Eur J Orthop Surg Traumatol
DOI 10.1007/s00590-014-1508-y

ORIGINAL ARTICLE

Study on anterior and posterior approaches for spinal tuberculosis: a meta-analysis

Aikeremujiang Muheremu · Xiaohui Niu · Zhongyan Wu · Wei Tian

Received: 11 May 2014 / Accepted: 4 July 2014

Abstract
Background Timely and appropriate surgical intervention can enhance the stability of spine, eliminate the compression on spinal cord and prevent the further development the complications that may follow. However, there is no optimum surgical approach that has been agreed by surgeons.
Objective Incidence rate of spinal tuberculosis is still high in many developing countries. Except from chemotherapy, some patients require surgical treatment at certain phases of disease development. However, there is still not a standard operative procedure for spinal tuberculosis in the current research, and we studied the differences of anterior and posterior approach for spinal tuberculosis, to provide guidance for the further operative treatments.
Methods We searched "Pubmed" (2000.1–2014.7), "Medline" (2000.1–2014.7), "Elseveir" (2000.1–2014.7), Cochrane library (2008.1–2014.7), Wanfang (2000.1–2014.7), and CNKI (2000.1–2014.7) databases with the key words of "thoracolumbar tuberculosis", "controlled randomized trial", "RCT", "anterior" "posterior", and searched for randomized controlled trials for spinal tuberculosis. We compared the operative time, total blood loss, correction of Cobb angle, loss of Cobb angle at final follow-up, fusion time of allograft, time of total hospital stay, and the effectiveness of operative treatment between the anterior and posterior surgical approaches by Revman5.3 software.
Results From 1,523 papers found, we chose eight randomized controlled trials comparing different surgical approaches for the treatment of spinal tuberculosis. The total number of patients was 754, in which 377 were treated with anterior approach and 377 were treated with posterior approach correction of Cobb angle ($P < 0.05$), and no significant differences were found regarding operation time, loss of correction of Cobb angle in the last follow-up, time of total hospital stay, and fusion time of bone graft ($P > 0.05$).
Conclusions There are significant differences between the two operative approaches regarding the correction of Cobb angle, but no significant differences regarding operation time, blood loss, loss of Cobb angle at the last follow-up, total fusion time, and length of total stay in the hospital.

Keywords Spinal tuberculosis · Anterior · Posterior · Meta-analysis

A. Muheremu · X. Niu
Department of Orthopedic Oncology Surgery, Beijing Ji Shui Tan Hospital, 31 Xinjiekou East Street, Xicheng District, Beijing 100035, People's Republic of China
e-mail: taklimakan321@hotmail.com

X. Niu
e-mail: niuxiaohui@263.com

Z. Wu
Department of Orthopedics, Fifth Affiliated Hospital of Xinjiang Medical University, No 118, West Henan Road, Xinshi District, Ürümqi 830010, Xinjiang, People's Republic of China
e-mail: wzyfah@163.com

W. Tian (✉)
Department of Spine Surgery, Beijing Ji Shui Tan Hospital, 31 Xinjiekou East Street, Xicheng District, Beijing 100035, People's Republic of China
e-mail: tianweijst1@163.com

Introduction

Prevalence of tuberculosis in developing countries still remains high [1]. Thoracolumbar spine is one of the main

Published online: 22 July 2014

targets of metastatic tuberculosis in the musculoskeletal system [2]. Since spinal tuberculosis can lead to spinal malformation and paralysis, it is also one of the most dangerous pathological changes in the musculoskeletal system [3]. Antituberculosis therapy is the most important for the treatment of spinal tuberculosis; however, for malformations that exceed 30° or with radiological and clinical manifestations of spinal cord compression, surgical fixation and fusion with bone graft are still necessary. Timely and appropriate surgical intervention can enhance the stability of spine, eliminate the compression on spinal cord, and prevent the further development of malformation and paralysis or death that may follow. Traditional surgical intervention for spinal tuberculosis includes the drainage of abscess and removing the lesion. With the growing recognition for the importance of spinal stability, more emphases was put on undergoing internal fixation and fusion on patients with significant malformations caused by tuberculosis. However, there is no optimum surgical approach that has been confirmed by surgeons. In the current research, studies comparing anterior and posterior approaches were collected and analyzed to confirm which approach may be more appropriate for the treatment of spinal tuberculosis.

Materials and methods

Inclusion criteria

Study design randomized controlled trials, RCT, half randomized trials, and cohorts
Objects spinal tuberculosis with the need of debridement and internal fixation. 1.1.3 intervention comparison of anterior and posterior approach for the debridement and internal fixation.
Outcome index operation time, blood loss, correction of Cobb's angle, time of hospital stay, time for fusion, as well as overall clinical outcome.

Exclusion criteria

Repeated publication of the same study, degenerative lumbar disk disease, infection, intraspinal tumor, bone tumor osteoporosis; studies included patients with the history of spinal surgery; reviews, lectures as well as other publication that adequate statistical information cannot be obtained from.

Method for search

According to the instructions of Cochrane collaboration Cochrane Musculoskeletal Group, databases including Medline (1990–2014.7), Embase (1990–2014.7), Elseveir (1990–2014.7), Cochrane library (2008–2014.7), Wanfang (Chinese) (1990–2014.7), and CNKI (Chinese) (1990–2014.7) were searched by two independent researchers by the mesh terms: "spinal tuberculosis", "controlled randomized trial", "RCT", "anterior", and "posterior". Hand search of main Chinese publication such as "Chinese Journal of Orthopaedics", "Chinese Journal of Spine and Spinal Cord", and "Chinese Journal of Tissue Engineering Research" was engaged for the search of relevant papers published before the year 2000.

Evaluation method

Two separate authors searched for the papers and extracted the data independently, and any dispute was solved by the third author. All the papers were evaluated by the method of randomization, appropriateness of blinding, outcome assessment, as well as the loss of follow-up. Studies with low loss of follow-up and appropriate methods were ranked as A, any study with severe default in the study design is ranked as C, and papers with quality in between were ranked as B.

Statistical analysis

Revman5.3 software provided by the Cochrane collaboration was used to analyze the data from papers. Study group with $P > 0.05$, $I^2 < 50$ % was regarded to have low heterogeneity, and fixed-effect model was used to perform meta-analysis; study group with $P < 0.05$, $I^2 > 50$ % was regarded to have high heterogeneity and the random effect model used.

Results

Search results

Among the 1,523 abstracts, 10 papers [4–13] (5 English and 5 Chinese language papers) were included in the study. Total patient number was 754, of whom 377 underwent anterior approach and 377 posterior approach (Fig. 1; Table 1). Delphi list assessing the risk of bias in all included papers revealed that the studies included have relatively high quality (Table 2).

Results of meta-analysis

Intraoperative time there were eight studies comparing the time needed for each surgical approach. A total of 530 patients were involved, 269 of whom received anterior approach and 261 with posterior approach. Standardized

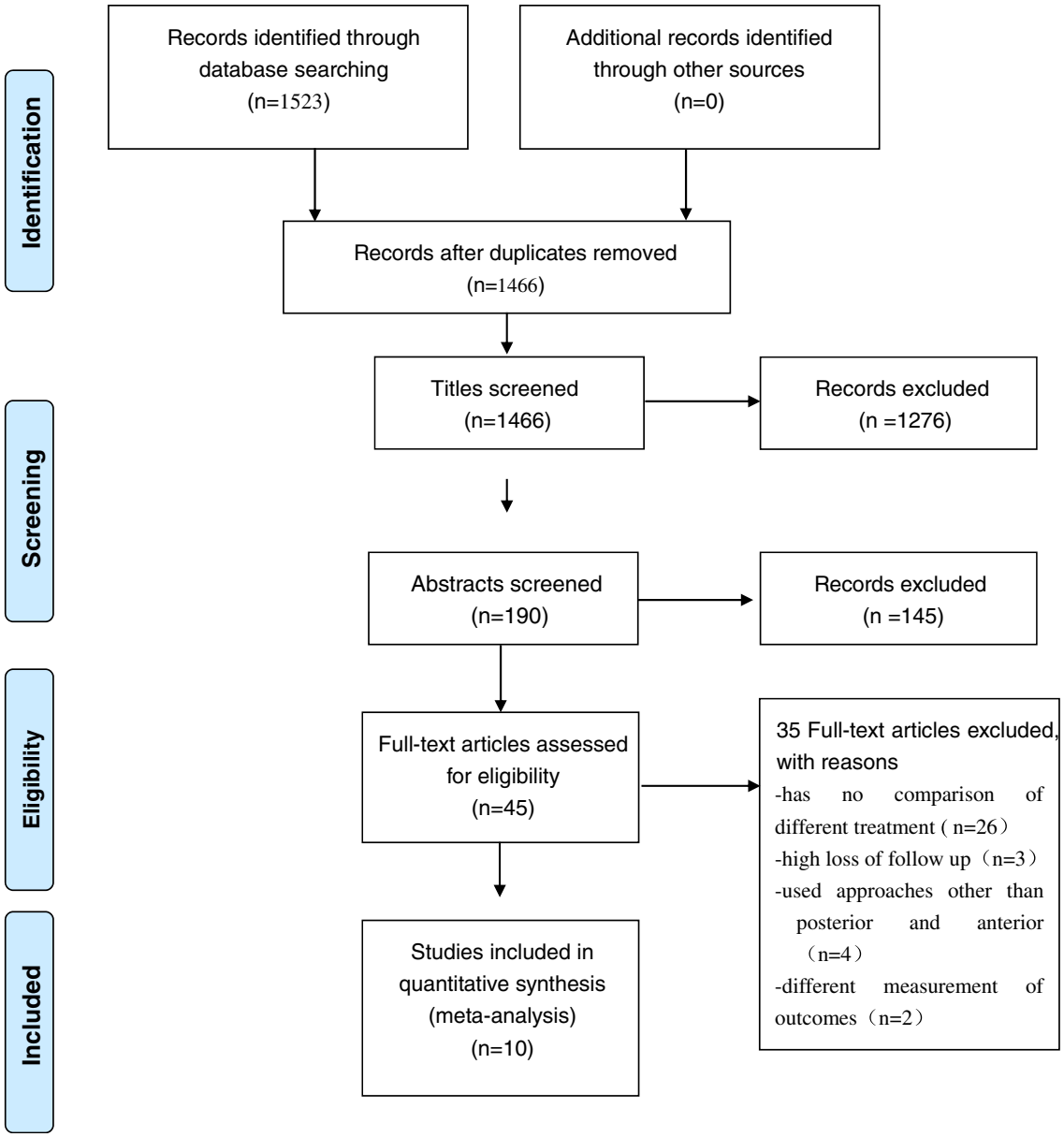

Fig. 1 Diagram of the selection of papers of the current research

mean difference between the two groups is 0.59 (−1.66, 0.49). Although anterior approach seems to need less intraoperative time, there are no significant differences between the two groups ($P > 0.05$; Fig. 2).

Intraoperative blood loss there were eight studies comparing the intraoperative blood loss for each surgical approach. A total of 530 patients were involved, 269 of whom received anterior approach and 261 with posterior approach. Standardized mean difference between the two groups is 1.15 (−2.33, 0.03). Although anterior approach seems to have less intraoperative blood loss, there are no significant differences between the two groups ($P > 0.05$; Fig. 3).

Correction of Cobb angle there were nine studies comparing the correction of Cobb angle for each surgical approach. A total of 679 patients were involved, 335 of whom received anterior approach and 344 with posterior approach. Standardized mean difference between the two groups is 1.11 (0.63, 1.59). Correction of Cobb angle with the posterior approach is significantly larger than that of anterior approach ($P < 0.01$; Fig. 4).

Loss of correction in Cobb angle by the last follow-up there were seven studies comparing the loss of correction in Cobb angle by the last follow-up for each surgical approach. A total of 564 patients were involved, 274 of whom received anterior approach and 290 with posterior

Table 1 Demographics of included studies

References	Groups	Patient no.	Age	Site			Type of study	Time of study	Follow-up month	Publication
				T_{11}	T_{11}-L2	L2				
Cai 2013	Anterior	49	46.1 ± 3.7	15	25	49	Cohort	2009.3–2011.12	10–32	China Modern Medicine
	Posterior	40	45.8 ± 3.5							
Cui 2011	Anterior	74	39 (16, 67)	43	34	67	Cohort	2004.1–2009.12	22–72	Chinese Journal of Spine and Spinal Cord
	Posterior	70	39 (16, 67)							
Hong 2012	Anterior	16	68.2 ± 3.1	N/A			RCT	2004.1–2009.6	26–45	Arch Orthop Trauma Surg
	Posterior	20	68.6 ± 3.2							
Garg 2012	Anterior	34	34.9	36	34	0	RCT	2001.1–2006.12	26	Indian Journal of Orthopedics
	Posterior	36	33.6							
Man 2012	Anterior	12	37.5 (24, 62)	0	26	0	Cohort	2007.10–2011.10	N/A	China Modern Medicine
	Posterior	14	37.5 (24, 62)							
Sun 2006	Anterior	7	49 ± 15.8	9	8	0.0	RCT	2001.1–2004.12	6–42	J Spinal Disord Tech
	posterior	10	63.7 ± 5.4							
Xiao 2012	Anterior	22	37.8 (14, 76)	13	20	14	RCT	2004.1–2010.3	12–62	International Orthopedics
	Posterior	25	38.1 (14, 76)							
Yuan 2011	Anterior	74	39 (16, 67)	52	38	67	RCT	2004.1–2009.12	22–72	International Orthopedics
	Posterior	83	39 (16, 67)							
Zhou 2008	Anterior	15	38 (20, 65)	0	9	15	Cohort	1990.6–2006.6	12–16	Orthopedic Journal of China
	Posterior	9	38 (20, 65)							
Zhou 2014	Anterior	74	36.7 ± 5.3	N/A			RCT	2010.4–2013.4	3–48	China Medicine and Pharmacy
	Posterior	70	36.7 ± 5.3							

approach. Standardized mean difference between the two groups is 0.15 (−0.29, 0.59). Although posterior approach seems to have less loss of correction in Cobb angle, there are no significant differences between the two groups ($P > 0.05$; Fig. 5).

Time for stay in hospital there were four studies comparing the total time to stay in hospital between two surgical approaches. A total of 199 patients were involved, 105 of whom received anterior approach and 94 with posterior approach. Standardized mean difference between the two groups is 0.10 (−0.84, 1.05). Although anterior approach seems to have less time for stay in hospital, there are no significant differences between the two groups ($P > 0.05$; Fig. 6).

Time for infusion there were five studies comparing the time for infusion between two surgical approaches. A total of 520 patients were involved, 260 of whom received anterior approach and 260 with posterior approach. Standardized mean difference between the two groups is 0.54 (−0.05, 1.13). Although anterior approach seems to have less time for infusion, there are no significant differences between the two groups ($P > 0.05$; Fig. 7).

Some of the papers have also compared overall clinical outcome and patient satisfaction, improvement in Frankel and AISA scores and found no statistical difference between the two groups.

Discussion

Spine is the site with highest prevalence of musculoskeletal tuberculosis [14]. With the widespread use of systematic antituberculosis drug treatment, most patients can be healed without any surgical intervention. However, tuberculosis in spinal segments can destroy the spinal body, which may cause severe complications such as kyphosis and spinal cord compression. For those patients, drug therapy only can hardly solve all the problems [15].

Either anterior or posterior approach can be applied for debridement and internal fixation of spinal tuberculosis. Anterior approach is currently more widely used because of larger operational horizon it can provide [16, 17]. However, anterior approach can hardly fix the kyphosis. When the lesion involved several spinal seg-

Table 2 Delphi list assessing the risk of bias in all included papers

References	Adequate random sequence generation?	Adequate allocation concealment?	Adequate blinding of patients?	Adequate blinding of care providers?	Adequate blinding of outcome assessment?	Incomplete outcome data addressed? (loss to follow-up)	Intention-to-treat analysis?	Groups similar at baseline?	Influence of cointerventions unlikely?	Adequate compliance with primary intervention?	Timing of outcome assessments similar?	Absence of other bias?	Total score
Cai 2013	−	−	+	−	+	+	+	+	+	+	+	?	8
Cui 2011	+	+	−	−	?	+	+	+	+	+	+	?	8
Garg 2012	?	−	+	−	+	+	+	+	+	+	+	?	7
Hong 2012	+	+	−	−	+	+	+	+	+	+	−	−	8
Man 2012	+	+	+	−	+	−	?	+	−	+	+	+	8
Sun 2006	?	+	+	−	+	+	+	+	+	+	+	?	9
Xiao 2012	+	−	−	−	+	+	?	+	+	+	+	+	8
Yuan 2011	?	−	+	+	+	+	?	+	+	+	+	?	8
Zhou 2008	?	?	−	+	+	+	−	+	+	+	?	?	7
Zhou 2014	+	+	+	−	+	+	+	+	+	+	−	−	9

ments, bone autograft can be easily absorbed, which affects the successful infusion of bone graft. In some cases, bone grafts get crushed or moved because of the pressure caused by spinal body and lead to even more severe kyphosis.

With the rapid development of radiology, the posterior approach has drawn the attention of more and more spinal surgeons. In the last 20 years, magnetic resonance imaging technique (MRI), computed axial tomography (CT) guided biopsy, and polymerase chain reaction (PCR) were widely used to accurately diagnose and locate spinal tuberculosis, which made it possible for posterior approach to get satisfactory debridement of the lesion. However, whatever the approach being applied, the main purpose of the surgery is to gain thorough debridement, adjustment of kyphosis, and increase the stability of spinal body [18, 19].

Since 2006, there have been several studies comparing the efficacy of either anterior or posterior approach for spinal tuberculosis. Some studies proposed that posterior approach has its advantages, which makes it a viable alternative of the anterior approach. However, there are still disputes over certain indexes among studies. In order to confirm the effectiveness of these two approaches, we have underwent meta-analysis comparing the operative time, total blood loss, correction of Cobb angle, loss of Cobb angle at final follow-up, fusion time of allograft, time of total hospital stay, and the effectiveness of operative treatment between the anterior and posterior surgical approaches. The results have revealed that posterior approach is superior than the anterior approach by means of Cobb angle correction, but have no significant difference by any other index.

The reason why the posterior approach can get better correction of Cobb angle may be contributed to the fact that posterior fixation is mainly based on three-dimensional vertebral pedicle fixation and that vertebral pedicle is the strongest part of the spine [20]. On comparison, anterior fixation is based on the fixation of the vertebral body, which is mainly spongy bone, and the osteoporosis caused by the lesion makes it much more unstable than the posterior approach. Thus, it may be better choice to apply posterior approach for patients with severe kyphosis. Above all, adequate antituberculosis treatment is vital for satisfactory recovery and maintenance of the stability of spine. Based on the clinical experience in our department, we recommend a 12-month treatment of 3HRZE/9HRE, in order to consolidate the therapeutic effect and to prevent from collapse of spinal body. This meta-analysis has several defects that may make its results less assuring, studies included were not of high quality, and the total number of participants was only 754. More RCTs or multicenter studies can be carried out to validate

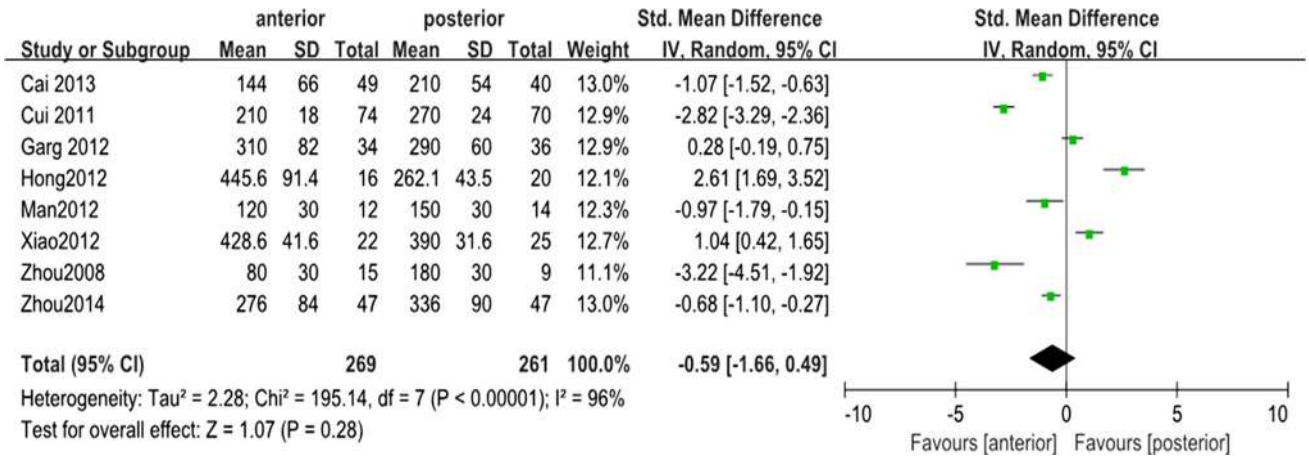

Fig. 2 Comparison of intraoperative time between two surgical approaches

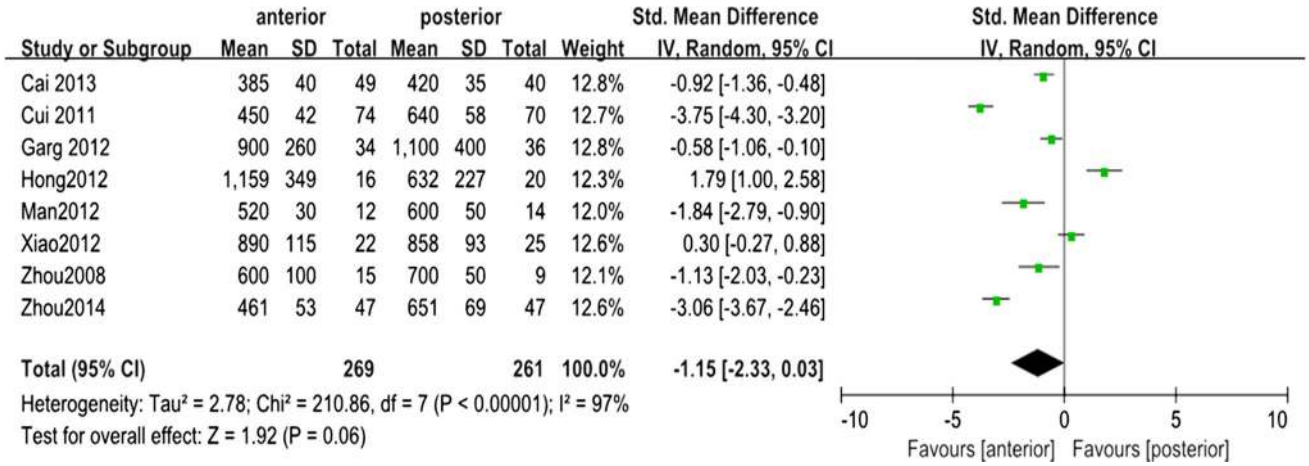

Fig. 3 Comparison of intraoperative blood loss between two surgical approaches

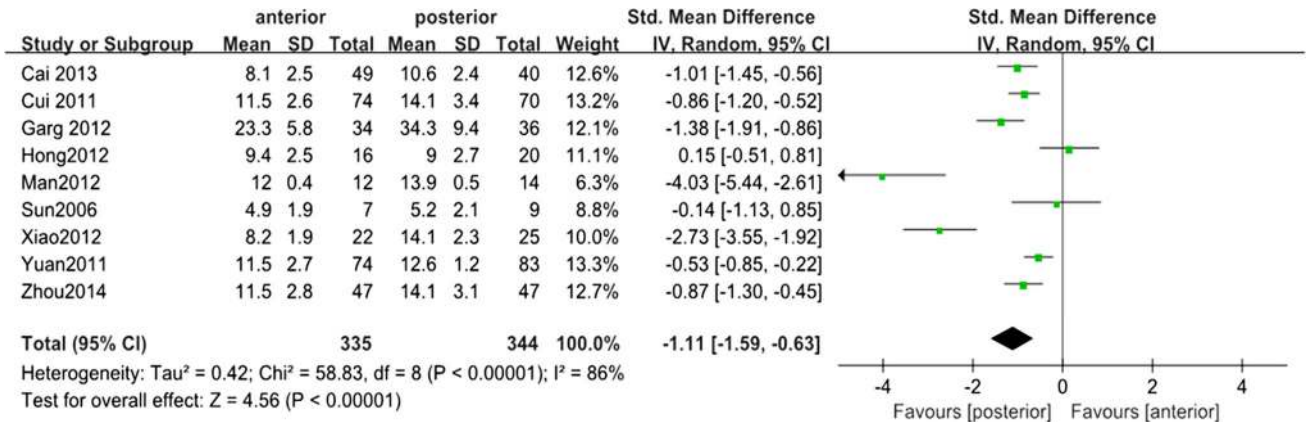

Fig. 4 Comparison of correction of Cobb angle between two surgical approaches

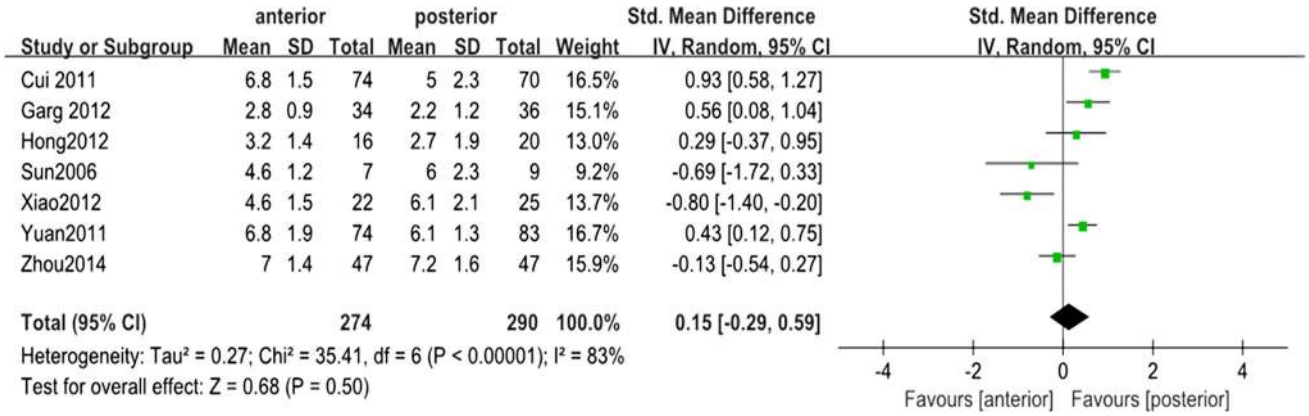

Fig. 5 Comparison of loss of correction in Cobb angle by the last follow-up between two surgical approaches

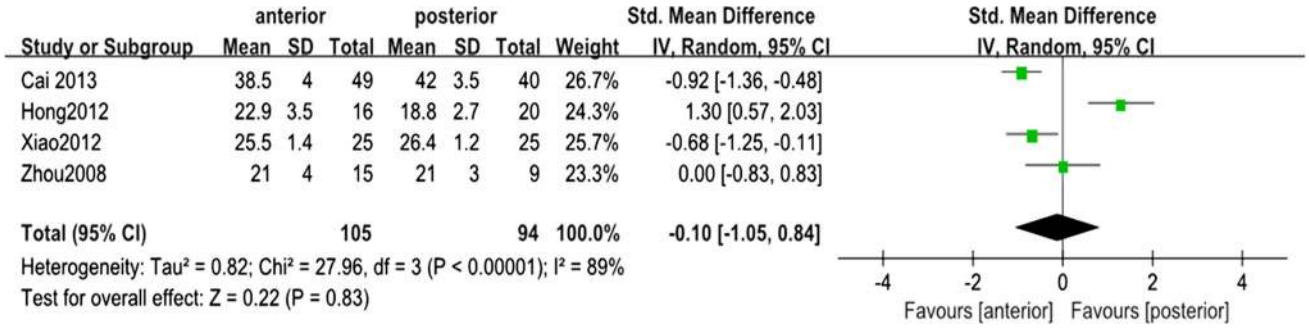

Fig. 6 Comparison of total time in hospital between two surgical approaches

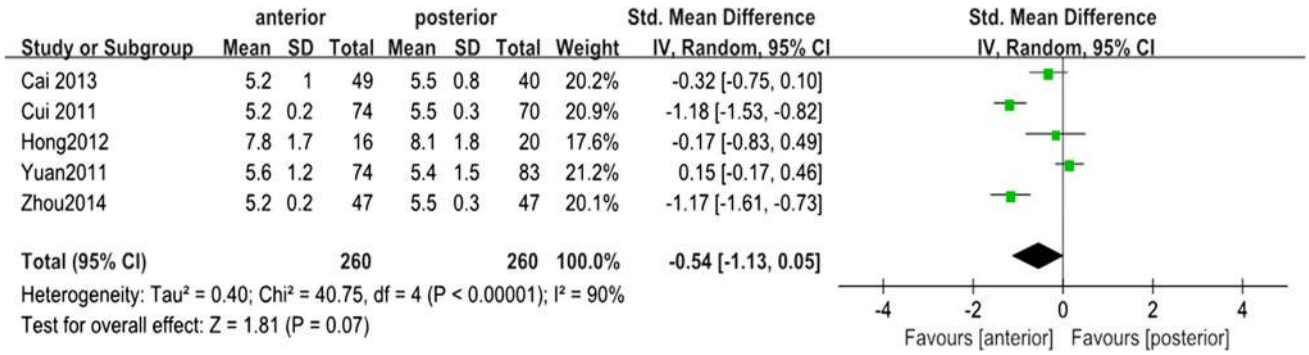

Fig. 7 Comparison of time of fusion between two surgical approaches

the posterior approach for the surgical treatment of spinal tuberculosis.

Conclusions

There are significant differences between the two operative approaches regarding correction of Cobb angle, but no significant differences regarding operation time, blood loss, loss of Cobb angle at the last follow-up, total fusion time, length of total stay in the hospital.

Conflict of interest None.

References

1. Ibrahim A, Lee K, Kanoo L, Tan C, Hamid M (2013) Epidemiology of spinal cord injury in Hospital Kuala Lumpur. Spine 38:419–424
2. Nagashima H, Yamane K, Nishi T et al (2010) Recent trends in spinal infections: retrospective analysis of patients treated during the past 50 years. Int Orthop 34:395–399
3. Jin D, Qu D, Chen J et al (2004) One-stage anterior interbody autografting and instrumentation in primary surgical management of thoracolumbar spinal tuberculosis. Eur Spine J 13:114–121

4. Cai X, Dong W (2014) Study on the effect of orthopedic and rehabilitation of anterior fixation and posterior fixation in the treatment of spinal tuberculosis. China Mod Med 20(14):11–13
5. Cui X, Ma Z, Chen X, Cai X, Guo L (2011) Selection and outcome of anterior vs posterior approach for spinal tuberculosis. Chin Journal Spine Spinal Cord 21:807–812
6. Garg B, Kandwal P, Upendra BN, Goswami A, Jayaswal A (2012) Anterior versus posterior procedure for surgical treatment of thoracolumbar tuberculosis: a retrospective analysis. Indian J Orthop 46:165–170
7. Hong QZ, Jin SL, Shu SZ, Yu XS, Shao HL, Qi G, Min ZL, Jin YL, Jian HW, Jing C (2012) Surgical management for thoracic spinal tuberculosis in the elderly: posterior only versus combined posterior and anterior approaches. Arch Orthop Trauma Surg 132:1712–1723
8. Man Y, Tang Y, Huang S, Zeng J, Zhou S (2012) Comparative study on anterior and posterior fixation in the treatment of lumbar spinal tuberculosis. China Mod Med 19:42–43
9. Sun HL, Joo KS, Yeun MP (2006) Single-stage transpedicular decompression and posterior instrumentation in treatment of thoracic and thoracolumbar spinal tuberculosis. J Spinal Disord Tech 19:595–602
10. Xiao BP, Qiang Z, Qin YH, Fei D, Jian ZX, Ze HZ, Kopjar B (2012) A posterior versus anterior surgical approach in combination with debridement, interbody autografting and instrumentation for thoracic and lumbar tuberculosis. Int Orthop 36:307–313
11. Yuan ZM, Xu C, Hong WL, Xing C, Xiao JC, Yi BB (2012) Outcomes of anterior and posterior instrumentation under different surgical procedures for treating thoracic and lumbar spinal tuberculosis in adults. Int Orthop 36:299–305
12. Zhou Z-J, Jian Y-K, Li B, Zhang M-X (2008) Evaluation of therapeutics for lumbar tuberculosis (analysis of 65 clinical cases). Orthop J China 16:1141–1143
13. Zhou S, Chen S, Wen G (2014) Selection and efficacy analysis of different anterior and posterior surgical methods for spinal tuberculosis. 5:201–203
14. Carlos PS, Dolores RP (2013) Bone and joint tuberculosis. Eur Spine J 22:556–566
15. Zhang H-Q, Lin M-Z, Shen K-Y, Ge L, Li J-S, Tang M-X, Wu J-H, Liu J-Y (2012) Surgical management for multilevel non-contiguous thoracic spinal tuberculosis by single-stage posterior transforaminal thoracic debridement, limited decompression, interbody fusion, and posterior instrumentation (modified TTIF). Arch Orthop Trauma Surg 132:751–757
16. Hodgson A-R, Stock FE, Fang HSY, Ong GB (1960) Anterior spinal fusion. The operative approach and pathological findings in 412 patients with pott's disease of the spine. Br J Surg 48:172–178
17. Mehta JS, Bhojraj SY (2001) Tuberculosis of the thoracic spine. A classification based on the selection of surgical strategies. J Bone Joint Surg Br 83:859–863
18. Sahoo MM, Mahapatra SK, Sethi GC, Dash SK (2012) Posterior-only approach surgery for fixation and decompression of thoracolumbar spinal tuberculosis: a retrospective study. J Spinal Disord Tech 25:217–223
19. Lü G, Wang B, Li J, Liu W, Cheng I (2012) Anterior debridement and reconstruction via thoracoscopy-assisted mini-open approach for the treatment. Eur Spine J 21:463–469
20. Rajasekaran S (2012) Kyphotic deformity in spinal tuberculosis and its management. Int Orthop 36:359–365