ELSEVIER

CrossMark

The Spine Journal 15 (2015) e1–e5

THE SPINE JOURNAL

Case Report

Multiple noncontiguous spinal fractures and occipitocervical dislocation in a patient with ankylosing spondylitis treated with a hybrid open and percutaneous spinal fixation technique: a case report

Arjun S. Sebastian, MD, Jeremy L. Fogelson, MD, Mark B. Dekutoski, MD, Ahmad N. Nassr, MD*

The Department of Orthopedic Surgery, Mayo Clinic, 200 First St, S.W., Rochester, MN 55905, USA

Received 28 February 2014; revised 6 January 2015; accepted 3 February 2015

Abstract

BACKGROUND CONTEXT: Spinal fractures occur with a greater frequency in ankylosing spondylitis (AS) patients. Treatment of these fractures is complicated because of a higher incidence of medical comorbidities, higher rate of neurologic deficits, and higher risk of neurologic deterioration.

PURPOSE: To report a case report of a novel, combined open and percutaneous surgical techniques used for the treatment of multiple noncontiguous spinal fractures in a patient with AS.

STUDY DESIGN/SETTING: We describe the surgical treatment and the outcome of a patient with AS that sustained an occipitocervical dislocation and two noncontiguous three-column extension injuries using a hybrid technique with open occipital to T3 fusion and percutaneous T5–L1 instrumentation at a tertiary care facility.

PATIENT SAMPLE: A 77-year-old man with multiple comorbidities and newly diagnosed AS.

OUTCOME MEASURES: Two-year clinical and radiographic outcome of a patient treated surgically for multiple spine injuries in the setting of an ankylosed spine.

METHODS: The patient was treated with a hybrid approach using both open fusion and percutaneous instrumentation techniques.

RESULTS: At 2 years postoperatively, the patient had recovered ambulatory ability and had a good clinical outcome.

CONCLUSIONS: We describe a unique case of noncontiguous spinal trauma in a medically complex patient with AS treated with a hybrid open and percutaneous technique to minimize surgical insult and blood loss, with a good clinical and radiographic outcome 2 years postoperatively.

Keywords: Ankylosing spondylitis; Spinal fractures; Percutaneous fixation; Minimally invasive techniques; Occipital-cervical dislocation; Hybrid technique

Introduction

Spinal disease in ankylosing spondylitis (AS) predisposes individuals with AS to spinal fractures, which can occur with very minor trauma [1–5]. Treating these injuries is challenging given the multiple comorbidities in these patients and the morbidity of an open surgery [6]. Here we

FDA device/drug status: Approved (Medtronic longitude instrumentation).

Author disclosures: ***ASS:*** Nothing to disclose. ***JLF:*** Nothing to disclose. ***MBD:*** Fees for Participation in Review Activities: SpineNet (C, Paid directly to institution); Royalties: Mayo Medical Ventures/Medtronic (F, Paid to author/institution); Consulting: Mayo Medical Ventures/Medtronic (unknown, Paid directly to institution); Speaking/Teaching Arrangements: AO Foundation: (B); Trips/Travel: AAOS, AO Foundation, AANS (B); Scientific Advisory Board: Broadwater Association (B, Paid directly to institution); Research Support: AO Foundation SpineNet (E); Fellowship Support: AO Foundation (F, Paid directly to institution). ***ANN:*** Research Support (Investigator Salary): Cervical Spine Research Society (F, Paid directly to institution), Orthopedic Research and Education Foundation (D, Paid directly to institution), AO Spine North America (D, Paid directly to institution); Research Support (Staff/Materials): Cervical Spine Research Society (F), Orthopedic Research and Education Foundation (D), AD Spine North America (D); Fellowship Support: OREF (D), AO Spine (E).

The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

* Corresponding author. The Department of Orthopedic Surgery, Mayo Clinic, 200 First St, S.W., Rochester, MN 55905, USA. Tel.: (507) 266-5262; fax: (507) 266-4234.

E-mail address: Nassr.ahmad@mayo.edu (A.N. Nassr)

http://dx.doi.org/10.1016/j.spinee.2015.02.005
1529-9430/

present a unique case of a patient with AS, who sustained three simultaneous spinal fractures and an occipitocervical dislocation after a fall from standing height. This patient was treated with a combined open cervical fusion and percutaneous thoracolumbar fixation to minimize morbidity.

Case report

A 77-year-old man with multiple medical comorbidities including morbid obesity, congestive heart failure, coronary artery disease, diabetes mellitus, and hypertension sustained a fall from standing height. Computed tomography (CT) scan revealed a C1 ring fracture, a three-column extension fracture at C7–T1, and an occipitocervical ligamentous injury with incongruity of the joints (Fig. 1, Left and Middle). Because of the patient's comorbidities and morbid obesity, he was a poor candidate for traditional open stabilization and was transferred in halo vest immobilization to our institution for surgical management. On admission, an additional T9–T10 three-column extension fracture was identified that was originally missed in the patient's evaluation (Fig. 1, Right). Given the imaging characteristics, including spinal ligamentous ossification and marginal syndesmophytes, the patient was diagnosed with AS. A magnetic resonance imaging of the cervical spine also demonstrated an edema in the ligaments at the occipitocervical junction consistent with a traumatic occipitocervical injury. The patient was optimized medically and then underwent an occipital to T3 posterior fusion via open technique and T5–L1 percutaneous instrumentation (Fig. 2).

To perform this technique, the patient was positioned supine on a flat radiolucent table with pinions placed in standard fashion. The patient was then rotisserie flipped into the prone position to minimize the chance of displacing the fracture or the occipitocervical injury. Fluoroscopy was used to check the occipitocervical alignment, paying special attention to the relationship of the clivus and odontoid to judge translation. Through an open approach, occipital plating, C2 pars screws, bicortical cervical lateral mass screws, and thoracic pedicle screws (T1–T3) were placed. A contoured rod was placed from the occipital plate down to T3 and secured with end cap blockers to effectively stabilize the occipitocervical and cervicothoracic injuries. A crosslink was placed at the C5 level, then decortication was performed, and bone morphogenetic protein impregnated *Mastergraft* (BioHorizons Birmingham, AL, USA) was placed. After this, biplanar fluoroscopy was used to place pedicle screws percutaneously to obtain several points of fixation on either side of the T9–T10 from T5–L1. Then 5.5-mm rods were contoured longitudinally for the patient's hyperkyphotic deformity and were passed subfascially from proximal to distal, passing through the towers of the percutaneous system. Before final tightening of the percutaneously passed rod, the length of the proximal rod coming into the open cervical incision was adjusted to allow for matting of the different instrumentation systems using wedding band style rod connectors through the caudal portion of the open incision (Fig. 3).

The operation took 5 hours with 1,000 cc of estimated blood loss. The patient did well postoperatively. After an 18-day hospital admission, he was transferred to a rehab facility and eventually discharged home. Follow-up CT at 2 years shows complete fusion of the C7–T1 and T9–T10 three-column injuries and a pseudoarthrosis at the occipitocervical junction with no signs of lucency about the occipitocervical instrumentation (Fig. 4). Since the patient had no pain or evidence of loosening on imaging, the decision was made to continue observing this clinically. At the most recent follow-up, the patient was ambulatory and complains only of loss of his occipitocervical motion.

Discussion

The incidence of noncontiguous spine fractures has been reported to be as high as 19% and typically involve the cervical and thoracic spine as in our case [7–11]. A case of an AS patient who sustained three spinal fractures has been reported, but these were not simultaneous or as extensive as

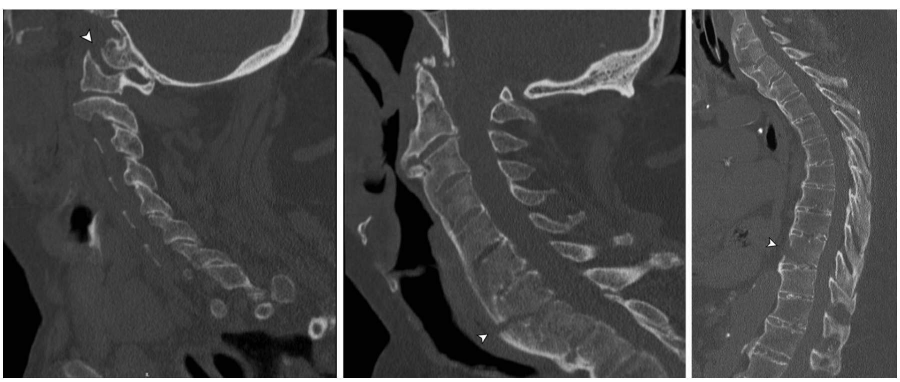

Fig. 1. (Left) Sagittal computed tomography of the occipitocervical ligamentous injury, white arrow indicates the widening of the occipitocervical articulation consistent with a ligamentous injury; (Middle) C7–T1 three-column extension injury, white arrow; and (Right) T9–T10 three-column extension fracture, white arrow.

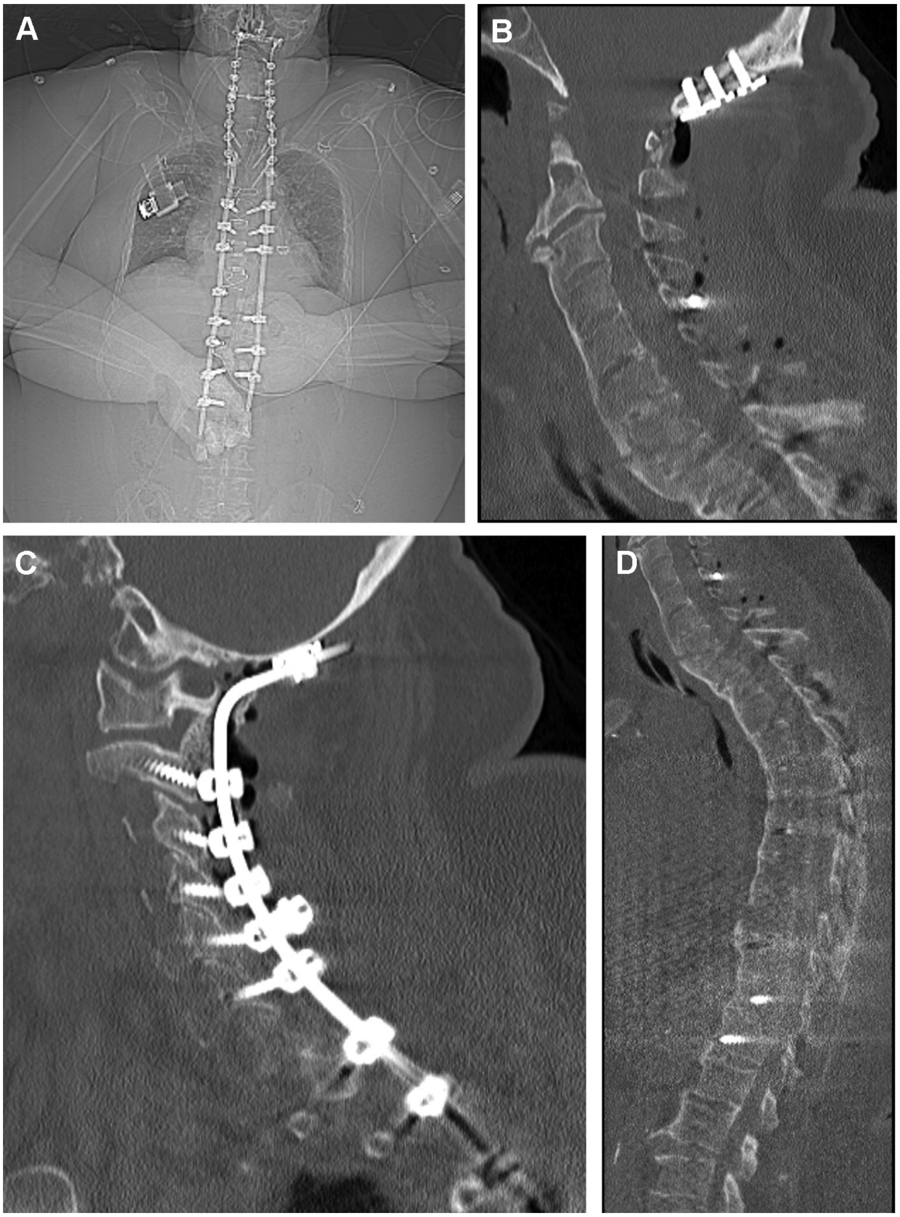

Fig. 2. (A) Postoperative computed tomography (CT) scout image; (B and C) postoperative CT of the occipitocervical fusion; and (D) postoperative CT of the percutaneous thoracolumbar fixation mated to the occipitocervical instrumentation.

our patient's injuries [11]. Typically, spinal fractures in AS occur in transitional zones or at the apex of kyphotic segments [3,7,12,13]. Occipitoatlantal injuries in patients with AS have been described in only two other cases [14,15]. However, to the authors' knowledge this is the first case of simultaneous occipitocervical dislocation with multiple noncontiguous spinal fractures.

Spinal fractures occur 3.5 times more often in AS patients than in the general population and are often unstable [16]. Multiple fractures can be easily missed in AS patients and with devastating consequences [12,17,18]. Neurologic compromise has been shown to occur in 81% of AS patients with a delayed diagnosis [7]. Occult noncontiguous fractures, such as the T9–T10 fracture in our patient can occur frequently. Finkelstein et al. [19] reported seven occult spinal fractures in a review of 21 AS patients who suffered blunt trauma. Six of these occult fractures were noncontiguous and five of those were in different regions of the spine. This emphasizes the importance of evaluating the whole spine in AS patients with spinal trauma, preferably with advanced imaging such as CT or magnetic resonance imaging [20–22]. Although our patient had multiple comorbidities, surgical stabilization is preferred given the poor outcomes reported with nonoperative treatment in these patients. Previous studies suggest that AS patients do not tolerate immobilization well, as it may result in neurologic decline, nonunion, pin site complications, or death [13,23,24]. Early surgical stabilization with

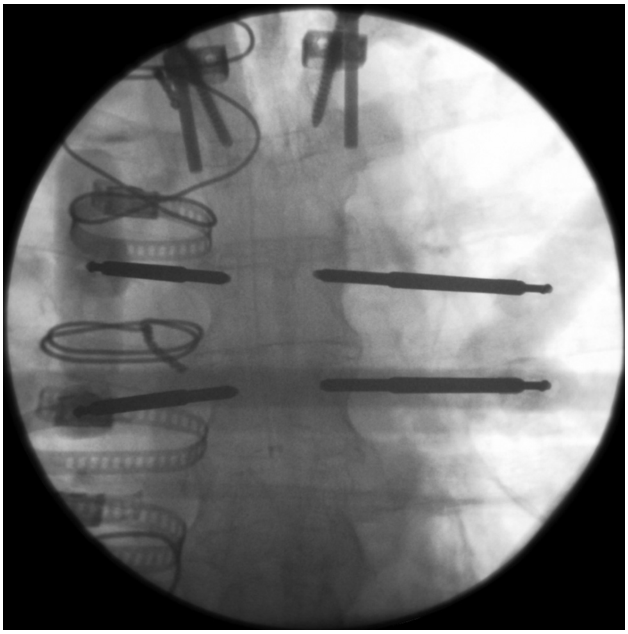

Fig. 3. Intraoperative fluoroscopy image demonstrating wedding band style rod connectors and percutaneous instrumentation.

posterior fusion has been shown to have good results [1,5,13,25]. Although very little is published on the use of percutaneous stabilization techniques in the setting of trauma in patients with an ankylosed spine, the concept is gaining popularity because of the decreased blood loss and the tendency for these patients to heal across their injuries once stabilized. In a preliminary report by Moussallem et al. [26] at the International Meeting on Advanced Spine Techniques, percutaneous techniques in this patient population were associated with lower perioperative morbidity and mortality.

Our patient underwent a combined procedure with open occipitocervical and cervicothoracic fusion, as well as percutaneous thoracolumbar stabilization. This hybrid approach is a unique way to address patients with multiple spinal injuries and comorbidities as it minimizes surgical dissection and intraoperative blood loss associated with traditional open techniques [27]. Kakarla et al. [28] reported a series of six patients with unstable thoracic fractures successfully treated with percutaneous thoracic instrumentation. Percutaneous instrumentation has several advantages in the trauma patient. It is particularly attractive in cases with primarily bony involvement as such injuries have a higher propensity to heal with stabilization. However, utilization of percutaneous stabilization in patients with obesity and multiple comorbidities requires a high level of comfort and experience with minimally invasive techniques. In our patient, we felt that percutaneous instrumentation of his T9–T10 fracture would be successful given AS patients' robust bone forming capability. A long construct

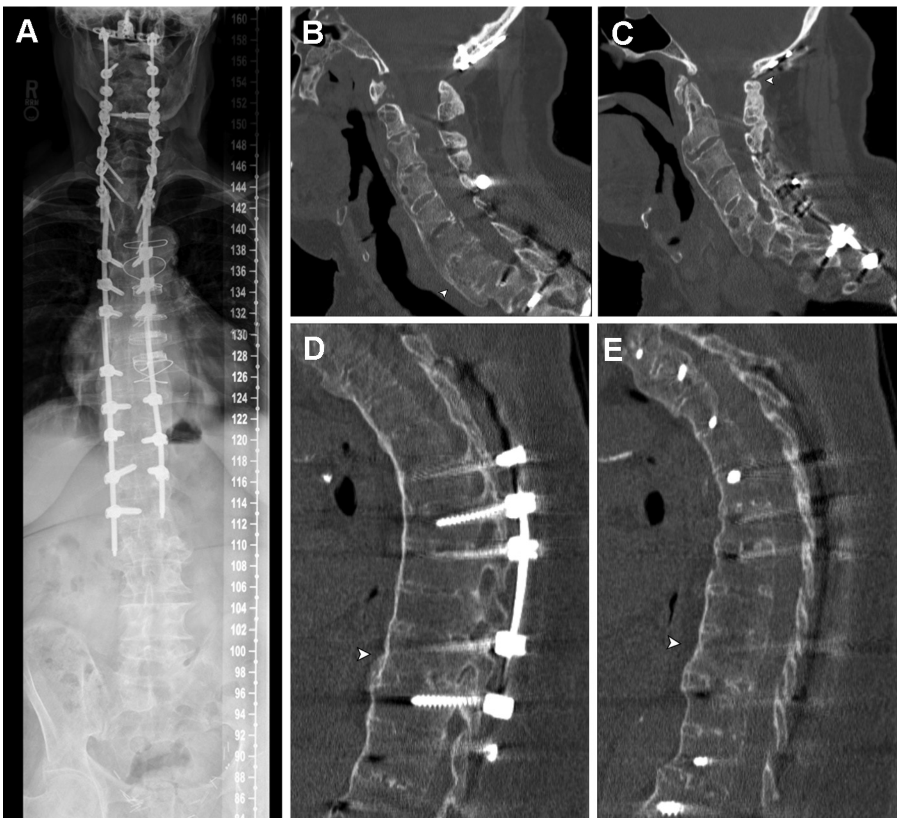

Fig. 4. Two-year follow-up imaging. (A) Full-length scoliosis P-A (posterior-anterior) plain film; (B) computed tomography (CT) of the healed C7–T1 fracture; (C) CT of a stable pseudoarthrosis at the occipitocervical junction; and (D and E) CT of the healed T9–T10 fracture.

was chosen as it was felt that the patient's thoracic fracture would not be amenable to short-segment fixation. In the senior authors' experience, short-segment fixation in a patient with a high body mass index and AS would be prone to stress fractures at the junctional segments.

Conclusion

We report a unique case of three simultaneous noncontiguous spinal fractures and an occipitocervical dislocation in a patient with AS. This injury was treated successfully with a novel technique using combined open and percutaneous techniques to minimize surgical morbidity and intraoperative blood loss. This technique may be a good option for patients with significant medical comorbidities that may not tolerate more extensive open procedures.

References

[1] Detwiler KN, Loftus CM, Godersky JC, Menezes AH. Management of cervical spine injuries in patients with ankylosing spondylitis. J Neurosurg 1990;72:210–5.
[2] Hunter T, Dubo HI. Spinal fractures complicating ankylosing spondylitis. A long-term followup study. Arthritis Rheum 1983;26:751–9.
[3] Murray GC, Persellin RH. Cervical fracture complicating ankylosing spondylitis: a report of eight cases and review of the literature. Am J Med 1981;70:1033–41.
[4] Olerud C, Frost A, Bring J. Spinal fractures in patients with ankylosing spondylitis. Eur Spine J 1996;5:51–5.
[5] Taggard DA, Traynelis VC. Management of cervical spinal fractures in ankylosing spondylitis with posterior fixation. Spine 2000;25:2035–9.
[6] Kubiak EN, Moskovich R, Errico TJ, Di Cesare PE. Orthopaedic management of ankylosing spondylitis. J Am Acad Orthop Surg 2005;13:267–78.
[7] Caron T, Bransford R, Nguyen Q, Agel J, Chapman J, Bellabarba C. Spine fractures in patients with ankylosing spinal disorders. Spine 2010;35:E458–64.
[8] Grisolia A, Bell RL, Peltier LF. Fractures and dislocations of the spine complicating ankylosing spondylitis. A report of six cases. J Bone Joint Surg Am 1967;49:339–44.
[9] Miller CP, Brubacher JW, Biswas D, Lawrence BD, Whang PG, Grauer JN. The incidence of noncontiguous spinal fractures and other traumatic injuries associated with cervical spine fractures: a 10-year experience at an academic medical center. Spine 2011;36:1532–40.
[10] Osgood CP, Abbasy M, Mathews T. Multiple spine fractures in ankylosing spondylitis. J Trauma 1975;15:163–6.
[11] Samartzis D, Anderson DG, Shen FH. Multiple and simultaneous spine fractures in ankylosing spondylitis: case report. Spine 2005;30:E711–5.
[12] Broom MJ, Raycroft JF. Complications of fractures of the cervical spine in ankylosing spondylitis. Spine 1988;13:763–6.
[13] Whang PG, Goldberg G, Lawrence JP, Hong J, Harrop JS, Anderson DG, et al. The management of spinal injuries in patients with ankylosing spondylitis or diffuse idiopathic skeletal hyperostosis: a comparison of treatment methods and clinical outcomes. J Spinal Disord Tech 2009;22:77–85.
[14] Albert GW, Menezes AH. Ankylosing spondylitis of the craniovertebral junction: a single surgeon's experience. J Neurosurg Spine 2011;14:429–36.
[15] Smith MD, Scott JM, Murali R, Sander HW. Minor neck trauma in chronic ankylosing spondylitis: a potentially fatal combination. J Clin Rheumatol 2007;13:81–4.
[16] Jo DJ, Kim SM, Kim KT, Seo EM. Surgical experience of neglected lower cervical spine fracture in patient with ankylosing spondylitis. J Korean Neurosurg Soc 2010;48:66–9.
[17] Einsiedel T, Schmelz A, Arand M, Wilke HJ, Gebhard F, Hartwig E, et al. Injuries of the cervical spine in patients with ankylosing spondylitis: experience at two trauma centers. J Neurosurg Spine 2006;5:33–45.
[18] Fox MW, Onofrio BM, Kilgore JE. Neurological complications of ankylosing spondylitis. J Neurosurg 1993;78:871–8.
[19] Finkelstein JA, Chapman JR, Mirza S. Occult vertebral fractures in ankylosing spondylitis. Spinal Cord 1999;37:444–7.
[20] Fishman EK, Magid D. Cervical fracture in ankylosing spondylitis: value of multidimensional imaging. Clin Imaging 1992;16:31–3.
[21] Harrop JS, Sharan A, Anderson G, Hillibrand AS, Albert TJ, Flanders A, et al. Failure of standard imaging to detect a cervical fracture in a patient with ankylosing spondylitis. Spine 2005;30:E417–9.
[22] Koivikko MP, Kiuru MJ, Koskinen SK. Multidetector computed tomography of cervical spine fractures in ankylosing spondylitis. Acta Radiol 2004;45:751–9.
[23] Schroder J, Liljenqvist U, Greiner C, Wassmann H. Complications of halo treatment for cervical spine injuries in patients with ankylosing spondylitis—report of three cases. Arch Orthop Trauma Surg 2003;123:112–4.
[24] Shen FH, Samartzis D. Surgical management of lower cervical spine fracture in ankylosing spondylitis. J Trauma 2006;61:1005–9.
[25] Cornefjord M, Alemany M, Olerud C. Posterior fixation of subaxial cervical spine fractures in patients with ankylosing spondylitis. Eur Spine J 2005;14:401–8.
[26] Moussallem CD, Nassr A, Cui Q, Currier B, Rose P, Huddleston PM III, et al. Perioperative complications in open versus percutaneous treatment of spinal fractures in patients with an ankylosed spine. Spine J 2012;12:S47.
[27] Song HP, Lu JW, Liu H, Zhang C. Case-control studies between two methods of minimally invasive surgery and traditional open operation for thoracolumbar fracures. Zhongguo Gu Shang 2012;25:313–6.
[28] Kakarla UK, Little AS, Chang SW, Sonntag VK, Theodore N. Placement of percutaneous thoracic pedicle screws using neuronavigation. World Neurosurg 2010;74:606–10.