Int J Clin Exp Med 2017;10(5):8118-8124
www.ijcem.com /ISSN:1940-5901/IJCEM0043181

Original Article

One-stage debridement of lumbosacral junction tuberculosis through unilateral musculussacrospinalis iliac bone flap reserving posterior ligamentous complex

Yuekui Jian, Hongying Fu, Zhuojia Zhou, Xinglin Wu, Zhiqian Wang, Bo Li

Department of Orthopedics, Guizhou People's Hospital, Guiyang 550002, China

Received August 5, 2016; Accepted November 20, 2016; Epub May 15, 2017; Published May 30, 2017

Abstract: This study intends to investigate the curative effect and safety of one-stage debridement of lumbosacral vertebral tuberculosis through unilateral musculussacrospinalis iliac bone flap approach reserving posterior ligamentous complex (PLC). A total of 385 lumbosacral vertebral tuberculosis patients received surgery in Guizhou People's Hospital were enrolled. The patients were divided into four groups, including unilateral musculussacrospinalis iliac bone flap approach group, anterolateral approach group, posterior lesions debridement + bone graft fusion + internal fixation group, and posterior combined anterolateral approach internal fixation group. The intraoperative blood loss, operation time, postoperative drainage time, hospital stays, ESR, Cobb angle, bone graft fusion time, VAS pain score, Frankel classification, and complications were observed and compared. The intraoperative blood loss, duration of postoperative drainage, hospital stay and bone graft fusion time in unilateral musculussacrospinalis iliac bone flap approach group were significantly shorter than those in other groups ($P<0.05$). ESR, Cobb angle, and VAS score decreased at 3 months after operation in all groups. The Cobb angle and VAS score obviously declined in test group compared with other groups ($P<0.05$). The proportion of neurological function improvement in test group was better than the other groups. The curative efficacy achieved 93.65%, while no recurrence occurred in test group at 12 months after operation. Unilateral musculussacrospinalis iliac bone flap approach can effectively present the lesion area, which is suitable to completely clear the lesions and easy for intervertebral bone graft to promote bone graft fusion and prevent protrusion deformity.

Keywords: Lumbosacral vertebral tuberculosis, posteriorligamentous complex, unilateral musculussacrospinalis iliac bone flap

Introduction

Although spine tuberculosis (TB) is one of the most common types of extrapulmonary TB, lumbosacral junction TB is rare and only accounts for 2-3% of spine TB [1-3]. Since spine TB usually causes kyphotic deformity, neurological deficits, and paralysis [4, 5], the treatment goal is to cure the disease and prevent spinaldeformity, instability, and neurodeficit. Though lumbosacral junction TBin the early stage can be treated by chemotherapy alone, surgical treatment is still the first choice for disease in advanced stage.

Numerous surgical treatment methods have been reported on lumbosacral junction TB, including different approaches and stages. Lumbosacral region is special because of upward high mobilized lumbar vertebrae and downward fixed sacral vertebrae, leading to heavy extension, flexion, rotation, and shear stress. Despite good clinical outcomes, the surgical traumais severe and the complication rate is extremely high [6]. Up to now, debridement with posterior fusion, anterior fusion, single-stage anterior andposterior fusion, and posterior fusion followed by anteriorfusion have been adopted, respectively [6-10]. However, there is still lack of reports about unilateral musculussacrospinalis iliac bone flap reports. Moreover, investigation of the curative effect and related complications of the current mainly applied surgical methods is relatively scarce [11, 12]. Hence, the aim of this clinical study is to evaluate the effects of one-stage debridement of lumbosacral junction TB through unilateral musculussacrospinalis iliac bone flap reserving

posterior ligamentous complex (PLC) approach in treating lumbosacral junction TB.

Materials and methods

Clinical information

A total of 385 patients with lumbosacral junction TB received surgical treatment in Guizhou People's Hospital from Jan 2009 to Jun 2015 were enrolled. There were 256 males and 129 females with mean age at 34.52±4.83 (17-56) years old. The average course of disease was 6.75±1.28 (3-15) months. For the segmental lesions, 48 cases were in L_4 (12.46%), 63 cases were in L_5 (16.36%), 54 cases were in S_1 (14.04%), 76 cases were in L_4-L_5 (19.74%), 75 cases were in L_5-S_1 (19.48%), and 69 cases were in L_4-S_1 (17.92%). For the complications, 87 patients showed sacroiliac joint tuberculosis (22.59%), 57 cases showed psoas major abscess (14.82%), 62 cases showed iliac fossa abscess (16.11%), 21 cases showed sinus tract (5.45%), 72 cases showed abscess intra-spinal canal (18.70%), and 86 cases showed nerve root compression symptoms (22.33%).

Patients who received standard anti-TB therapy (3SHRZ/9HRZ) and did not respond well were included. All the patients received CT and MRI examination to evaluate the TB destruction region. Patients who suffered from history of lumbosacral surgery, history of adolescent scoliosis or kyphosis or ankylosing spondylitis, lesions confined to the anterior vertebral column, or psoas or iliac abscesses located far from the sacral vertebrae were excluded. The study was approved by the ethics committee of Guizhou People's Hospital. All enrolled subjects had signed informed consent.

Preoperative procedure

All patients received standard anti-TB drugs with the SHRZ/HRZ chemotherapy regimen (300 mg/day isoniazid, 450 mg/dayrifampicin, 750 mg/day ethambutol, 750 mg/day pyrazinamide) for an average 3-4 weeks prior to surgery.

Operation procedure

The patients in test group (group A) received general anesthesia. An iliac bone at 5 cm length was obtained from anterior superior spine. Next, the patient was placed at prone position. A median incision was made at lumbosacral portion from tailing end arc to posterior superior iliac spine. The musculussacrospinalis was peeled up to posterior superior iliac spine and cut off at the end of posterior sacrum. The iliac plate was peeled at posterior superior iliac spine to prepare a musculussacrospinalis iliac bone flap at 2.5×2.5 cm. The flap was flipped up and separated to L_4 parapophysis. Next, the L_4 inferior articular process and vertebral plate, together with L_5 superior articular process and vertebral were removed (S_1 portion of articular process and sacrum when necessary, if the L_5 vertebral body destruction, all L_5 pedicle resection). After cutting off L_5 transverse process, the fascia between transverse process was opened to isolate from L_4 nerve root to lumbosacral trunk. Screw was set at vertebral pedicle based on destruction region. Supraspinous ligament, interspinous ligaments, and contralateral vertebral plate were not damaged. The lesion was removed on the operation side, while the lesion near the vertebral pedicle on the opposite side was removed from lateral using 90° curet. After removing the lesion according to preoperative CT, small bone block was filled to form flat surface if the postcentrum bone surface appeared sunken after clearance. The titanium mesh or bone block was filled after strutting the vertebral pedicle screw to the contralateral of centrum middle line. After examined by C arm fluoroscopy, the screw was pressed to test titanium mesh or bone block strong degree. After washing the incision, 2 g isoniazide and streptomycin were put into the lesion. An epidural catheter was laid for postoperative local anti-TB treatment. The musculussacrospinalis iliac bone flap was restored and fixed by screw or suture.

The patients received anterolateral approach in group B, posterior lesions debridement + bone graft fusion + internal fixation group in group C, and combined approach to debride lesions and graft bone in group D.

Postoperative treatment

The drainage tube was pulled out at 2-3 days after surgery when the volume <10 ml/day. Antibiotics were routinely used for 3-5 days and the stiches were removed at 10-14 days after operation. The patients were encouraged to perform muscle contraction practice including coxa and knee bending on the 1st day after surgery, off-bed activity under the protection lumbosacral protective clothing on the 3rd day, and

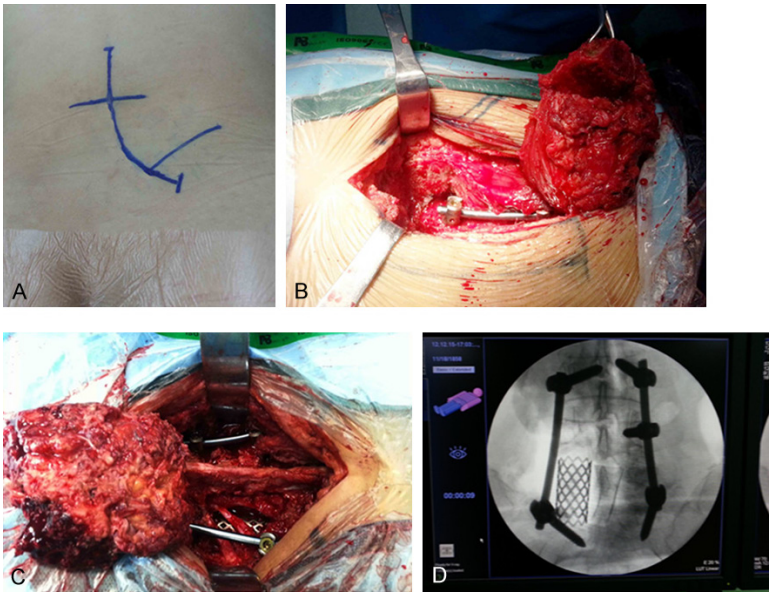

Figure 1. Unilateral musculussacrospinalis iliac bone flap surgery. A: Skin incision selection. B, C: Intraoperative musculussacrospinalis iliac bone flap. D: Intraoperative fixation.

back muscle training without protective clothing after 6 months. Anti-tuberculosis drug therapy was sustained for 12 months. All cases were followed up to 12 months postoperatively, and 3, 6, 12 months after surgery review for relapse.

Follow-up index

Intraoperative blood loss, operation time, postoperative drainage time, hospital stays, bone graft fusion time [13], erythrocyte sedimentation rate (ESR), visual analogue scale (VAS), neurological function Frankel classification, and C-reaction protein (CRP) were monitored during treatment. Curative effect was evaluated based on the amelioration of nerve function as (final follow up score - preoperative score)/(29-preoperative score) ×100%. The postoperative improvement rate ≥75% was considered as excellent, 50-75% as good, 25-50% as mediocre, and <25% as bad. The total curative effect rate was calculated as (number of excellent and good)/total number ×100%. The extent ofdecompression, placement of graft, and instrumentation were assessed at immediately and 12 months after surgery by routine lateral and anteroposterior radiographs or CT. Complications and recurrence were evaluated after surgery.

Statistical analysis

All statistical analyses were performed using SPSS 17.0. A paired t test was used to analyze pre-, postoperative ESR and CRP. Discrepancy of the normal distribution was evlated using the one-way ANOVA. The enumeration data was compared by chi-square test. $P<0.05$ was considered as statistical significance.

Results

General information comparison

Intraoperative musculussacrospinalis iliac bone flap was showed in **Figure 1A-C**, and intraoperative fixation was showed in **Figure 1D**. The mean blood loss, postoperative drainage time, hospital stays, and bone graft fusion time in group A were obviously lower than that in other groups ($P<0.05$) (**Table 1**). No complications or adverse reaction was observed in group A. One patient appeared ureteral injury in group B, two cases occurred incision infection in group C, and one subject showed large blood vessel injury in group D. All the adverse reactions were controlled after symptomatic treatment.

ESR, Cobb angle, and VAS score comparison before and after surgery

There were no statistical significance on preoperative ESR, Cobb angle, and VAS score observed among different groups ($P>0.05$). ESR and Cobb angle returned to normal, while VAS score obviously declined at three months after surgery in each group. No significant difference was found in ESR among each group ($P>0.05$). Group A exhibited lowest Cobb angle and VAS score compare with other groups ($P<0.05$) (**Table 2**).

Frankel grading comparison

There were 53, 140, 56, and 69 cases of patients appeared different levels of dysneuria in each group before surgery. At three months after operation, a total of 41 cases (65.08%), 93 cases (61.18%), 33 cases (45.83%), and 36

Table 1. General information comparison ($\bar{x}\pm s$)

Group	Operation time (min)	Intraoperative blood loss (ml)	Postoperative drainage time (h)	Hospital stays (d)	Bone graft fusion time (m)
A	153.48±14.56	617.52±26.46	31.23±7.34	16.62±4.14	5.15±1.12
B	124.25±16.63	786.24±38.34	38.95±8.76	17.56±4.37	5.98±1.34
C	154.36±17.45	1023.37±57.83	56.68±12.25	22.34±5.12	7.68±1.78
D	246.82±22.34	1125.28±62.54	62.43±15.57	23.75±5.68	6.43±1.56
F value	32.48	53.62	27.12	16.58	6.33
p	<0.01	<0.01	<0.01	<0.01	0.02

Table 2. ESR, Cobb angle, and VAS score comparison before and after surgery ($\bar{x}\pm s$)

Group	ESR (mm/h)		Cobb angle (°)		VAS score	
	Before surgery	3 months after surgery	Before surgery	3 months after surgery	Before surgery	3 months after surgery
A	41.43±7.56	17.57±5.24	36.32±12.46	14.23±6.82*	8.86±1.38	2.23±0.46*
B	39.85±6.93	18.78±6.48	38.23±12.26	16.82±7.33	8.59±1.22	3.27±0.82
C	42.03±7.47	16.84±7.56	35.24±11.83	18.60±7.39	8.62±1.26	3.79±0.73
D	41.21±7.45	18.93±7.94	37.86±12.56	17.44±8.62	8.91±1.03	3.66±0.62

*P<0.05, compared with that in group B, C, and D.

Table 3. Frankel grading comparison

Group	Cases	Preoperative Frankel grade					3-month postoperative Frankel grade				
		A	B	C	D	E	A	B	C	D	E
A	63	0	6	13	34	10	0	1	2	9	51**
B	152	0	18	34	88	12	0	11	14	22	105
C	72	0	7	11	38	16	0	3	6	14	49
D	98	0	11	15	43	29	0	5	11	17	65
Total	385	0	42	73	203	67	0	20	33	62	170

**P<0.01, compared with group B, C, and D.

cases (36.73%) obtained neurological function improve in four groups. The improvement level showed markedly difference among four groups (χ^2=19.65, P<0.01) (**Table 3**).

Curative effect comparison

After 12-month follow-up, CT revealed that the internal fixation showed no movement (**Figure 2C**, **2D**) compared with short-term after surgery (**Figure 2A**, **2B**). The last follow-up was performed at 12 months after surgery. The curative effect rate in group A achieved 93.65%, which was significantly higher than the other groups (P<0.05) (**Table 4**). No patients relapsed in group A, whereas 8 cases, 2 cases, and 2 cases demonstrated local tuberculosis recurrence in group B, C, and D, respectively.

Discussion

Lumbosacral junction TB is rare, and the treatment remains difficult and controversial [14]. Although early diagnosis and adequate conservative anti-TB treatment can effectively cure TB [7], advanced lumbosacral junction TB still needs surgery. Persistent back pain, instability, neurological deficit, deformity, massive cold abscesses, and poor response to conservative treatment are generally the common indications for surgery [15]. In ourseries, lumbosacral junction TB surgery is performed with the purpose of debriding lesions, restoring nerve function, and reconstructing spinal stability in one-stage.

Lumbosacral junction TB damages intervertebral discs and vertebrae, as well as the declined lumbosacral angle, may dislocate the L_4-S_1 joint, resulting in joint capsule laxity. Thus, the intervertebral disc must be removed when debriding TB lesions. However, without the intervertebral disc, the shear stress can accelerate zygopophysis degradation, leading to back pain. Therefore, except removing lesions, one purpose of the lumbosacral junction TB surgery is to recover the height of vertebrae and prevent local shear stress. Numerous approaches have been reported for lumbosacral junction

Figure 2. Internal fixation after surgery detected by CT. A, B: Short-term examination. C, D: 12-month follow-up examination.

TB [8, 9, 11]. Anterior procedure has been accepted by most surgeons because of its advantage in allowing direct access and reconstruction of the vertebrae [16]. Specially, major blood vessels, nerves, and ureters injury present an obvious challenge for anterior instrumentation at the L_4-L_5 and L_5-S_1 segments [11]. It is also difficult to decompress the caudaequina nerve roots and effectively internal fix the spine. Single posterior approach is also used by researchers. Zaveri and Mehta got success in treating lumbar and lumbosacral TB with transforaminal lumbar interbody fusion and posterior instrumentation [9]. It was also reported that one-stage posterior surgery improved kyphosis angle and recover neurologic deficit with 6 months [17]. However, since it is difficult to observe the stability of bone graft or titanium mesh immediately, effective compression cannot be easily achieved. The titanium mesh is also difficult to be placed as the dura mater and nerve root restrain the space for the mesh, and lesions clearances is restricted because of musculussacrospinalis obstruction. Furthermore, some scholar tested anterior radical debridement combined with posterior instrumentation. He et al. [11] reported that anteroposterior approaches could effectively heal L_5-S_1 vertebral TB with the deficiency in average surgical time, blood loss, and hospital stay. Double-stage operations were also reported by the literature [18, 19], but the time interval between two surgeries is still controversial and lack of data support [20, 21].

Unilateral musculussacrospinalis iliac bone flap approach is mainly used in lower lumbar spine degeneration. It shows various advantages in spite of the lack of reports of its application in treating lumbosacral junction TB. Firstly, it maximally protects the posterior structure of spinal, including supraspinous ligament, interspinous ligaments, contralateral vertebral plat, and muscle (contralateral screw can be put through minimally invasive or small incision way). Secondly, it obtains the space between dura mater and nerve root for titanium mesh placement through completely nerve root isolation. Thirdly, as the musculussacrospinalis iliac bone flap is fold upward, it is easy to expose the nerve between L_4-S_1 transverse process, treat bleeding, and clear lesions. Fourthly, since the titanium mesh or bone graft achieve enough length, the stability

Table 4. Curative effect comparison

Group	Cases	Excellent n (%)	Good n (%)	Mediocre n (%)	Bad n (%)	Effective rate (%)
A	63	25 (39.68)	34 (53.97)	3 (4.76)	1 (1.59)	93.65
B	152	42 (27.64)	93 (61.18)	13 (8.55)	4 (2.63)	88.82
C	72	14 (19.45)	43 (59.72)	9 (12.50)	6 (8.33)	79.17
D	98	31 (31.63)	48 (48.98)	11 (11.23)	8 (8.16)	80.61
χ^2 value						9.04
p						0.03

after compression is better without significant spine shortening. Fifthly, musculussacrospinalis iliac bone flap fold upward keeps the musculussacrospinalis in tension-free status, leading to good muscle protection and faster healing. At last, it prevents numerous complications, such as major blood vessels, nerves, and ureters injury that may occur in anterior approach. Our study showed significant improvement of functional nerve impairment by the last follow-up, and solid fusion at the instrumented segments was achieved in all cases.

As an approach choice, unilateral musculussacrospinalis iliac bone flap approach also has limitations. At first, undersize musculussacrospinalis iliac bone flap may impact the stability of fixation, which affects flap healing, leading to unilateral dorsal muscle myasthenia and complications. Secondly, numerous venous plexus exists the foramen intervertebrale may cause bleeding, resulting in bipolar electrocoagulation usage which may damage nerve root. Thirdly, there are ramusanastomoticus locate between nerve roots before meeting ischiadic nerve, leading to damage during separation. Fourthly, psoas major abscess can only be drained from posterior lateral side, and abscess of iliac fossa needs additional incision. Lastly, high anatomy knowledge is required by the surgeon.

Conclusions

Unilateral musculussacrospinalis iliac bone flap approach can effectively present the lesion area, which is suitable to completely clear the lesions and easy for intervertebral bone graft to promote bone graft fusion and prevent protrusion deformity.

Acknowledgements

This study was supported by the Guizhou Province Talent Team Foundation (20114102). Guizhou Province Talent Team Innovation Fund (No. 20114102).

Disclosure of conflict of interest

None.

Address correspondence to: Bo Li, Department of Orthopedics, Guizhou People's Hospital, 83 Zhongshan East Road, Guiyang 550002, China. Tel: +86 085185922979; E-mail: doctorbol@163.com

References

[1] Pun WK, Chow SP, Luk KD, Cheng CL, Hsu LC and Leong JC. Tuberculosis of the lumbosacral junction. Long-term follow-up of 26 cases. J Bone Joint Surg Br 1990; 72: 675-678.

[2] Tuli SM. Severe kyphotic deformity in tuberculosis of the spine. Int Orthop 1995; 19: 327-331.

[3] Kalra KP, Dhar SB, Shetty G and Dhariwal Q. Pedicle subtraction osteotomy for rigid post-tuberculous kyphosis. J Bone Joint Surg Br 2006; 88: 925-927.

[4] Peto HM, Pratt RH, Harrington TA, LoBue PA and Armstrong LR. Epidemiology of extrapulmonary tuberculosis in the United States, 1993-2006. Clin Infect Dis 2009; 49: 1350-1357.

[5] Garcia-Rodriguez JF, Alvarez-Diaz H, Lorenzo-Garcia MV, Marino-Callejo A, Fernandez-Rial A and Sesma-Sanchez P. Extrapulmonary tuberculosis: epidemiology and risk factors. Enferm Infecc Microbiol Clin 2011; 29: 502-509.

[6] Bezer M, Kucukdurmaz F, Aydin N, Kocaoglu B and Guven O. Tuberculous spondylitis of the lumbosacral region: long-term follow-up of patients treated by chemotherapy, transpedicular drainage, posterior instrumentation, and fusion. J Spinal Disord Tech 2005; 18: 425-429.

[7] Moon MS, Moon YW, Moon JL, Kim SS and Sun DH. Conservative treatment of tuberculosis of the lumbar and lumbosacral spine. Clin Orthop Relat Res 2002; 40-9.

[8] 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 (Phila Pa 1976) 2003; 28: 1036-1042.
[9] Zaveri GR and Mehta SS. Surgical treatment of lumbar tuberculous spondylodiscitis by transforaminal lumbar interbody fusion (TLIF) and posterior instrumentation. J Spinal Disord Tech 2009; 22: 257-262.
[10] Arora S, Kumar R, Batra S and Nath R. Transpedicular drainage of presacral abscess and posterior decompression of acute cauda equina syndrome in caries spine: a case series of 3 patients. J Spinal Disord Tech 2011; 24: E26-30.
[11] He Q and Xu J. Comparison between the antero-posterior and anterior approaches for treating L5-S1 vertebral tuberculosis. Int Orthop 2012; 36: 345-351.
[12] Lee CK, Vessa P and Lee JK. Chronic disabling low back pain syndrome caused by internal disc derangements. The results of disc excision and posterior lumbar interbody fusion. Spine (Phila Pa 1976) 1995; 20: 356-361.
[13] Bridwell KH, Baldus C, Berven S, Edwards C 2nd, Glassman S, Hamill C, Horton W, Lenke LG, Ondra S, Schwab F, Shaffrey C and Wootten D. Changes in radiographic and clinical outcomes with primary treatment adult spinal deformity surgeries from two years to three- to five-years follow-up. Spine (Phila Pa 1976) 2010; 35: 1849-1854.
[14] Wellons JC, Zomorodi AR, Villaviciencio AT, Woods CW, Lawson WT and Eastwood JD. Sacral tuberculosis: a case report and review of the literature. Surg Neurol 2004; 61: 136-139; discussion 139-141.
[15] Bhojraj S and Nene A. Lumbar and lumbosacral tuberculous spondylodiscitis in adults. Redefining the indications for surgery. J Bone Joint Surg Br 2002; 84: 530-534.
[16] Song JF, Jing ZZ, Chen B, Ai ZS and Hu W. One-stage anterolateral surgical treatment for lumbosacral segmenttuberculosis. Int Orthop 2012; 36: 339-344.
[17] Sun L, Song Y, Liu L, Gong Q and Zhou C. One-stage posterior surgical treatment for lumbosacral tuberculosis with major vertebral body loss and kyphosis. Orthopedics 2013; 36: e1082-1090.
[18] Jenkins DH, Hodgson AR, Yau AC, Dwyer AP and O'Mahoney G. Stablization of the spine in the surgical treatment of severe spinal tuberculosis in children. Clin Orthop Relat Res 1975; 69-80.
[19] Moon MS, Woo YK, Lee KS, Ha KY, Kim SS and Sun DH. Posterior instrumentation and anterior interbody fusion for tuberculous kyphosis of dorsal and lumbar spines. Spine (Phila Pa 1976) 1995; 20: 1910-1916.
[20] Moon MS, Kim SS, Lee BJ, Moon JL and Moon YW. Surgical management of severe rigid tuberculous kyphosis of dorsolumbar spine. Int Orthop 2011; 35: 75-81.
[21] Jain AK, Dhammi IK, Prashad B, Sinha S and Mishra P. Simultaneous anterior decompression and posterior instrumentation of the tuberculous spine using an anterolateral extrapleural approach. J Bone Joint Surg Br 2008; 90: 1477-1481.