# The treatment experience of chronic suppurative spondylitis of the thoracolumbar spine

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## Abstract

# Background

This study investigated the diagnostic and therapeutic experience, including conservative, endoscopic and surgical methods, of chronic suppurative spondylitis.

# Methods

A total of 39 patients were included in the imageological, laboratory, and pathological examinations. The patients underwent conservative treatment or operation according to their respective conditions. We used erythrocyte sedimentation rate (ESR) and c-reactive proteins (CRP) to evaluate the state of the illness, visual analogue scales (VAS) to assess lower back and lower limb pain, and the oswestry dysfunction index (ODI) to assess the degree of functional disability. All patients were followed up for 12–36 months.

# Results

Two patients were treated conservatively with antibiotics for 6–8 weeks, while 34 patients underwent different open surgeries, including two cases who underwent second stage surgery. Endoscopic surgery was operated on 3 patients under acute inflammatory stage. All patients' body temperature, VAS score, ESR, and CRP decreased significantly ($P < 0.05$). Imaging showed that lesions were stationary and that bone fusion occurred 8–14 months after surgery, with an average of $10.00 \pm 0.92$ months.

# Conclusions

Clinicians should acquire a detailed medical history and evaluate the laboratory and imaging results comprehensively to select an appropriate treatment plan. Treatment, including the choosing of an adequate surgical method, should be based on the purpose of the operation and the patient's general condition.


## Introduction

Suppurative spondylitis, also known as spinal suppurative osteomyelitis, includes vertebral osteomyelitis, discitis, and epidural abscesses [1]. The disease tends to occur in young adults, but recent literature reports that older adults or people with compromised immune systems are also prone to the disease [2].

In general, the cardinal symptoms of suppurative spondylitis are hyperpyrexia, local ache, and nerve-related symptoms. However, once the disease enters the chronic stage, its symptoms become atypical. The chronic disease state is difficult to diagnose early, and it is easily confused with spinal tuberculosis. If misdiagnosed or missed, it can easily lead to spinal deformity, nerve damage, even paralysis [3].

Therefore, early diagnosis and effective treatment plans are crucial for disease rehabilitation. Current clinical treatment of chronic suppurative spondylitis (CSS) is not standardized. The timing of infection resistance, indications for surgery, surgical methods and approach, reliability of bone grafting, a single or staged surgery, use of internal fixation, and development of minimally invasive surgery are all controversial [4]. From April 2016 to April 2019, 39 patients with CSS were treated in our department and the clinical results were satisfactory, as summarized below.

## Patients And Methods

# Inclusion and exclusion criteria

Inclusion criteria: (1) disease course > 3 months; (2) clinical MRI, CT, and X-ray diagnosed as suppurative spondylitis and pathologically confirmed; and (3) informed consent was given and approved by the hospital ethics committee.

Exclusion criteria: (1) children and infants and (2) CSS caused by trauma.

# General information

There were 24 male and 15 female patients ranging from 35 to 82 years, with an average age of 53.35±6.24 years. The lesion sites included 10 cases of thoracic vertebra and 29 cases of lumbar vertebra. The onset temperature was 38.1°C–40.2°C. Laboratory examination showed an increased white blood cell count in 36 cases, while all patients had increased erythrocyte sedimentation rate (ESR, 30–106 mm/h) and c-reactive protein (CRP, 30–125 mg/L). MRIs mainly showed a low T1 signal and high T2 signal for vertebral body and intervertebral discs, which could spread to adjacent vertebral body or intervertebral discs with disease progression. We observed vertebral bone destruction in 34 cases using CT and vertebral collapse in 30 patients using X-ray. This study was approved by the Ethics Committee of our hospital.

# Treatment and methods

34 patients underwent different open surgical methods according to lesion site, age, and systemic conditions, including primary posterior lesion removal plus bone grafting internal fixation, anterior lesion removal plus reconstruction, and anterior lesion removal plus reconstruction plus posterior graft internal fixation. Two patients underwent second stage surgery and two patients underwent a conservative treatment instead of surgery. 3 patients were performed an endoscopic surgery. Based on bacterial cultures and drug sensitivity, we administered intravenous infusion of sensitive antibiotics for 2–4 weeks and continued oral administration of sensitive antibiotics for 4 weeks.

# Evaluation indicators

We identified bacterial cultures and lesion tissues, and excluded tuberculosis using the Xpert MTB/RIF assay, and evaluated suppurative spondylitis activity via regular reexamination of blood routine, ESR, and CRP. We used VAS to assess lower back and lower limb pain. The ODI was used to assess the degree of functional disability. We regularly performed an MRI in patients undergoing conservative treatment to determine the level of vertebral inflammation and abscess size.

# Statistical analysis

Data were analyzed using SPSS 22.0. Measurement data are expressed as mean± standard deviation, repeated measurements were analyzed by one-way ANOVA or paired t-test, and $P < 0.05$ indicated a statistically significant difference.

## Results

# Post-treatment situation

The first operation was successful in all patients. Pain symptoms were significantly relieved and the VAS score decreased from 7.86±1.58 before surgery to 4.84±0.96 seven days after surgery ($P < 0.05$). Body temperature decreased from 39.20±0.82 °C pre-operation to 36.85±0.39 °C seven days post-operation ($P < 0.05$). In open surgery group, wounds underwent primary healing in 32 patients and infection occurred in two cases. While in endoscopic surgery group, wounds underwent primary healing in all cases. Abscesses recurred two weeks after the open operation in one patient, who was treated with secondary posterior debridement and drainage, after which the symptoms disappeared. There were no other complications, such as urinary tract infection, pulmonary infection, or deep venous thrombosis in the lower limbs.

Due to age, we conservatively treated two patients for systemic condition and degree of inflammation with antibiotics for 6–8 weeks. Their body temperature decreased from 38.9 °C before treatment to an average of 36.7 °C after seven days of treatment. The patients' pain symptoms were also significantly reduced and their VAS scores decreased from 8.05 before treatment to 3.96 after seven days of treatment.

# Follow-up

All patients were followed up for 12 to 36 months, with an average of 22.58±5.86 months. None of the 39 patients relapsed during follow-up. Fig1 shows the VAS and ODI scores. VAS and ODI scores decreased significantly over time ($P < 0.05$). During the final follow-up, 32 patients had no pain, 7 had mild pain, and no patients were in intense pain. There were 32 cases of unrestricted lumbar mobility, 7 cases of mildly limited lumbar mobility, and no cases of significantly limited lumbar mobility. Imaging showed stationary lesions and bone fusion occurring 8–14 months after surgery, with an average of 10.00±0.92 months in open surgery group. No patients had sinus tract formation, thoracolumbar kyphosis, internal fixation loosening, or fractures.

# Laboratory examination

All cases in surgery group (open surgery and endoscopic surgery) were diagnosed as suppurative inflammation by postoperative pathology and HE staining showing a large number of inflammatory cells infiltrating the damaged tissue, including neutrophils and monocytes. The bacterial cultures of intraoperative specimens showed positive findings in 35 cases, including 18 cases of Staphylococcus aureus, 9 cases of Escherichia coli, and 8 cases of Staphylococcus epidermidis. All Xpert MTB/RIF assay were negative. Figures 2–5 show four typical cases. Case 1: A 56-year-old man showed vertebral tuberculosis at T9/10 at first instance (PCT, 0.06; CRP, 14.7 mg/L; ESR, 51 mm/h; PPD test, positive; T-spot, negative). We administered anti-tuberculosis treatment (levofloxacin + isoniazid + rifampicin + pyrazinamide + streptomycin) for one week, followed by T9/10 lesion clearance + autogenous ilium bone grafting + posterior internal fixation (Fig2). Case 2: A 70-year-old female suffering from postoperative intractable back pain who could not bend to touch the ground showed no recovery following three months of rehabilitation treatment (Fig3). Case 3: An 80-year-old female patient with chronic suppurative inflammation of the lumbar spine. There was no significant improvement compared with the situation before treatment. Following improved blood culture, sensitive antibiotics were given intravenously for three weeks and an MRI showed complete absorption of the intravertebral abscess and a reduced abnormal vertebral signal range (Fig4). Case 4: A 62-year-old male patient with lumbar disc herniation underwent an endoscopic surgery. After the operation, the patient had persistent low back pain, difficulty urinating and lower limb weakness. MRI showed inflammatory response on the vertebrae. An endoscopic debridement surgery and drainage was performed at the 12th day after the operation and sensitive antibiotic was given to the patient (Fig5).

# Discussion

The pathogenesis of purulent spondylitis is mainly hematogenous infection with posterior trauma and local spread [5]. The main pathogenic bacteria of suppurative spondylitis are S. aureus [6] and E. coli [7], while other rare bacteria include Streptococcus, Pneumococcus, Salmonella, Pseudomonas, and Candida [8, 9].

The pathological features of suppurative spondylitis are primarily the coexistence of bone destruction with bone hyperplasia and sclerosis [10]. Clinically, it can be divided into acute phase, subacute phase, chronic phase and healing phase [3]. CSS is often misdiagnosed and missed due to its insidious condition and atypical symptoms and imaging, which is easily confused with spinal tuberculosis. In this study, 12 patients were diagnosed with spinal tuberculosis via imaging and symptoms before definite etiological diagnosis. They were treated with concurrent diagnostic anti-tuberculosis therapy, and 10 of them were treated effectively. This may be due to anti-tuberculosis treatment drugs containing rifampicin and levofloxacin, which are effective against some gram-positive and negative bacteria. Therefore, using diagnostic anti-tuberculosis treatment as a basis for the differential diagnosis of CSS and spinal tuberculosis should be treated with caution.

In addition to routine imaging and laboratory tests, new laboratory testing methods have been approved in recent years. the Xpert MTB/RIF assays have high diagnostic specificity for tuberculosis and is used as the basis for differential diagnosis discerning CSS and spinal tuberculosis. We have performed Xpert MTB/RIF assays on all samples from our department since June 2012 and the Xpert MTB/RIF assays results are highly consistent with disease test results. In addition, highly sensitive bacteriological detection can detect pathogens and can be used as an important diagnostic criterion. However, currently, this is not widely used due to the high requirements for specimen materials and the high testing costs. Currently, suppurative spondylitis has the following diagnostic criteria: (1) postoperative pathological biopsy; (2) percutaneous puncture biopsy bacterial culture; (3) blood culture (done at least twice); (4) local pain or neurological symptoms; (5) at least one imaging examination (X-ray, CT, MRI, or bone scan); and (6) laboratory tests revealing an acute inflammatory response (CRP > 30 mg/L, ESR > 30 mm/h, T > 38°C).A definite diagnosis must satisfy both (1) and (2), or (5) and at least one of (1), (2), or (3). The disease can be highly suspected if it satisfies both (6) and one of (1), (2), or (5). There is also the possibility of disease detection if (4) and one of (3) or (5) coexist. [11]

If patients have been clearly diagnosed, conservative treatment may be considered for patients with mild poisoning, tolerable pain, mild vertebral destruction, absence of deformity and kyphosis, segmentation stability, intolerance to surgery, and absence of paravertebral abscesses [12, 13]. The use of sensitive antibiotics is one of the main factors affecting treatment. If the efficacy of wide-spectrum antibiotics is poor, it should be adjusted over time and, if necessary, the department responsible for treating infections should be consulted to help adjust antibiotics. Sensitive antibiotics should be used once pathogenic bacteria are identified [14]. Most studies recommend intravenous antibiotics for 6–8 weeks, followed by an oral antibiotic treatment for 6 weeks [15–17]. Other studies show that IV antibiotics can be administered for 4–6 weeks until clinical signs and laboratory examination results return to normal, after which oral antibiotics can be continued for 6 weeks [18]. Later reexamination of CRP and ESR can monitor the developmental direction of the disease. Two patients in this group were treated conservatively: one was an aged patient with many basic diseases and the other had mild symptoms of poisoning and a mild degree of vertebral destruction.

Surgery is still the primary treatment for CSS. Currently, the general principles of surgical treatment are extensive and thorough removal of lesions, and the removal of all infected necrotic tissue or unhealthy bone [19]. Thorough removal of tissue that is vascularized during debridement is the key to successful surgery [20]. The procedure requires opening subchondral blood vessels to facilitate antibiotic delivery. Local instability or deformities caused by lesion destruction or removal need to be orthopedic or stabilized. Emergency decompression should be performed if complete paraplegia occurs. Surgical indications include 1) obtaining a bacteriological diagnosis when a non-open biopsy is unsafe or the result is negative, 2) presence of severe abscess symptoms, such as relaxation fever and sepsis, 3) poor effect of conservative treatment, such as sustained high ESR or no relief of pain, 4) nerve symptoms caused by spinal cord compression, and 5) obvious deformity or vertebral body destruction [21, 22].

One-stage surgery is generally recommended as the optimal operation timing. Some studies show that even if the patient is in acute infection stages but shows nerve compression symptoms, decompression and fixation in one surgical instance can also be performed. The hardware used for all patients is titanium screws and rods or plates, known as safe braking, for patients with ongoing active infections [23]. This material is chosen to deter organisms from colonizing the titanium material biofilm [24]. If the patient exhibits significant pain and spinal deformity, an orthopedic procedure can be performed following effective antibiotic treatment. Second stage surgery is only performed in patients of poor general condition or with inflammation in the acute phase, persistent high fever, or severe symptoms.

The current, primary debate is still the choice of surgical approach. This is mainly because lesions are often located in the anterior column of the spine and the intervertebral disc and vertebral body are the most common infection sites, while the posterior column of the spine is rarely infected. Therefore, anterior surgery is recommended [25]. After extensive anterior debridement, the anterior column of the spine loses its integrity and becomes potentially unstable, especially when multiple segments of the spine are involved. Therefore, surgical reconstruction is necessary to maintain sagittal balance and appropriate anterior column reconstruction methods are selected according to the degree and scope of vertebral body destruction. If lesions only colonize a single vertebral body of the thoracic vertebra, an autogenous bone graft of the ilium is usually sufficient. Nevertheless, the lesion site of the patient is primarily the lumbar vertebra or involves multiple vertebral bodies. Because autogenous bone graft is often difficult to accomplish, a combination of autograft and allograft is required. Further studies show that getting satisfactory operation results using autologous materials is difficult. Therefore, the titanium mesh is the proper choices, especially when the anterior column of patients has the more serious infection [26]. The advantage of this method is not only lower dosages of autologous bone block, but also its outstanding stability, ability to withstand greater pressure, and the simultaneous avoidance of bone resorption in autologous transplantation. Compared with autografts, we saw no postoperative infection or recurrent possibility with titanium mesh, and the bone fusion rate was almost 100% [25, 27]. Despite this, the anterior approach is highly complicated, so avoiding the anterior approach substantially reduces the risk of intraoperative complications. However, the anterior spinal column appears to be most at risk of subsidence. Therefore, some scholars determined the degree of segmental lordosis or kyphosis of the fused segments pre- and post-operatively using an adapted Cobb method. Interestingly, they observed only minor subsidence of 3.4° in instrumented segments, which is less than using a combined anterior and posterior approach with an autologous bone graft or titanium mesh cage and pedicle screw rod fixation [25]. Nevertheless, with long-distance screw-rod fixation alone, kyphotic deformities or preoperative signs of instability may increase the risk of implant failure [28]. The advantage of the posterior approach is that the exposure is low and the wound is small, so this method can clearly shorten the strict postoperative bedrest time [29]. However, due to incomplete debridement, this approach is only suitable for patients with accumulated disc lesions or a small amount of bone damage. In this study, 34 patients underwent surgical treatment, including posterior surgery in 20 cases (with second phase debridement in two cases), anterior and posterior combined surgeries in eight cases, and anterior surgeries in six cases. There were no significant differences in VAS and ODI scores among the three groups. We believe it is very important to choose the appropriate surgical approach according to the degree and extent of vertebral damage and abscess site. Total laminectomy is contraindicated for most patients, as it could accelerate infection and may aggravate spinal deformity in patients, thus leading to aggravated nerve compression. Laminectomy should be performed only in patients with primary epidural abscesses.

With the continuous development of spinal endoscopy and the improvement of the concept of minimally invasive, endoscopic surgery has been widely used in the treatment of lumbar diseases and has obvious advantages in the treatment of spinal infection [30]. This operation is an important complement to the traditional operation method. The puncture approach of endoscopic surgery is safe, which could avoid to damage the stability of the spine. Through the optical fiber video the operator could directly remove lesions and put accurate drainage tube to the focal center. With the most of inflammatory factor, pus, pathogenic bacteria had been removed by the physiological saline flushing during the operation, the intervertebral disc pressure was effectively reduced, and pain was obviously relieved [31]. Endoscopic surgery is suitable for the patients without severe kyphosis and nerve function damage, which is worth popularizing and applying.

# Conclusion

For patients with suspected CSS, clinicians should inquire about medical history in detail and comprehensively evaluate the laboratory and imaging examinations to determine an appropriate treatment plan. All surgical methods have advantages and disadvantages, so the decision should be based on the purpose of the operation and the patient's general condition. In addition, the minimally invasive spine technology with many advances needs to be further promoted.

# Abbreviations

Erythrocyte sedimentation rate (ESR); C-reactive proteins (CRP); Visual analogue scales (VAS); Oswestry dysfunction index (ODI); Chronic suppurative spondylitis (CSS).

# Declarations

**Ethics approval and consent to participate:** This study was approved by the Ethics Committee of Zhongnan Hospital of Wuhan University (2020080K). The need for individual consent was waived by the committee because of the retrospective nature of the study.

**Consent for publication:** Not applicable.

**Availability of data and materials:** The datasets used 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**: CH, LW designed the study and drafted the manuscript; ZD, YX collected the data; XZ, BR analysed the data; LC, WJ, RW provided administrative, technical, and material support; LC supervised the study. All authors have read and approved the manuscript.

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# Figures

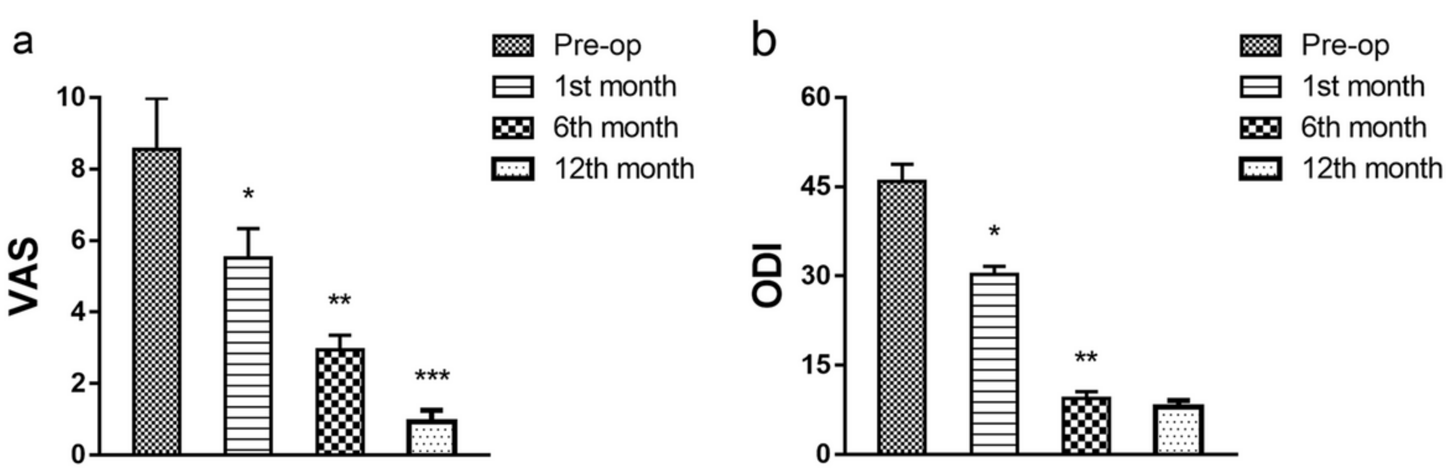



**Figure 1**

The VAS and ODI scores at different time. (a) The VAS scores decreased significantly over time (P < 0.05). (b) The ODI scores were decreased significantly form pre-operation to the 6th month after operation (P < 0.05)

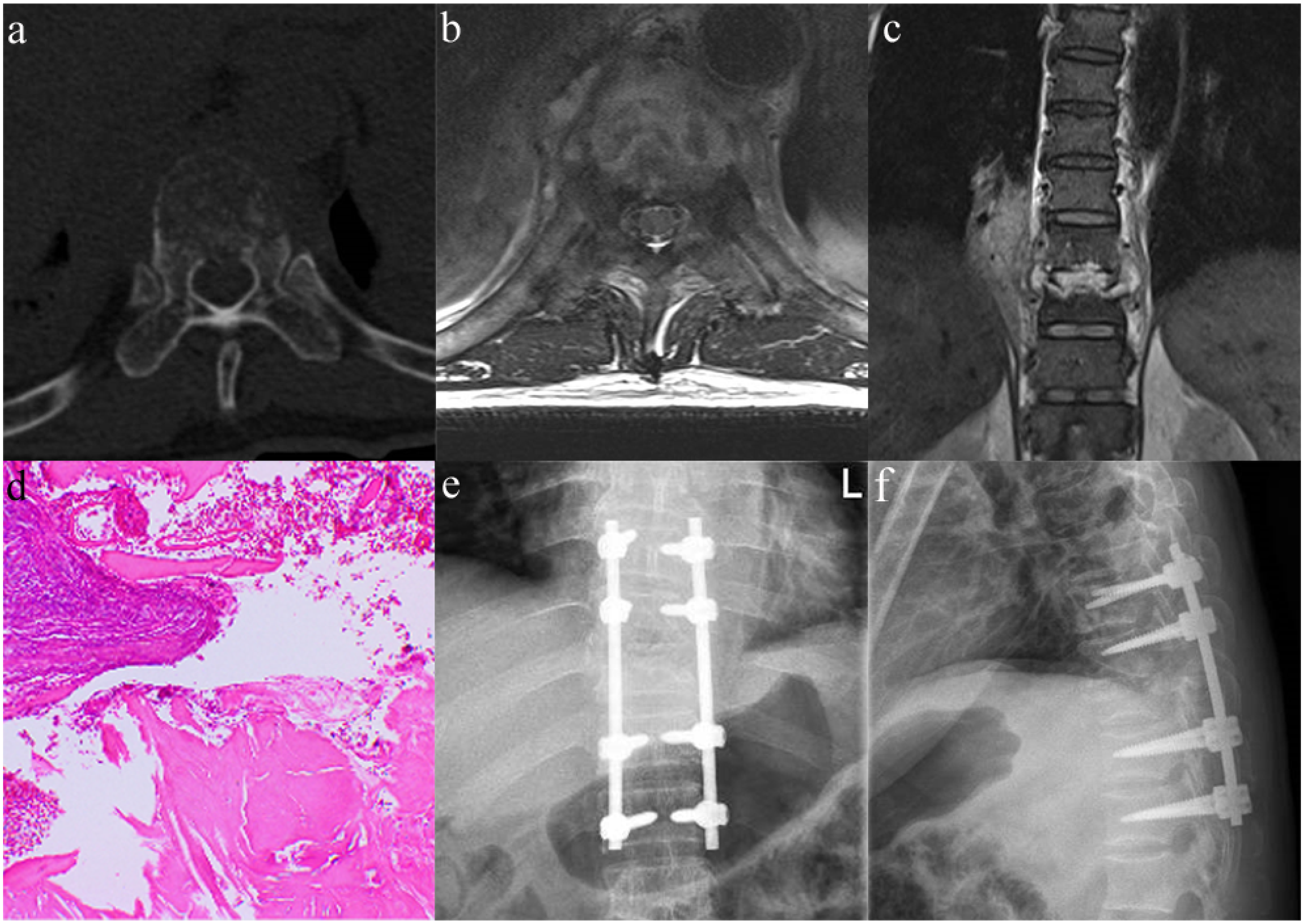
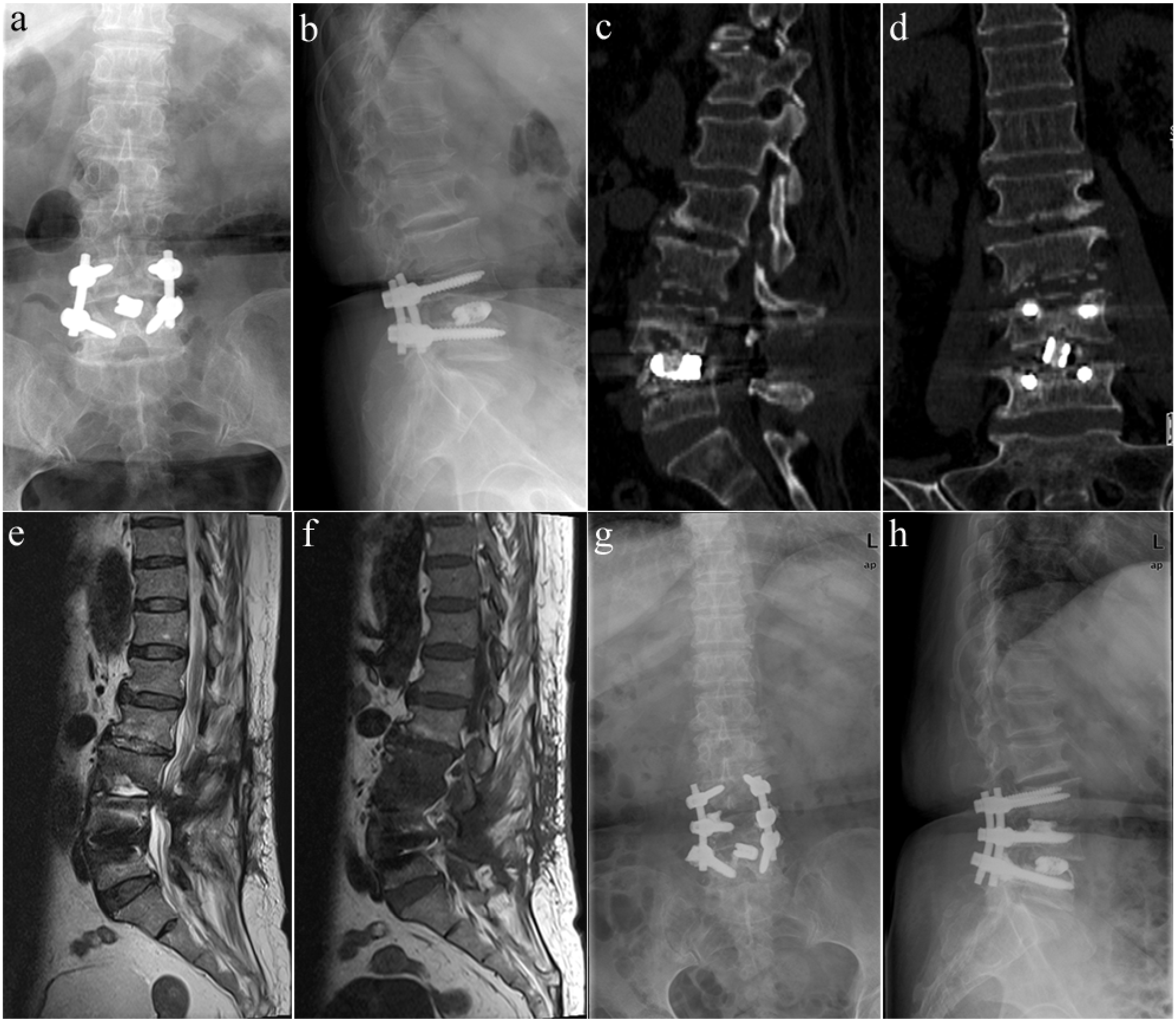



**Figure 2**

(a) CT showing T9/10 vertebral destruction. (b) (c) MRI scan showing an inflammatory reaction and a paravertebral abscess at T9/10. (d) The pathological examination showing chronic suppurative inflammation with abscess formation. (e) (f) The postoperative X-ray.




### Figure 3

(a) (b) L4/5 fusion internal fixation. (c) (d) L3 vertebral destruction three months after surgery. (e) (f) High T1 signals in L3/4 intervertebral discs and low T1 signals in vertebral bodies. (g) (h) Lesion removal and the prolonged internal fixation

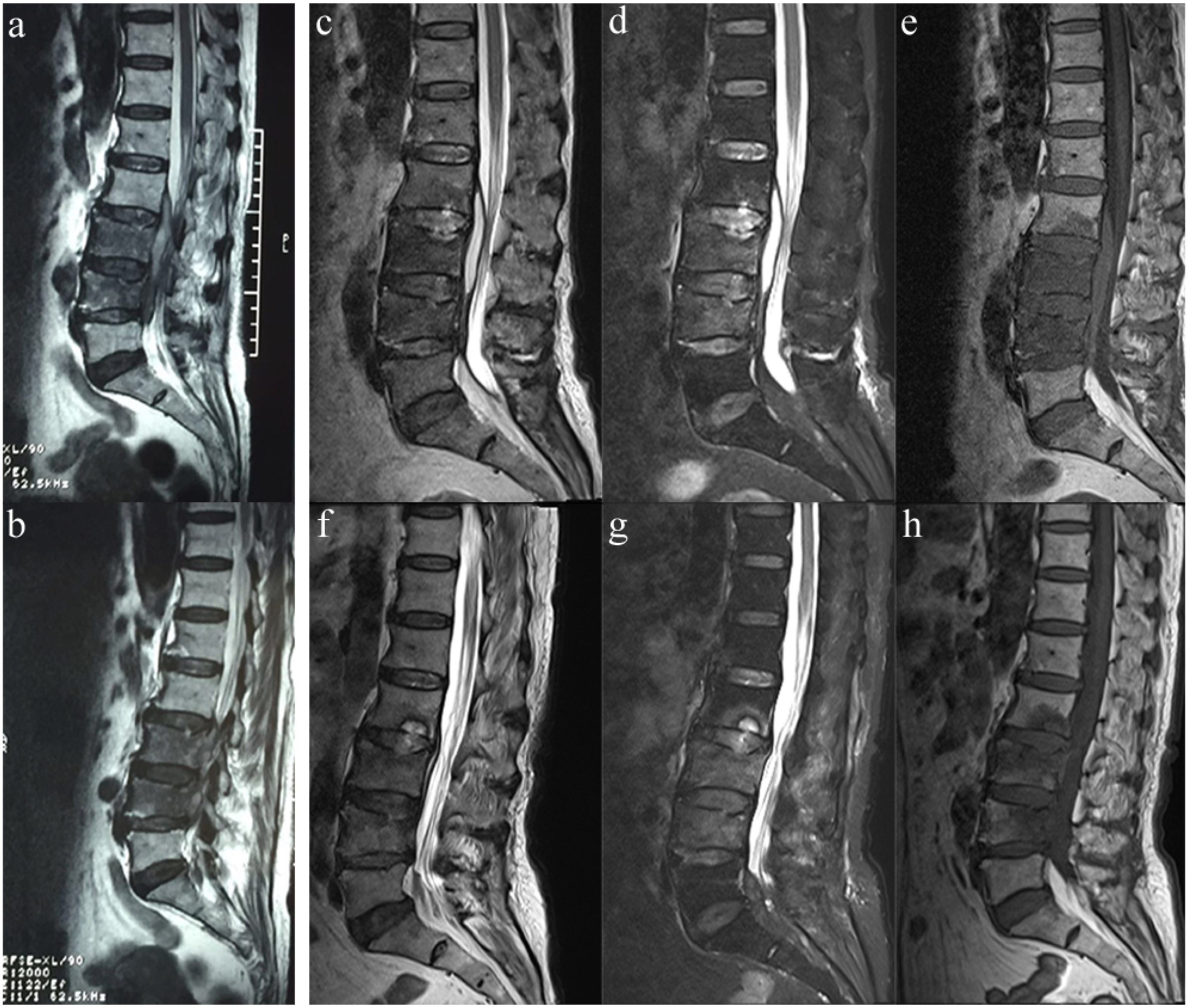



**Figure 4**

(a) (b) Low T1 signals in L3/4 and intravertebral epidural abscesses. (c–e) MRI reexamination after treatment with cefoperazone sodium and sulbactam sodium for seven days. (f–h) MRI showed a reduced abnormal vertebral signal range.

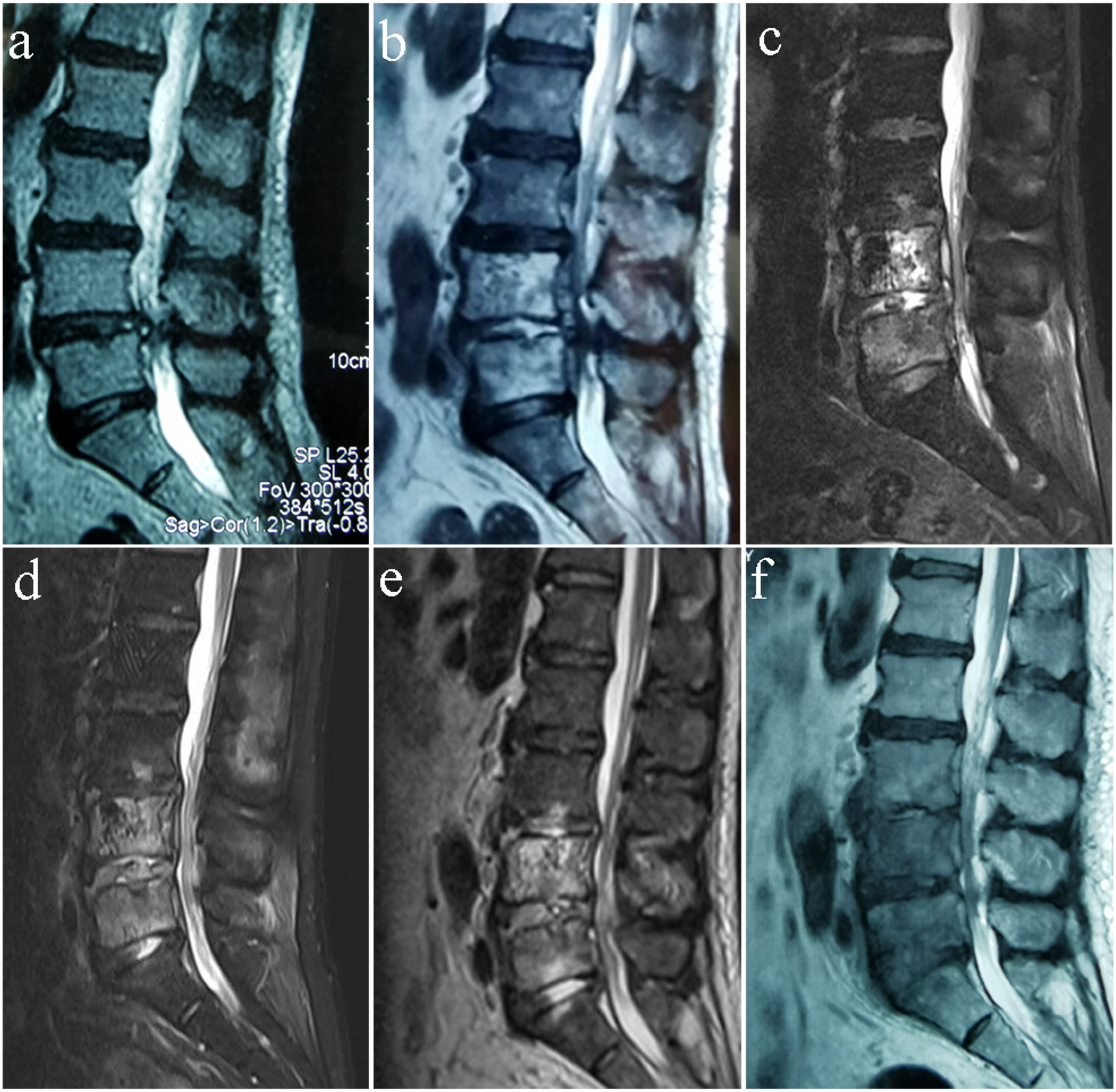



**Figure 5**

(a) (b) The 3rd and 10th day after the operation. (e-f) The 6th, 18th, 26th day and the 5th month after the debridement operation