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Clinical Study

Viability and long-term survival of short-segment posterior fixation in thoracolumbar burst fractures

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Abstract

BACKGROUND CONTEXT: Short-segment pedicle screw instrumentation constructs for the treatment of thoracolumbar fractures gained popularity in the 1980s. The load-sharing classification (LSC) is a straightforward way to describe the extent of bony comminution, amount of fracture displacement, and amount of correction of kyphotic deformity in a spinal fracture. There are no studies evaluating the relevance of fracture comminution/traumatic kyphosis on the long-term radiologic outcome of burst fractures treated by short-segment instrumentation with screw insertion in the fractured level.

PURPOSE: To evaluate the efficacy of the six-screw construct in the treatment of thoracolumbar junction burst fractures and the influence of the LSC score on the 2-year radiologic outcome.

STUDY DESIGN: Case series of consecutive patients of a single university hospital.

PATIENT SAMPLE: Consecutive patients from one university hospital with nonosteoporotic thoracolumbar burst fractures.

OUTCOME MEASURES: Being a radiology-based study, the outcome measures are radiologic parameters (regional kyphosis [RK], local kyphosis, and thoracolumbar kyphosis [TLK]) that evaluate the degree and loss of correction.

METHODS: Retrospective analysis of all consecutive patients with nonosteoporotic thoracolumbar burst fractures managed with a six-screw construct in a single university hospital, with more than 2 years' postoperative follow-up.

RESULTS: Eighty-six patients met the inclusion criteria, and 72 (83.7%) with available data were ultimately included in the study. The sample included 53 men and 19 women, with a mean (standard deviation [SD]) age of 35.6 years (14.4 years) at the time of surgery. Mean LSC score was 6.3 (SD 1.6, range 3–9). Forty-four of 62 (70.9) fractures had a score greater than 6. Mean (SD) RK and

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TLK deteriorated significantly during the first 6 months of follow-up: 2.90° (4.54°) p=.005 and 2.78° (6.45°) p=.069, respectively. Surgical correction correlated significantly (r=0.521, p<.0001) with the time elapsed until surgery. Loss of surgical correction (postoperative to 6-month RK and TLK increase) correlated significantly with the LSC score (r=0.57, p=.004; r=0.51, p=.022, respectively). Further surgery because of correction loss was not required in any case.
CONCLUSIONS: The six-screw construct is effective for treating thoracolumbar junction burst fractures. The medium-to-long-term loss of correction is affected by the amount of bony comminution of the fracture, objectified through the LSC score.

Keywords: Burst fracture; Short-instrumentation; Pedicle screw; Load sharing classification; Post-traumatic kyphosis; Thoracolumbar junction

Introduction

Short-segment pedicle screw instrumentation constructs for the treatment of thoracolumbar fractures gained popularity in the 1980s [1–3]. However, early construct failure was reported when the anterior spinal column was compromised [2].

In 1994, McCormack et al. [4] proposed the load-sharing classification (LSC) as a straightforward way to describe the extent of bony comminution, amount of fracture displacement, and amount of correction of kyphotic deformity in a spinal fracture. Several years later, the classification was shown to be valid and reliable [5,6]. Fractures with mild comminution (LSC ≤6) have been successfully repaired with short-segment pedicle instrumentation (four screws, two in each adjacent vertebra, leaving the fracture free). An anterior approach with anterior reconstruction has been recommended for highly comminuted fractures (LSC ≥7). In addition to comminution, the location of the fracture also determines the risk of collapse [7]. At the thoracolumbar junction (T10–L2), the center of gravity falls on the anterior half of the vertebral body and there is a greater kyphogenic effect than in fractures occurring in the mid- or low lumbar spine [7].

One randomized controlled trial has shown that transpedicular grafting does not prevent failure of short fixation in the treatment of thoracolumbar burst fractures [8]. Transpedicular balloon vertebroplasty has been reported to restore vertebral anatomy and augment the anterior column [9,10]. Partial loss of reduction was seen in most cases after balloon deflation, and cement leakage occurred in 25% of cases [9]. Anterior procedures using structural graft or cages address the anterior column insufficiency [11] in some cases. Combined anterior/posterior approaches have also been advocated [12], but they are a major undertaking for the patient.

Recent in vitro biomechanical studies in an unstable burst fracture model have shown that the addition of two screws in the fractured vertebra (six-screw construct) increases the stiffness of short-segment pedicle instrumentation. Two recent randomized controlled trials [13,14] confirmed the biomechanical findings and showed that instrumentation of the fractured vertebra is safe, dramatically reduces the failure rate of short-segment instrumentations, and yields 2-year follow-up results similar to those of long instrumentations. To our knowledge, there are no studies evaluating the relevance of fracture comminution/traumatic kyphosis on the long-term radiologic outcome of burst fractures treated by short-segment instrumentation with screw insertion in the fractured level. The aim of our study was to evaluate the efficacy of the six-screw construct in the treatment of burst fractures of the thoracolumbar junction and determine the influence of the LSC score on the 2-year radiologic outcome.

Material and methods

We retrospectively analyzed all consecutive patients with a nonosteoporotic thoracolumbar (T11–L2) burst fracture, surgically managed with six-screw constructs in a single university hospital, and with more than 2 years of follow-up. Institutional review board approval from local ethics committee was obtained.

The standard surgical technique, described previously [13,14] includes proper positioning of the patient, with hyperextension of the thoracolumbar junction, and use of a posterior midline approach (one vertebrae above and one below the fractured vertebra). Insertion of long monoaxial pedicle screws in the fractured and adjacent vertebrae is frequently performed under C-arm control to ensure that the screws placed are parallel to the end plates of healthy vertebrae and to reproduce the posttrauma kyphosis at the fractured one. Screws in the fractured vertebra must be strictly parallel to the healthy end plate. When both end plates are fractured, screws should be placed in the middle. Fracture reduction is obtained using lordotic rods tightly connected to the upper screws. Rods are progressively connected first to the fractured vertebra and then to the vertebra below by a cantilever maneuver. The precontoured rods push the fractured vertebra anteriorly and restore the physiological sagittal spinal alignment. Monoaxial screws properly placed in the fractured vertebra correct the posterior tilting of the vertebra. Facet joints and posterior vertebral arches are decorticated and bone graft is placed posterior and posterolaterally.

Two independent investigators reviewed the patients' charts, following a preestablished protocol. Fractures were scored according to the LSC using preoperative X-rays and computed tomography scans. The time elapsed to sur-