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Original research

Minimally invasive pedicle screw fixation combined with percutaneous vertebroplasty for the treatment of thoracolumbar burst fracture

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HIGHLIGHTS

- We introduce a minimally invasive technique for thoracolumbar burst fracture.
- The technique could be performed easily and safety.
- The technique is a good choice for thoracolumbar burst fracture.

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ABSTRACT

Introduction: To evaluate the feasibility, efficacy and safety of minimally invasive pedicle screw fixation (MIPS) combined with percutaneous vertebroplasty (PVP) using calcium phosphate for the treatment of thoracolumbar burst fracture without neurologic deficits.

Methods: Between September 2011 and April 2013, a total of thirty-seven patients with a mean age of 50.73 years (range 40–63 years), who suffered from thoracic or lumbar burst fracture without neurologic deficits underwent the procedure of MIPS combined with PVP using calcium phosphate. The preoperative and postoperative pain assessment were evaluated using Visual Analogue Scale (VAS) and American Spinal Injury Association (ASIA). The Cobb angles and central and anterior columns height were measured on the lateral radiographs before surgery and immediately, 1 month, 3 months, 6 months, 1 year and 2 years after surgery.

Results: The patients were followed up for an average of 27.54 ± 2.47 months. The mean VAS significantly decreased from 9 (range 6–10) before surgery 2 (range 1–3) immediately after surgery and 1 (range 0–2) at 2-year follow-up. The Cobb angle was 22.58 ± 1.70° before surgery and 4.11 ± 1.41° immediately after surgery and 5.06 ± 1.11° at 2-year follow-up. The central and anterior vertebral body height decreased from 44.10 ± 7.0% and 49.76 ± 6.43% before surgery to 80.09 ± 4.05% and 93.31 ± 1.87% immediately after surgery, respectively. No significant changes in vertebral body height restoration were observed during 2 years follow-up after surgery. In addition, there were no instrumentation failure and complications in all patients.

Conclusions: Our study indicated that MIPS combined with PVP using calcium phosphate is a good choice for the treatment of thoracolumbar burst fracture without neurologic deficits.

1. Introduction

Thoracolumbar burst fractures are most common in spine injuries, which usually occur at the thoracolumbar spine junction [1]. The management of thoracolumbar burst fracture usually unstable still remains controversial, especially for patients without neurologic deficits. Although conservative managements, including pain control and physical therapy-assisted mobilization, have been

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reported to provide satisfactory outcomes, unfortunately most cases still suffer from early or late complications, such as residual kyphosis, prolonged recumbency, pressure sores, and late neurologic impairment [1, 2]. Surgical treatment has been widely accepted as an effective method for thoracolumbar burst fractures because it has several advantages including immediate spinal stability, and more reliable restores of sagittal alignment, vertebral height, and canal dimension [3].

Among operative options, segment pedicles screw instrumentation is a well-described technique performed easily for spinal fracture. However, the technique presents more limits to augment the anterior column after reducing a fractured vertebral body. Insufficient anterior column support finally induces hardware failure and loss of reduction [4]. Percutaneous vertebroplasty (PVP), minimal invasive injection of bone cement into the fractured vertebral body, can stabilize vertebral body and presents positive outcomes when alone used in some selected patients with spinal burst fracture [5]. A study by Fuentes et al reported that PVP combined with short-segment pedicle screw fixation could achieve similar verbebral height recovery and kyphosis correction rates to those obtained with open surgery. No instrumentation failure or measurable loss of sagittal curve and vertebral height correction were found within a mean of 26 months follow up [6].

In recent years, minimally invasive surgery has been successfully used in the treatment of spinal fractures, and more studies reported that the technique, when compared with standard open approaches, is associated with less soft tissue destruction (muscle atrophy and denervation), reduced intraoperative blood loss, and shorter time of hospitalization [7]. Because of more advantages of minimal invasive technique, it may be a suitable choice for patients with unstable spinal fracture that require open reduction. In the present study, we designed a technique of minimally invasive pedicle screw fixation (MIPS) combined with PVP using calcium phosphate for thoracolumbar burst fracture. We had successfully performed the technique to treat patients with thoracolumbar osteoporosis vertebral compressive fractures (VCFs), which could prevent secondary fracture after PVP [8, 9]. However, whether the minimally invasive technique was suitable for thoracolumbar burst fractures remains unclear. The purpose of this study was to evaluate the feasibility, efficacy and safety of MIPS combined with PVP using calcium phosphate for the treatment of thoracolumbar burst fractures.

2. Materials and methods

2.1. Patients

The clinical study proposal was approved by the medical ethics committee of our committee. From September 2011 to April 2013, 37 patients with thoracolumbar burst fractures classified as type A3 without neurologic deficits were selected for this study. Preoperative clinical assessments, neurological tests according to American Spinal Injury Association (ASIA), and pain assessments using visual analog scale (VAS) were recorded. The radiological tests performed prior to surgery included standard anteroposterior and lateral roentgenograms of the thoracolumbar spine, CT scans with axial, sagittal and coronal reconstruction, and magnetic resonance imaging (MRI) for checking that the spinal cord and the posterior ligamentous complex were intact (Fig. 1 A, B, C1, C2). All patients had the presence of one recent 4 days (range 2–7 days) thoracolumbar burst fractures, defined as more than 20° of local kyphosis and/or 35% of vertebral height loss, and edema, a fracture

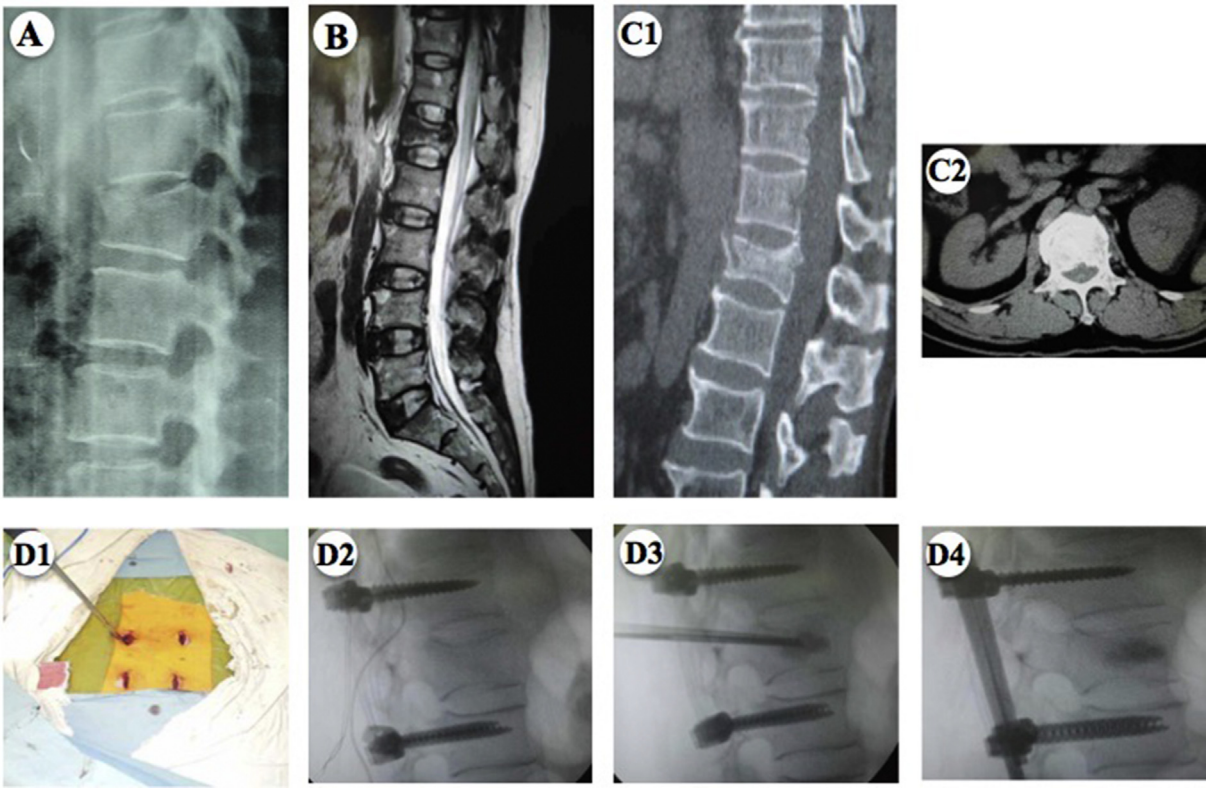

Fig. 1. Pre-operative (A) lateral X-ray, (B) MRI, and (C1) CT showed a type A3.1 L-1 fracture. Pre-operative (C2) axial CT showed no neurological compression. (D1) Photograph and (D2) fluoroscopic image showed placement of pedicle screws into the vertebrae adjacent to the fractured one using a minimally invasive technique. (D3) Fluoroscopic image showed the injection of bone cement after insertion of minimally invasive pedicle screws. (D4) Fluoroscopic image showed the placement of rods over the pedicle screws in adjacent vertebrae.