European Review for Medical and Pharmacological Sciences 2016; 20: 3161-3167

Clinical efficacy of one stage posterior debridement joint graft fixation for lumbar vertebral fractures in spinal tuberculosis patients with compression

W.-Y. YU, C. LOU, F.-J. LIU, D.-W. HE

Department of Orthopaedic Surgery, the Fifth Affiliated Hospital of Wenzhou Medical University, P.R. China

Abstract. – OBJECTIVE: Spinal tuberculosis, though destructive, can be cured in many patients by chemotherapy, though surgery is often necessary for decompression and deformity correction. Our aim of this study was to investigate the clinical efficacy of posterior debridement joint graft fixation therapy for lumbar vertebral fractures in patients with spinal tuberculosis with a compression fracture.

PATIENTS AND METHODS: We prospectively included 48 patients diagnosed with spinal tuberculosis and lumbar compression fracture in our hospital from June 2010 to June 2013. The patients were randomly divided into observation group (n = 27) and control group (n = 21). The patients in the control group underwent an anterior debridement joint bone fixation therapy, whereas, the patients in the observation group underwent one stage posterior debridement joint bone fixation therapy. The patients in the both groups were followed-up for about 2 years and the postoperative complications were recorded and analyzed.

RESULTS: Incision length, operative time and blood loss in patients of the observation group were significantly lower than the control group ($p < 0.05$). The kyphosis Cobb's angle was found to be reduced in a time-dependent manner in both groups, however, patients in the observation group achieved a significant reduction than the control ($p < 0.05$). The ASIA grade of few patients in the observation group significantly ($p < 0.05$) improved to class E from D at the time of the end of follow-up. The patients under the class 'excellent' and 'good' of Kirkaldy-Willis criteria were significantly ($p < 05$) higher in the observation group (92.6%) than the control group (85.7%). Also, the patients in the Bridwell grade I and II in the observation group (88.9%) were significantly ($p < 0.05$) higher in comparison with control group (81%). The prevalence of postoperative complications was significantly lower in the observation group (18.5%) when compared with the control group (28.6%).

CONCLUSIONS: Our results indicate that one-stage posterior debridement joint bone fixation therapy is an effective and safe procedure for patients with spinal tuberculosis and lumbar compression; this method is worthy of clinical application.

Key Words: Posterior debridement, Spinal tuberculosis, Vertebral compression fractures, Kyphosis cobb's angle, ASIA.

Introduction

The incidence (TB) of tuberculosis worldwide are increasing constantly and reached 260 million in the year 2014 with an increase of 12.5% over 2013. Irregular anti-TB medications and non-standardized anti-TB drugs contribute to the increasing incidence of the disease. Extra-pulmonary tuberculosis accounts for 56.8-72.4% of all incidences of musculoskeletal tuberculosis[1]. Early symptoms of atypical spinal tuberculosis combined with radiological lagged progress involving multiple spinal segments and sections associated with compression fractures lead to a severe increase in the difficulty of operation, poor clinical outcome and quality of life of patients, which has become important and requires academic attention[2]. One stage anterior debridement joint bone fixation therapy is being widely used in the clinical setting for the treatment of spinal TB. But this method is time-consuming, needs constant changing of surgery position, causes trauma to tissues such as pleura, peritoneum and, results in the spread of infection and other postoperative complications[3]. The later developed anterior debridement combined with posterior fusion and fixation approach requires longer operating time, causes greater blood loss and more

Corresponding Author: Dengwei He, MD; e-mail: dengweihe430@163.com

postoperative complications[4,5]. There are only few studies that are available on the surgical methods to be adopted for a better clinical outcome in patients with spinal TB with a compression fractures. Hence, we carried out this paper, to investigate and compare the clinical efficacy and feasibility of surgical methods such as posterior debridement joint bone fixation therapy and anterior debridement joint bone fixation therapy for the treatment of spinal TB with compression fracture in order to provide new evidence for clinical treatment using these therapies.

Patients and Methods

Patients

A total of 48 patients with spinal tuberculosis with a lumbar compression fracture were prospectively recruited from our hospital between June 2010 and June 2013. These patients had varying degrees of symptoms including, back pain, sciatica, morning stiffness, fever, reduced muscle strength and kyphosis. The diagnosis was established through laboratory findings such as erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), tuberculosis specific antibody (T-Spot) and through radiological assessments including spinal X-ray, magnetic resonance imaging (MRI) and computed tomography (CT). The patients were excluded from the study if they had 1) traumatic, neoplastic vertebral fractures, 2) spinal TB co-exist with cervical, thoracic tuberculosis and intolerance to conventional anti-TB drugs, 3) previous spinal surgeries, 4) severe organ dysfunction or autoimmune diseases and 5) unwillingness to participate in the study. All the patients were randomly divided into two groups namely, observation group (n = 27) and control group (n = 21).

The observation group consisted of 16 males and 11 females, aged 22 to 63 years with an average of 43.6 ± 5.1 years. The duration of the disease ranged from 10 days to 3 years with an average of 8.6 ± 1.2 months. There were 13 and 14 patients with T12-L1 and L1-L2 vertebral damage respectively. The kyphosis Cobb's angle was found to be 4.5°-27.4° and the average was 12.5 ± 2.8°. The neurological function was evaluated by American Spinal Injury Association (ASIA) impairment scale and according to that, one patient was of A grade, two patients were of grade B, five patients were of C grade, 16 patients were of D grade, and five were of E grade. The control group consisted of 11 males and 10 females, aged 20 to 74 years with an average of 43.9 ± 6.3 years. The duration of the disease ranged from 19 days to 4 years with a mean duration of 8.7 ± 1.1 months. The affected vertebral segments involving the T12-L1 and L1-L2 were found in 10 and 11 patients respectively.

The kyphosis Cobb's angle ranged from 6.5° to 23.5° and the average was 11.5 ± 2.5°. As per the assessment based on ASIA grade, one patient each belonged to A and B grade, three patients belonged to C grade, 12 patients belonged to D grade, and four patients belonged to E grade.

Pre-operative management of patients

Once clinical diagnosis has been made and if surgery was necessary, all the patients were given quadruple anti-tubercular drugs which consisted of isoniazid 0.2 g/day, rifampicin 450 mg/day, pyrazinamide 750 mg/day, and streptomycin 0.75 g/day for a period of 2-4 weeks to restore body temperature (< 37.5°C) and erythrocyte sedimentation rate (< 40-60 mm/h) to normalcy. Once the patients were *Mycobacterium tuberculosis* negative and showed normal levels for tests for anemia, liver and kidney function, electrolytes and hypoproteinemia they underwent surgery.

Operative Procedure

All the control group of patients underwent anterior debridement joint bone fixation therapy as follows. After anesthesia, left or right lateral position was chosen according to the position of the vertebral body. An incision was made in the thoracoabdominal region along the lower edge of the 12th rib. Then, the tissues were peeled off layer by layer to expose the vertebra till vision included a vertebra and the upper and lower vertebrae. Then, the intervertebral nutrient vessels were amputated to expose vertebral lesions. Curette was used to debride the lesion and liposuction, abscess drainage, scraping of sclerotic bone lesions around Banda healthy bone were all performed until there was no infectious debris or pus. With C-arm X-ray, the lesion adjacent of the normal vertebrae was inserted with pedicle screws. Then, a temporary fixation rod was placed on the lighter side of the lesion to evade spinal cord injury during decompression and the kyphosis was slowly corrected. After this, according to the intervertebral height and angle, suitable titanium mesh filled with autologous bone was selected and inserted into the bone to stabilize

vertebral height and lock nail plate (rod) system. Streptomycin 1.0 g and isoniazid 0.2 g were administered locally, and a drainage tube was placed before incisions were sutured.

The observation group patients underwent posterior debridement joint bone fixation therapy and the surgical method was follows: after general anesthesia, the patients were positioned in the prone position. A vertical incision of the back in the middle of the spine was performed and the bilateral facet joints, outer parts of the lamina were exposed. The rest was followed as described for the control patients. After close postoperative observation of changes in patients, anti-inflammatory and anti-tubercular drugs (for 12 to 18 months) were provided to maintain airway patency. The patients were encouraged to stand up and the drainage situation observed (7 to 9 days after drainage < 50 ml/24h times by extubation).

Peri-operative Analyses

The incision length, operative time and blood loss in patients who underwent anterior joint bone fixation therapy (control) or posterior joint bone fixation therapy (observation) were recorded and compared.

Postoperative Analyses

The kyphosis Cobb's angle, ASIA grades, Kirkaldy-Willis grades, Bridwell grades and surgery-associated complications were all evaluated in patients of observation and control group postoperatively and compared.

The neurological function was evaluated according to the American Spinal Injury Association (ASIA) impairment scale ([6]) and the grading of patients was as follows: Grade A (Complete: No sensory or motor function is preserved in the sacral segments S4-S5; Grade B (Sensory incomplete): Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5AND no motor function is preserved more than three levels below the motor level on either side of the body; Grade C (Motor incomplete): Motor function is preserved below the neurological level and more than half of the key muscle functions below the neurological level of injury have a muscle grade less than 3; Grade D (Motor incomplete): Motor function is preserved below the neurological level and at least half of key muscle functions below the neurological level of injury have a muscle grade ≥ 3; Grade E (Normal): If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments and the patient had prior deficits, then the AIS grade is E.

The evaluation of functional outcome (lesions healing) was done following Kirkaldy-Willis improved evaluation criteria[7], where grade 'Excellent' referred to patients who resumed normal work and other activities were mild or unrestricted; grade 'Good' referred to patients who resumed normal work but some other activities were restricted, sometimes complaining of back pain after physical work and were required to rest a few days; grade 'Available' the patient could return to work, mild, recurrent back pain might occur from time to time causing them to be absent from work and they took rest for 1 to 2 weeks, 1 or 2 times a year.

The fusion of bone was evaluated following Bridwell classification[8], where Grade I: fusion with remodelling and trabeculae present; grade II: intact graft with incomplete remodelling and no lucency present; Grade III: intact graft with potential lucency at the cranial or caudal end; Grade IV: absence of fusion with collapse/resorption of the graft fusion were the criteria for evaluation.

Transplant-related complications recorded during the follow-up were loosening screws, titanium (bar) screw breakage, loose bone graft and fusion, bone block prolapse or collapse.

The study was approved by independent Ethics Committee of our Hospital. The informed consent was obtained from patients or their families.

Statistical Analysis

SPSS18.0 statistical software (SPSS Inc., Chicago, IL, USA) was used to analyze the data. Quantitative data was expressed by average ± standard variation. A *t*-test was used to compare the length of the lesion, operative time and the amount of blood loss between observation and control groups. X^2 test was used to compare the Cobb's angle, ASIA, Kirkaldy-Willis and Bridwell grades of patients of observation and control groups. $p < 0.05$ was regarded as having statistical significance.

Results

Lesion Length, Operative Time and Amount of Blood Loss

The lesion length was shorter and the operative time, amount of blood loss were lower in the

Table I. Peri-operative analysis of lesion length, operative time and blood loss in observation and control group patients.

Group	Lesion length (cm)	Surgery time (min)	Amount of blood loss (ml)
Observation group	7.5±1.2	154.6±22.5	450.2±30.8
Control group	8.6±1.3	203.8±35.7	706.8±45.6
t	2.625	3.572	3.831
p	0.037	0.024	0.021

Table II. Post-operative evaluation of cobb's angle and ASIA grades in patients of observation and control groups.

		After surgery			Follow-up for 2 years		
Group	Patients	Cobb's angle	ASIA D grade	ASIA E grade	Cobb's angle	ASIA D grade	ASIA E grade
Observation group	27	9.6±0.8	8	17	8.4±0.5	5	21
Control group	21	10.7±1.2	9	8	9.3±1.4	8	10
t X2)		4.035	4.125	4.527	4.628		
p		<0.001	<0.001	<0.001	<0.001		

observation group patients (posterior debridement joint bone fixation therapy) in comparison with patients of the control group who had anterior debridement joint bone fixation therapy ($p < 0.05$, Table I).

Patients Follow-up

Kyphosis Cobb's angle and ASIA grades. All the patients were followed up for two years. The kyphosis Cobb's angle after surgery and at the end of follow-up were found to be significantly lower in the observation group patients than the control group patients ($p < 0.05$). After surgery, patients in the observation group who improved by one grade (ASIA D to ASIA E) were significantly higher in comparison with control group ($p < 0.05$). Also, at the end of follow-up, the number of patients improved by one grade (ASIA D to ASIA E) were higher in observation group than control group ($p < 0.05$, Table II, Figures 1, 2 and 3).

Figure 1. Preoperative magnetic resonance imaging (MRI) of a patient with tuberculosis in the lumbar spine: bone erosion and destruction in intervertebral space in L3-L5; stenosis and abscess in L4 and L5.

Figure 2. Postoperative magnetic resonance image analysis of patient showing interbody fusion with bone graft and defect of the spine reconstructed.

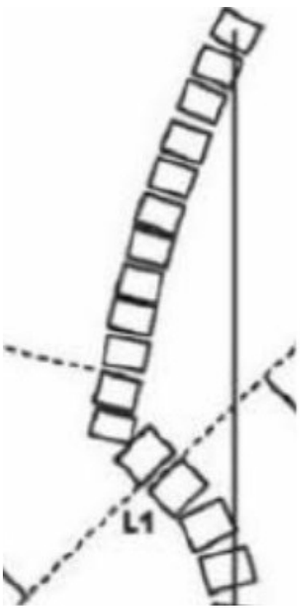

Figure 3. The kyphosis Cobb's angle.

Bone Fusion, Functional Outcome and Transplant-associated Postoperative Complications

The number of patients in the observation group who healed with Kirkaldy-Willis 'excellent' and 'good' together were significantly higher (92.6%) compared to control group (85.7%, $p < 0.05$). Also, the number of patients with Bridwell grades I and II were higher (88.9%) in the observation group than the patients in the control group (81%) with significant difference ($p < 0.05$, Table III).

Discussion

Early clinical symptoms of spinal tuberculosis and radiological findings are atypical, leading to a high rate of misdiagnosis, and the condition needs to be further improved. Meanwhile, spinal tuberculosis can lead to osteoporosis fracture, destruction, empty, abscesses; inflammation as a result of vertebral compression fractures that also increase the complexity of the operation, resulting in poor prognosis and increase in postoperative complications[9,10]. Conventional treatment alone cannot yield satisfactory results while surgery can relieve spinal cord compression in varying degrees, correct spinal deformity and improve neurological function in patients[7]. The ultimate goals of surgery are, to completely remove the lesion, to restore vertebral height and curvature of the spine, stability and reconstruction. Preoperative administration of anti-TB drugs followed by surgery is a promising approach while surgery alone without regular anti-TB chemotherapy has a higher risk of recurrence and the clinical outcome is often poor[11,12].

Since the 1960s after Stock and Hodgson[13] treated spinal tuberculosis patients by the removal of the lesion and an anterior interbody fusion surgical treatment, the latter is widely regarded as the "gold standard". With the constant summing up of clinical practice, it is found that the shortcomings of the surgical approach include surgeon with expertise, trauma, bleeding volume; support forces graft often unsatisfactory, kyphosis not fully corrected, frequent bone block absorbed, collapse and breakup of the case resulting in kyphosis worse again and sometimes displacement of nerve graft[14-16]. In recent years, one stage posterior debridement combined with bone graft and internal fixation resulted in a rapid development and the procedure has the following advantages[17-19]: 1) Lesser trauma, single incision, excision of lesions successfully completed in a period, bone implant and reconstruction of spinal stability; 2) surgical procedures without changing the patient's position and easy examination of spinal fractures with fewer complications during correction; 3) a single incision helpful in cleaning up of lesions along both sides with internal fixation

Table III. Post-operative evaluation of bone fusion, functional outcome and transplant associated complications

		Kirkaldy-Willis standard		Bridwell grades		
Group	Patients	Excellent	Good	I	II	Complications n (%)
Observaction group	27	16	9	14	10	5 (18.5)
Control group	21	8	10	8	9	6 (28.6)
X^2		5.221	4.568	5.426		
16=1p		< 0.001	<0.001	<0.001		

removal more convenient and safe; 4) fixed pedicle with effective restoration of the physiological curvature of the spine, thus reducing the loosening of fixation and fracture phenomena; 5) short operative time, shorter hospitalization period which resulted in a great reduction of the financial burden of patients.

The other factor is that the lumbar has a broad range of motion with spinal region having a high stress and since it is a three-column uneven force, once spinal tuberculosis occurs, it easily leads to a kyphosis and a nerve damage, and posterior spine after surgery will destroy the column, resulting in decreased stability of the spine. Nowadays, it is still controversial whether clearing by a posterior interbody fusion method of lesion fixation for treatment is suitable or not[20-22]. The present study thus comparatively analyzed the efficacy of posterior and anterior debridement bone joint fixation therapy for spinal tuberculosis with a vertebral compression fracture and concluded as follows. The incision length, operative time and blood loss in patients in the observation group with one stage posterior debridement joint bone fixation therapy were significantly lower than the control group. The Cobb's angle of patients in the observation group at the end of follow-up was significantly lower than the control group. The patients in the observation group at the end of follow-up showed significant improvements in their neurological function, bone fusion and lesion healing when compared with control group patients. Also, the prevalence of postoperative complications was significantly lower than the control group. But, there are also some shortcomings and deficiencies associated with one stage posterior debridement joint bone fixation therapy. They include i) surgery has a narrow field of vision ii) the surgical site revealed is limited and iii) the necrotic tissue cannot be removed under direct vision. Therefore, it is a big difficulty to thoroughly eliminate the focus[23-25].

Conclusions

Compared to the anterior debridement joint bone fixation therapy, one-stage posterior debridement joint bone fixation therapy for the treatment of patients with spinal tuberculosis with a compression fracture is better in improving the patients' clinical outcome being associated with a reduced postoperative complications and it is worthy of clinical popularization and application.

Acknowledgements

This study was supported by the Science and Technology Project of Lishui,Zhejiang Province.Project title:Study on correlation between intervertebral disc and/or posterior ligament injury and delayed traumatic kyphosis after thoracolumbar fracture surgery.Project Number :2014JYZB25.

Conflict of Interest

The Authors declare that they have no conflict of interests.

References

1) Rasouli MR, Mirkoohi M, Vaccaro AR, Yarandi KK, Rahimi-Movaghar V. Spinal tuberculosis: diagnosis and management. Asian Spine J 2012; 6: 294-308.
2) Gehlot PS, Chaturvedi S, Kashyap R, Singh V. Pott's spine: retrospective analysis of MRI scans of 70 Cases. J Clin Diagn Res 2012; 6: 1534-1538.
3) Huang QS, Zheng C, Hu Y, Yin X, Xu H, Zhang G, Wang Q. One-stage surgical management for children with spinal tuberculosis by anterior decompression and posterior instrumentation. Int Orthop 2009; 33:1385-1390.
4) Klockner C and Valencia R. Sagittal alignment after anterior debridement and fusion with or without additional posterior instrumentation in the treatment of pyogenic and tuberculous spondylodiscitis. Spine 2003; 28: 1036-1042.
5) Yau AC, Hsu LC, O'Brien JP, Hodgson AR. Tuberculous kyphosis: correction with spinal osteotomy, halo pelvic distraction, and anterior and posterior fusion. J Bone Joint Surg A 1974; 56: 1419-1434.
6) Sundararaj GD, Amritanand R, Venkatesh K, Arockiaraj J. The use of titanium mesh cages in the reconstruction of anterior column defects in active spinal infections: can we rest the crest? Asian Spine 2011; J 5: 155-161.
7) Zhang HQ, Lin MZ, Shen KY, Ge L, Li JS, Tang MX, Wu JH, Liu JY. Surgical management for multilevel noncontiguous thoracic spinal tuberculosis by single-stage posterior transforaminal thoracic debridement, limited decompression, interbody fusion, and posterior instrumentation (modified TTIF). Arch Orthop Trauma Surg 2012; 132: 751-757.
8) Jain AK, Dhammi IK, Jain S, Kumar J. Simultaneously anterior decompression and posterior instrumentation by extrapleural retroperitoneal approach in thoracolumbar lesions. Indian J Orthop 2010; 44: 409-416.
9) Jain AK, Jain S. Instrumented stabilization in spinal tuberculosis. Int Orthop 2012; 36: 285-292.
10) Walter J, Kuhn SA, Reichart R, Kalff R, Ewald C. PEEK cages as a potential alternative in the treatment of cervical spondylodiscitis: a preliminary report on a patient series. Eur Spine J 2010; 19: 1004-1009.

11) He Q, Xu J. Comparison between the anteroposterior and anterior approaches for treating L5-S1 vertebral tuberculosis. Int Orthop 2012; 36: 345-351.

12) Ma YZ, Cui X, Li HW, Chen X, Cai XJ, Bai YB Outcomes of anterior and posterior instrumentation under different surgical procedures for treating thoracic and lumbar spinal tuberculosis in adults. Int Orthop 2012; 36: 299-305.

13) Zaveri GR, Mehte SS. Surgical treatment of lumbar tuberculous spondylodiscitis by transforaminal lumbar interbody fusion (TLIF) and posterior instrumentation. J Spinal Disord Tech 2009; 22: 257-262.

14) Zhang HQ, Wang YX, Guo CF, Zhao D, Deng A, Wu JH, Liu JY. One-stage posterior focus debridement, fusion, and instrumentation in the surgical treatment of cervicothoracic spinal tuberculosis with kyphosis in children: a preliminary report. Childs Nerv Syst 2011; 27: 735-742.

15) Brown DB, Gilulal A, Manu S, Shimony JS. Treatment of chronic symptomatic vertebral compression fractures with pereutaneousvertebroplasty. AJR 2004; 182: 319-322.

16) World Health Organization. Global tuberculosis control: WHO report 2010 [EB]. http://www.who.int/tb/publications/global_report/en/.

17) Global tuberculosis control: WHO report 2011. Geneva: World Health Organization, 2011.

18) Pu X, Zhou Q, He Q, Dai F, Xu J, Zhang Z, Branko K. A posterior versus anterior surgical approach in combination with debridement, interbody autografting and instrumentation for thoracic and lumbar tuberculosis. Int Orthop 2012; 36: 307-313.

19) Wang B, Lv G, Liu W, Cheng I. Anterior radical debridement and reconstruction using titanium mesh cage for the surgical treatment of thoracic and thoracolumbar spinal tuberculosis: minimum five-year follow-up. Turk Neurosurg 2011; 21: 575-581.

20) He Q and Xu J. Transpedicular closing wedge osteotomy in the treatment of thoracic and lumbar kyphotic deformity with different etiologies. Eur J Orthop Surg Traumatol 2013; 23: 863-871.

21) Garg B, Kandwal P, Nagaraja UB, Goswami A, Jayaswal A. Anterior versus posterior procedure for surgical treatment of thoracolumbar tuberculosis: A retrospective analysis. Indian J Orthop 2012; 46: 165-170.

22) Yang P, He X, Li H, Zang Q, Yang B. Clinical efficacy of posterior versus anterior instrumentation for the treatment of spinal tuberculosis in adults: a meta-analysis. J Orthop Surg Res 2014; 9: 10.

23) Sun L, Song Y, Liu L, Gong Q, Zhou C. One-stage posterior surgical treatment for lumbosacral tuberculosis with major vertebral body loss and kyphosis. Orthopedics 2013; 36: e1082-1090.

24) Zhang HQ, Lin MZ, Li JS, Tang MX, Guo CF, Wu JH, Liu JY. One-stage posterior debridement, transforaminal lumbar interbody fusion and instrumentation in treatment of lumbar spinal tuberculosis: a retrospective case series. Arch Orthop Trauma Surg 2013; 133: 333-341.

25) Zhang H, Sheng B, Tang M, Guo C, Liu S, Huang S, Gao Q, Liu J, Wu J. One-stage surgical treatment for upper thoracic spinal tuberculosis by internal fixation, debridement, and combined interbody and posterior fusion via posterior-only approach.