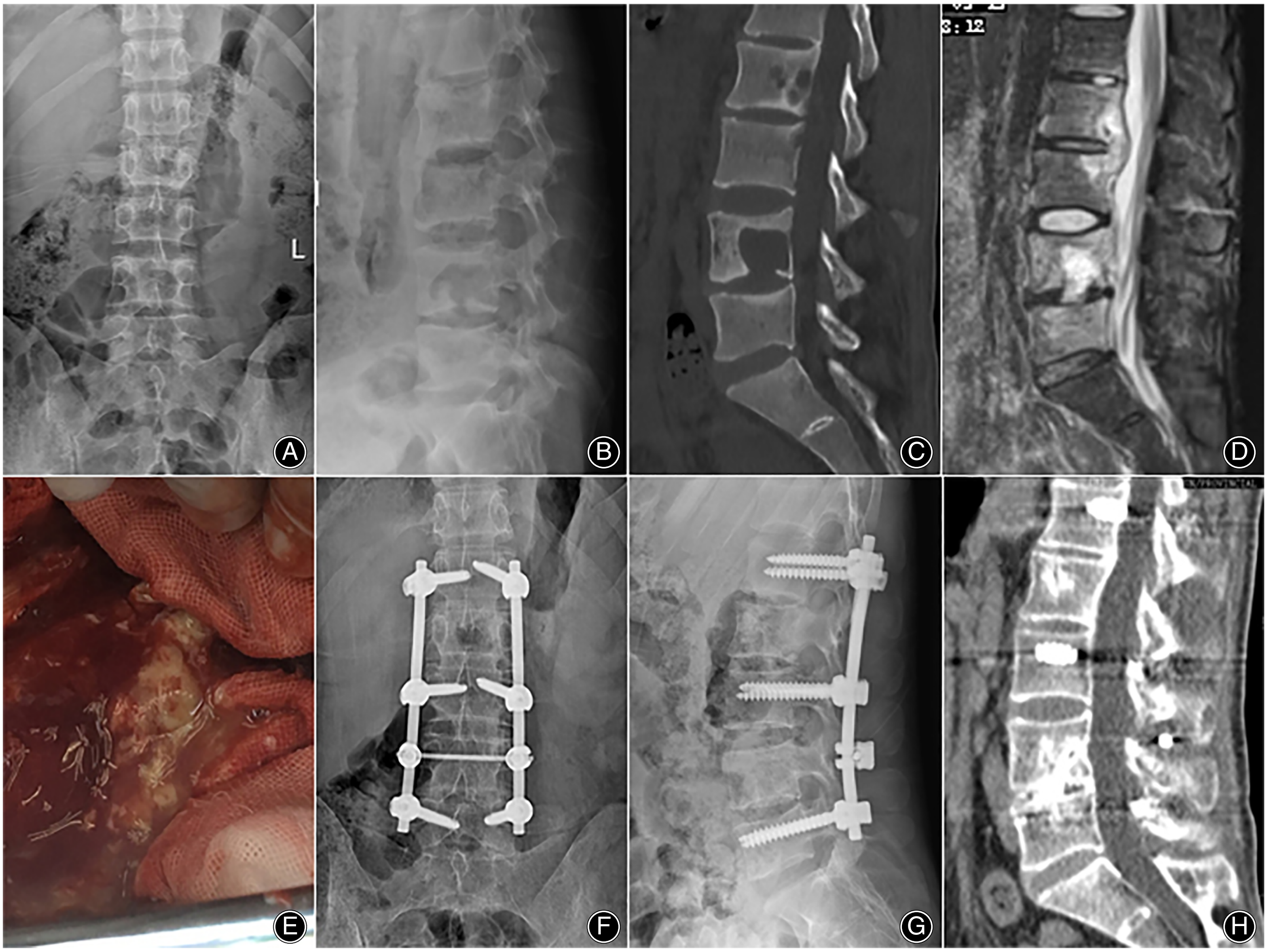

FIGURE 4 A 29-year-old man with L4-5 and L2-3 TB lesions complained of moderate low back pain for 7 months and radiating pain for 1 month. He underwent the combined posterior–anterior surgery of posterior instrumentation and anterior debridement with interbody fusion in one stage. (A, B) Preoperative X-ray shows the narrow L4-5 intervertebral interval. (C) Preoperative CT image shows big osteolytic destruction of the L4 vertebrae, small osteolytic destruction of the L2 and L3 vertebrae, and narrow L4-5 intervertebral interval. (D) Preoperative MRI image shows the high signal intensity of the L2, L3, and L4 vertebrae and variable signal intensity of the L4-5 intervertebral space in the fat-suppression sequence. (E) Intraoperative picture shows caseous tissue in the psoas major and prevertebral region. (F-G) X-ray images 7 days after the operation show a good position of pedicle screw fixation. (H) CT image 24 months after the operation indicates that solid interbody fusion was obtained, and lumbar lordosis and intervertebral space height were not significantly lost

significant ($p > 0.05$). The mean abscess disappearance time from MRI examination was 5.9 ± 1.2 months in the P group, markedly longer than the P-A group (5.0 ± 0.9 months) (Tables 3 and 4).

Spinopelvic Sagittal Alignment Evaluation

The inter-observer and intra-observer ICCs of spinopelvic sagittal parameters are shown (Table 5). The preoperative angles of LK, LL, SS, PI, and PT did not differ between the P and P-A groups. The LK and LL dramatically improved after operation in both groups ($p < 0.05$). However, the SS, PI, and PT did not differ after operation in both groups ($p > 0.05$). Additionally, the correction angle loss of LK was not significant during the12 months of follow-up ($p > 0.05$) (Table 6).

Complication

The complication was 15.1% in group P and 17.4% in group P-A and there was no significant difference of overall complication rate and specific complication rate between the two groups ($p > 0.05$) (Table 7).

Discussion

Main Findings of this Study

This study aimed to compare the therapeutic effects of single posterior and combined posterior–anterior surgeries to treat LTB patients. Our current results indicated that both procedures have similar good symptom amelioration, functional disability improvement, and infectious lesion healing. However, single posterior surgery was less traumatic. We also found that both procedures are safe and have a low risk of complications. Though single posterior surgery had a smaller preoperative paravertebral abscess size, it was slower for lesion healing and activity recovery. Meanwhile, both procedures presented a good and similar quality of LK correction, LL reconstruction, and maintenance of spinopelvic sagittal parameters.

Role of Debridement and its Effects on Clinical Results

Since STB is an infectious spine disease, how to deal with the lesion is the focus of the procedure. In Hong Kong, Hodgson and Stock[13] developed a single anterior procedure in the 1960s. They reported that the single anterior surgery of debridement and interbody fusion was pretty good for most STB cases because the radical lesion clearance and instant

TABLE 3 Evaluation indexes comparison between Group P and Group P-A

Evaluation indexes	Group P (*N* = 73)	Group P-A (*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
Duration of drainage retention (days)	5.5 ± 1.0	5.7 ± 0.9	0.154
Hospital stay (days)	10.0 ± 1.6	12.4 ± 1.7	0.000
Time of abscess disappearance (months)	5.9 ± 1.2	5.0 ± 0.9*	0.000
Time return to normal activity (months)	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

* $p < 0.05$, the difference between Group P and Group P-A was significant.

TABLE 6 Radiological indexes comparison between Group P and Group P-A

Schedule	Group P		Group P-A	
	Pre-op	Post-op 12th M	Pre-op	Post-op 12th M
LK(°)	13.4 ± 5.8	7.6 ± 3.5#	14.1 ± 6.8	7.0 ± 2.9#
LL (°)	31.9 ± 8.1	35.3 ± 4.5#	32.7 ± 7.1	37.0 ± 7.0#
SS (°)	30.2 ± 5.2	31.6 ± 4.8	30.4 ± 4.2	32.0 ± 4.4
PI (°)	39.7 ± 7.2	40.8 ± 7.6	40.4 ± 7.5	41.3 ± 7.1
PT (°)	10.5 ± 2.8	9.8 ± 2.1	10.2 ± 3.4	9.2 ± 2.3

Abbreviations: Pre-op, pre-operation; Post-op, post-operation.; # $p < 0.05$, compared with pre-op indexes.

TABLE 4 Inflammatory and functional indexes comparison between Group P and Group P-A

Schedule	Group P		Group P-A	
	Pre-op	Post-op 12th M	Pre-op	Post-op 12th 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#

Abbreviations: Pre-op, pre-operation; Post-op, post-operation.; # $p < 0.05$, compared with pre-op indexes.

TABLE 5 Reliability assessment for radiological indexes

Variable	Group P		Group P-A	
	inter-observer (ICC)	intra-observer (ICC)	inter-observer (ICC)	intra-observer (ICC)
LK(°)	0.903	0.879	0.867	0.898
LL (°)	0.895	0.913	0.883	0.907
SS (°)	0.879	0.907	0.898	0.887
PI (°)	0.874	0.892	0.893	0.911
PT (°)	0.878	0.898	0.886	0.905

TABLE 7 Complication comparison between Group P and Group P-A

Evaluation indexes	Group P ($N = 73$)	Group P-A ($N = 46$)	p Value
Rate of surgical complications (%)	15.1% (11/73)	17.4% (8/46)	0.775
Cerebrospinal fluid leakage	1/73	0/46	0.429
Neurological status deterioration	2/73	0/46	0.264
Water-electrolyte imbalance	1/73	2/46	0.327
Intestinal dysfunction	2/73	3/46	0.339
Wound infection	2/73	1/46	0.852
Donor region pain	2/73	2/46	0339
Pseudarthrosis	0/73	0/46	–
Implant subsidence	1/73	0/46	0.429
Break or pullout of screws	0/73	0/46	–

Note: *p < 0.05, the difference between Group P and Group P-A was significant.

anterior basic stability of the vertebral column are easily obtained. Thus, single anterior approach surgery of debridement and interbody fusion had been the golden procedure for STB surgical treatment for a long time. However, the trend had changed since the effectiveness and safety of pedicle screw fixation were confirmed in STB surgical treatment.[14,15] Combined posterior–anterior approach surgery of anterior debridement and interbody fusion with posterior instrumentation gradually became the most widely accepted surgical procedure for STB due to its good exposure of TB lesion, radical debridement of the necrotic disc and bone sequestrum, excellent biomechanical anatomy reconstruction, and safe implantable site.[16,17]

Huang et al.[18] reported 15 STB children who underwent anterior lesion clearance, interbody graft fusion, and posterior pedicle fixation. Since all cases obtained a good curative result during the 12–48 months of follow-up, they believe combined posterior–anterior surgery is feasible and effective for STB surgical treatment. Jin et al.[19] indicated that anterior debridement is the key step for STB healing. The lesion clearance should include not only pus, tissue of caseous necrosis, and peripheral granulation tissue but also the sclerotic bony tissue and bone bridge next to the lesion because the tissues might prevent anti-TB drugs from getting into the pathological bone tissue.

Since the beginning of the 21st century, many scholars have suggested that spine stability is essential for STB healing and should receive more attention because bacterial infections cannot be eradicated through a single surgical method.[20] Lee et al.[21] reported 10 STB patients with less bone destruction or poor medical condition who were successfully treated by posterior decompression, limited debridement, and transpedicular instrumentation with posterolateral fusion and chemotherapy. They believe that posterior instrumentation might also be very helpful in suppressing infection at the anterior site. Chen et al.[11] reported 12 STB patients who planned to receive posterior instrumentation combined with two-stage anterior debridement and interbody fusion. However, they could not tolerate the subsequent anterior spinal surgery due to their poor physical condition. Surprisingly, seven patients (58.3%) received good to excellent clinical results after at least 12 months of chemotherapy. Wang et al.[22] reported that, for 51 thoracic and lumbar STB patients who received only posterior instrumentation and short posterior or posterolateral fusion without posterior or anterior clearance of the necrotic tissue, every case achieved bony union without infection relapse within a mean follow-up of 68.8 months. Several authors have reported that the single posterior approach of debridement, interbody fusion, and pedicle fixation led to similar clinical results to combined posterior pedicle fixation and anterior approach of debridement and interbody surgery,[23,24] consistent with our current results. Notably, we also found that, although single posterior surgery was less traumatic than combined posterior–anterior surgery, it presented slower TB lesion healing and activity recovery due to a relative inferior debridement efficacy.

Role of Posterior Structure Resection and their Effects on Kyphotic Correction and Spinopelvic Parameters Changes in the Posterior Approach Surgery

Despite the single posterior procedure advantage of less trauma, many experts did not consider this surgery as their first choice because, for most TB lesions located at the anterior column of the spine, if the debridement was necessary, a certain degree of laminectomy and facetectomy might be unavoidable, which would lead to iatrogenic instability and even spinopelvic sagittal parameter changes.[25] Zhang et al.[26] reported seven children with advanced thoracolumbar STB and kyphotic deformity treated with one-stage posterior decompression, interbody grafts, and posterior instrumentation and fusion, followed by chemotherapy. The average kyphosis of 37.9° pre-operation decreased to 5.4° after the operation, besides presenting good pain relief, neurological improvement, and infection control. Madan et al.[25] showed that posterior decompressions, debridement, and transpedicular screw fixation have good kyphotic correction, pain reduction, and neurological status recovery.

Wang et al.[23] compared the results of single posterior debridement, interbody fusion, and instrumentation with one-stage anterior debridement, interbody fusion, and posterior instrumentation to treat thoracic and lumbar STB. They found that single posterior approach had a weaker kyphotic correction and correction maintenance, attributed to posterior column excision. Zhou et al.[27] compared the clinical efficacy of single posterior debridement, bone grafting, and instrumentation with single-stage anterior debridement, bone grafting, and posterior instrumentation to treat adult patients with thoracic and thoracolumbar spinal tuberculosis (TB). They found no significant kyphotic deformity differences between the two groups. Recently, some experts found that spinopelvic sagittal parameters are closely related to low back pain (LBP), which is caused by lumbar disc herniation, spondylolisthesis, scoliosis, and other lumbar disorders.[28,29] Thus, we believe that spinopelvic parameters should not be neglected for radiological results evaluation in the surgical treatment of lumbar STB. Emmanuelle et al.[30] reported that LBP patients had low SS, LL, and PI. Barrey et al.[31] compared the spinopelvic parameters between three lumbar degenerative diseases (25 cases of disc herniation, 32 of degenerative disc disease, and 32 of degenerative spondylolisthesis). They found that the translation of the C7 plumb line, and LL and SS loss were significantly different between the three diseases. Few studies have reported spinopelvic parameters in STB. Herein, we not only studied the lumbopelvic parameters in STB but also compared the differences in spinopelvic parameters between the posterior and combined posterior–anterior procedures. We found that both procedures had an excellent ability of LK correction and LL reconstruction and maintenance. However, we did not observe significant efficacy differences for spinopelvic parameter realignment between posterior procedure and combined posterior–anterior procedure.

The Advantages and Disadvantages of these Two Procedures

The advantages of combined posterior–anterior procedure are as follows: It has a good view of lesion exposure, thus more beneficial for radical debridement, moreover, after abscess drainage and necrotic disc clearance and pathological bone resection, the collapsed anterior column can be rebuilt in a biomechanical satisfactory position. Last but not least, the fixation device is implanted in the sterile place where it is far away from infection site. The drawbacks of combined posterior–anterior procedure are that it is more time-consuming and more traumatic.

The advantage of single posterior procedure are as follows: it has one incision and there are no complicated anatomical structures in the process of lesion exposure except the spinal cord, so the operation time and blood loss are always smaller than the combined posterior–anterior procedure. Moreover, single posterior procedure is more beneficial for spinal cord and nerve root decompression when complicated with epidural abscess. Last but not least, almost every spinal surgeon is familiar with this approach, so it is easy to learn and to be promoted. The drawbacks of single posterior procedure are that it is less effective in the paravertebral debridement and needed to resect some normal posterior anatomical structure.

From our experiences, there is no clear boundary for choosing which of these two techniques, if there is a big paravertebral abscess or flow abscess in the anterior side, we will choose combined posterior–anterior procedure with no doubt, if not, both is OK but single posterior surgery will always be prioritized.

Limitations and Strengths

Herein, we explored the role of debridement and its effects on the clinical results for two approaches and the role of posterior structure resection and its effects on kyphotic correction and spinopelvic parameter changes in the posterior approach surgery. Hence, these results are valuable for surgical STB treatments. However, our current study also has some limitations. For example, this was a retrospective study, lacked a blinded design, the sample size was not big enough, and had a subjective bias for the surgical approach.

Conclusion

Both single posterior and combined posterior–anterior surgeries presented a good therapeutic effect for LTB patients with low surgical complication rates and good quality LK correction and LL reconstruction and maintenance. Additionally, single posterior surgery was less traumatic than combined posterior–anterior surgery but with slower TB lesion healing and activity recovery. Compared to debridement, stability seems be more vital for STB healing, posterior structure resection does not affect the effect of spinopelvic realignment.

Author Contributions

W.W.L and D.D.P contributed to the study design and drafting of the manuscript. Y.Q.C, Q.L.G, and Y.Y.F participated in case recruitment, data collection, and analysis. J. L and Y.C.Z were responsible for funding acquisition.

Ethics Statement

The trial was conducted in accordance with the Declaration of Helsinki. The study was approved by the Ethics Committee of Shaanxi Provincial People's Hospital (No. 20210313–01) and informed consent was taken from all individual participants who accepted surgery.

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