



Original Research

Comparison of short-segment pedicle fixation with versus without inclusion of the fracture level in the treatment of mild thoracolumbar burst fractures



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HIGHLIGHTS

- SSPF is one of the standard methods for treating TBFs.
- SSPF had advantages over PSFFV method in minimal invasiveness and lower cost.
- SSPF yields excellent results in treating mild TBFs regardless of whether the fixation includes the fractured vertebra or not.

ARTICLE INFO

Article history:

Received 3 September 2016
Received in revised form
15 November 2016
Accepted 16 November 2016
Available online 17 November 2016

Keywords:

Thoracolumbar burst fracture
Load sharing classification
Vertebral wedge angle
Short segment
Posterior

ABSTRACT

Background: A review of the literature showed that posterior short-segment fixation including the fractured vertebra (PSFFV) has better outcomes in the treatment of thoracolumbar burst fractures (TBFs) than patients with short-segment pedicle screw fixation (SSPF) alone. However, its efficacy in mild TBFs with load-sharing scores of 3 and 4 points has not been specifically analyzed. The aim of this study was to compare the clinical, functional and radiologic results of PSFFV with SSPF for mild TBFs and to determine whether the screws in the fractured vertebra were necessary for these patients.

Methods: In this retrospective study, sixty-nine patients with mild TBFs were divided into 2 groups according to the number of instrumented levels. Group A included 34 patients treated by SSPF (four screws: one level above and below the fracture), and Group B included 35 patients treated by PSFFV (six screws: including the fractured vertebra). Clinical and radiologic parameters were evaluated before surgery, after surgery, and at follow-up. They included clinical outcomes: visual analog scale (VAS), Oswestry Disability Index (ODI). Being a radiology-based study, the radiologic measures included vertebral wedge angle (VWA), and anterior vertebral height (AVH).

Results: A sum of 69 patients (34 patients in Group A and 35 patients in Group B) were enrolled in the study. The patients in both the groups showed similar outcomes with regards to age, gender, fracture type and site. We did not find any statistically difference between the two groups in corrected rate of VWA or AVH ($P > 0.05$). In terms of clinical variants such as VAS and ODI scores, there were also no significant differences. However, the SSPF had advantages over PSFFV method in operative time, blood loss, postoperative drainage and postoperative hospitalization time ($P > 0.05$). There were no serious complications occurring during our study, such as infection, blood vessel injury, spinal cord or nerve root injury. No patient needed revision for loss of correction or failure of instrumentation.

Conclusions: SSPF alone is a safe and effective surgical method for restoration and maintenance of vertebral column stability in treating mild TBFs. It gives excellent clinical and radiological results regardless of whether the fractured vertebra is included in the fixation or not.

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1. Introduction

Thoracolumbar fracture is one of the most common areas of fracture in the axial skeleton [1–3]. For treating cases with neurological injuries, posterior screw fixation has been widely

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accepted. However, the proper management of thoracolumbar burst fractures (TBFs) in the absence of a neurological deficit remains controversial. Some scholars advocate early surgical treatment even for mild TBFs because of a certain degree of spinal deformity, low back pain occurring over time [3,4].

The surgical approaches include anterior surgery, posterior surgery, and a combination of anterior and posterior surgery. Short-segment pedicle screw fixation (SSPF) is one of the most standard surgical approaches in treatment of TBFs. This technique has many advantages of preserving segment motion, providing superior correction of kyphosis, and reducing blood loss [3–5]. However, some reports suggest the high failure rate of the traditional SSPF, which is not satisfactory as predicted [7–10]. Further, it is reported that the main cause of this failure is the structural and mechanical deficiency of the anterior column [8–10]. To prevent this, various surgical techniques are used to augment the anterior column. Among them, the additional insertion of two screws in the fractured vertebra (posterior short-segment fixation including fractured vertebra [PSFFV]) is introduced and well demonstrated. Also, biomechanical studies have shown that addition of a screw at the level of the fracture increases the stiffness of the construct and reduces the failure rate of short-segment pedicle instrumentation [9–11].

Although previous studies have demonstrated that PSFFV has better outcomes than patients with SSPF alone [11–13], those reports intend to assess the outcomes for patients with moderate and severe fractures. For patients with mild TBFs, there are no reports specifically comparing the efficacy between the two approaches. The question remains unclear about whether the additional insertion of two screws in the fractured vertebra is necessary for these patients. The purpose of the current study was to compare the efficacy and results of PSFFV with SSPF in the treatment of mild TBFs and to determine whether the two screws in the fractured vertebra were necessary. The severity of the fracture in the present study was assessed by the load-sharing classification (LSC) proposed by McCormack et al. [14]. Patients with load-sharing scores of 3 and 4 points were included in this study. Different parameters important in the outcome would be evaluated and discussed.

2. Materials and methods

This is a retrospective study performed in authors' spinal care center. Under the approval of local institutional review board, a total of 72 patients with mild TBFs without neurologic injury who had undergone PSFFV or SSPF were enrolled. The inclusion criteria for subjects were as follows: age between 30 and 55 years; with load-sharing scores of 3 and 4 points; follow-up exceeding 1.5 years. Our exclusion criteria were as follows: LSC score ≥ 5 ; long segment instrumentation; combined anterior-posterior surgeries; follow-up of less than 1.5 years; and pathological fractures. All the operations were performed by one of the two authors without any discriminations according to the fixation type.

All patients had preoperative anteroposterior and lateral radiographs, and computed tomography (CT) scan of the spine. CT scans were taken to classify the fracture type, to assess vertebral comminution, and to see whether the pedicles of the neighboring vertebrae were intact and able to take the screws. Load sharing score was calculated based on the scoring system described by McCormack et al. [14]. Each calculation was independently done by two blinded senior attending spinal surgeons. Data were collected and analyzed according to two different subgroups.

The pre-operative, post-operative and follow-up radiographs were evaluated. Analysis of the plain radiographs included: vertebral wedge angle (VWA) and anterior vertebral height (AVH) (Fig. 1). The VWA and AVH of the fractured vertebra were measured

as shown in Fig. 1. Data for initial, immediate post-operative and final follow-up radiological analyses were compared. The criteria for implant failure was considered as follow: presence of screw breakage, screw pullout, peri-implant loosening, rod breakage, and an increase in the local kyphosis of more than 10° [7]. The patient's functional outcome was assessed by visual analog scale (VAS) score for pain and Oswestry Disability Index (ODI) scores.

3. Statistical analysis

The software Statistical Package for the Social Sciences (SPSS, version 17.0) was used for all analyses. The clinical, functional and radiologic results were compared between two groups using Student *t*-test. A *p*-value < 0.05 was considered statistically significant.

4. Surgical procedure

A conventional open procedure was used in this study. Patients were in the prone position with vacated abdomen. Under general anesthesia, the posterior midline approach was performed. The fracture site was determined with locator and C-arm. In group A, monoaxial screws were only inserted into the vertebra cephalad and caudal to the fracture. Screws were 40 or 50 mm long, depending on the level and size of the vertebra. The internal fixation was applied bilaterally, and cross-links were used to augment torsional rigidity. Reduction of the fracture and indirect decompression of the spinal canal were accomplished by the rod contouring, extension and compression-distraction forces before tightening the screws. In group B, The posterior fixation short-segment pedicle screw fixation included the fractured vertebra. The screws in the fractured vertebra were all polyaxial and were inserted into both the pedicles using freehand technique. Fusion was performed in all patients by using autograft from iliac bone. The degree of kyphosis correction and the position of the screws were assessed by the postoperative radiographs. All patients were periodically followed-up with clinical and radiologic evaluation.

5. Results

5.1. Patient basic information

After application of the inclusion and exclusion criteria, seventy-two patients who presented to our department with single-segment TBFs without neurologic injury between June 2010 and June 2014 were enrolled in this study. The injury mechanism includes vehicle accident and high falling. Three patients discontinued their visits for unknown reasons and thus were excluded from the study. Finally, a total of 69 patients, including 42 males and 27 females, were included in this study.

The participants were divided into two groups: short-segment pedicle screw fixation (Group A, 34 cases) and posterior fixation including fractured vertebra approach (Group B, 35 cases). The mean age of the patients in Group A was 40.67 years (range: 31–54 years), and the male-female ratio was 20:14. As for fracture site, 5 patients were in T11, 12 in T12, 10 in L1 and 7 in L2. The mean age of the patients in Group B was 41.86 years (range: 30–55 years), and the male-female ratio was 22:13. Among them, 4 patients were in T11, 11 in T12, 9 in L1 and 11 in L2. As shown in Table 1, T12 was the most commonly affected vertebra ($n = 23$), followed by L1 ($n = 19$), L2 ($n = 18$), and T11 ($n = 9$). All the fractures had load sharing scores of 3 or 4 points. According to AO spine injury classification system, all the patients were A3 type. The follow-up time was more than 1.5 years for each patient. On the whole, all the patients were operated within one week. Specifically, the mean time from the injury to operation was 4.5 days. There was no statistically significant

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