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Original Research

Comparison of unilateral versus bilateral pedicle screw fixation at the level of fracture using posterior short-segment pedicle instrumentation in the treatment of severe thoracolumbar burst fractures

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HIGHLIGHTS

- PSFFV is one of the standard methods for treating TBFs.
- The reliability of the LSC system on the decision-making in the treatment of severe TBFs is questionable.
- Patients undergoing SSPI with UPSF as compared with BPSF for treating unstable TBFs had similar outcomes.

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ABSTRACT

Background: Thoracolumbar burst fractures (TBFs) are often followed by bilateral pedicle screw fixation (BPSF) at the level of fracture using posterior short-segment pedicle instrumentation (SSPI). There has been increasing support for unilateral pedicle screw fixation (UPSF) in an attempt to reduce complications and costs. The aim of this study was to compare the clinical and radiologic results of UPSF versus BPSF at the level of fracture using SSPI in the treatment of severe TBFs.

Methods: The records of 42 consecutive patients with severe TBFs who underwent SSPI were divided into 2 groups according to the number of screws in the fracture level, including 20 patients (five screws) in UPSF group and 22 patients (six screws) in BPSF. Different clinical and radiological parameters were recorded before surgery, after surgery, and 1.5 years after operation. The patients'clinical outcomes were assessed using visual analog scale (VAS), and Oswestry Disability Index (ODI). For radiological evaluation, changes in local kyphosis angle (LKA), vertebral wedge angle (VWA), and anterior vertebral height (AVH) were investigated using plain radiographs.

Results: Mean follow-up was 18.3 months for UPSF group and 19.0 months for BPSF group ($P > 0.05$). There were no significant differences in the age, gender, fracture type and site in both groups. Radiologically, no statistically difference was observed between the two groups in corrected rate of LKA, VWA, or AVH(all $P > 0.05$). With respect to clinical variants including VAS and ODI scores, there were also no significant differences. However, the UPSF group seemed to have advantages over BPSF group in operative time, blood loss, postoperative drainage, hospitalization time ($P > 0.05$). Especially, implant cost for the BPSF group was 22% greater than the UPSF group. No serious complications occurred in our study. In all cases, fusions healed well and no revision surgery was performed for loss of correction or failure of instrumentation during follow-up.

Conclusions: The present study is the first to demonstrate that patients undergoing SSPI with UPSF as compared with BPSF for the treatment of severe TBFs had similar clinical and radiologic outcomes.

1. Introduction

In spite of the high incidence of thoracolumbar fracture in the axial skeleton, the indications of operative treatment and the

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optimal method of surgery for this site of fracture remain debate [1,2]. Nowadays, several surgical techniques, including posterior, anterior, open, invasive, and combined posterior-anterior ones, are available for the treatment of thoracolumbar burst fractures (TBFs). More recently, with the improvements in instrument quality, there is a general consensus that short-segment pedicle instrumentation (SSPI) is a standard method for treating TBFs with the advantages of reducing the blood loss, preserving segmental motion, and having fewer complications [3,4]. It is also worth mentioning that the incidences of postoperative low back pain are significantly reduced [3,4].

However, many reports have shown that this technique leads to a high incidence of early instrumentation failure and progression of kyphotic deformity [5–8]. In order to reduce previously mentioned complications, some authors advocate the technique of SSPI including the insertion of two screws at the fractured vertebra [1,7,9]. Gradually, it is documented that this technique has better outcomes than patients with SSPI. Also, biomechanical studies have showed its advantages of increasing the stiffness of the construct and protecting the anterior column [9–11]. Notably, even for patients with severe TBFs, SSPI including the insertion of two screws at the fractured vertebra can also provide good clinical and radiologic outcomes [12].

Our previous clinical experiences make us believe that SSPI with unilateral pedicle screw fixation (UPSF) at the level of fracture can provide comparable results as bilateral pedicle screw fixation (BPSF). However, there is limited clinical evidence that directly compares UPSF versus BPSF at the level of fracture using SSPI in the treatment of severe TBFs. Therefore, the aim of this study was to compare the clinical and radiologic results of this two techniques.

2. Materials and methods

2.1. Subjects

Under the approval of the Ethical Committee of Nanjing Medical University, a sum of 43 patients with severe TBFs undergoing posterior surgery were enrolled in the authors' hospital from January 2009 to June 2015. The inclusion criteria for subjects were as follows: age between 36 and 58 years; LSC score$\geq$7; follow-up time more than 1.5 years. Our exclusion criteria were as follows: LSC score$\leq$6; long segment instrumentation; combined anterior-posterior surgeries; follow-up of less than 1.5 years; and pathological fractures. An informed consent form was obtained from each patient prior to their participation in the study.The patients were divided into two groups according to the number of screw in the fracture level.

2.2. Clinical and radiographic parameters

Patients were assessed with regards to age, gender, trauma etiology, fracture level, fracture type, clinical and radiologic outcomes, and injury details. All the patients performed the preoperative radiographs, computed tomography (CT) and magnetic resonance imaging (MRI) scans of the thoracolumbar spine. CT was taken to classify the fracture type and to assess the severity of the fracture. MRI was used to ascertain whether the posterior ligamentous complex (PLC) and spinal cord were injured. The severity of the fracture was evaluated based on the scoring system proposed by McCormack et al. [13]. In addition, the operative indication was also assessed based on the thoracolumbar injury classification system [14]. The neurologic status was estimated according to the American Spinal Injury Association (ASIA) grading system. Finally, data were collected and analyzed according to two different subgroups.

Radiologic parameters were analyzed from the plain radiographs including local kyphosis angle (LKA), vertebral wedge angle (VWA), and anterior vertebral height (AVH). The measuring methods were shown in https://vpn.njmu.edu.cn/science/article/pii/,DanaInfo=www.sciencedirect.com+S1529943014013461 Fig. 1. Data for preoperative, immediate post-operative and follow-up radiological measures were collected. The clinical outcomes were assessed by Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) scores. The signs of implant failure including the presence of screw breakage, screw pullout, implant loosening, rod breakage, and an increase in the local kyphosis of more than 10° were assessed at the follow-up radiographs [5].

2.3. Statistical analysis

Student *t*-test was performed for statistical analysis of surgical outcomes between two groups. The software Statistical Package for the Social Sciences (SPSS, version 17.0) was used for all analyses. Any value of p-value < 0.05 were considered significant.

2.4. Surgical procedure

Posterior midline incision was performed under general anesthesia and fracture site was determined by C-arm. Patients were in the prone position. All operations were performed by one of the senior authors using the same internal fixation system (Stryker Corporation). In UPSF group, except from the four monoaxial screws inserting into the vertebra one level above and below the fracture, we only inserted one screw (polyaxial) into the fractured vertebra. However, in BPSF group, two polyaxial screws were inserted into the fractured vertebra. Screws with a diameter of 5.5–6.5 mm and a length of 40–50 mm, depending on the level and size of the vertebra, were placed through the pedicles using the freehand technique. The cross link was used to augment torsional rigidity for each patient. Reduction of the fracture and indirect decompression of the spinal canal were accomplished by the rod distraction forces before tightening the screws.

The bilateral surfaces of posterior lamina and wall of the facet were decorticated by using a high speed drill. Then, fusion was performed in all patients by using autograft from iliac bone. Laminectomy was done according to the extent of compression on neural tissue in pre-operative CT and MRI. The degree of kyphosis correction and the position of the screws were assessed by the postoperative radiographs [3].

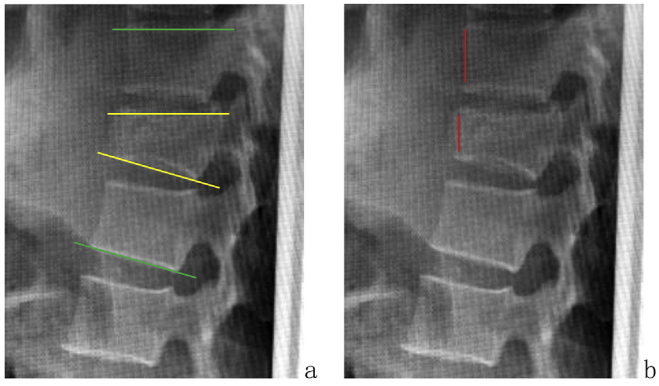

Fig. 1. In the lateral radiographs, the vertebral wedge angle (VWA) was calculated between the proximal and distal end plates of the fractured vertebra (yellow line: Left). The local kyphosis angle (LKA) was measured between the proximal end plates of the vertebra above the fractured vertebra and the distal end plates of the vertebra below the fractured vertebra in Fig. 1a (green line: Left).The anterior vertebral height was measured as shown in Fig. 1b.