Injury, Int. J. Care Injured 46S4 (2015) S75–S82

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Spinal fracture reduction with a minimal-invasive transpedicular Schanz Screw system: clinical and radiological one-year follow-up

Markus Loibl[a,*], Mariya Korsun[a], Julian Reiss[a], Boyko Gueorguiev[b], Michael Nerlich[a], Carsten Neumann[a], Florian Baumann[a]

[a] *Department of Trauma Surgery, Regensburg University Medical Center*
[b] *AO Research Institute Davos, Davos, Switzerland*

KEYWORDS

thoracic spine
lumbar spine
spinal trauma
vertebral body fracture
minimal-invasive surgery
internal fixators
outcome
reduction

ABSTRACT

Introduction: Surgical management of thoracolumbar trauma involves correction of posttraumatic deformity and placement of transpedicular instrumentation. The aim of this prospective cohort study was to generate first results reflecting the clinical and radiological outcome of patients treated with percutaneous dorsal instrumentation for fractures of the thoracic and lumbar spine with the use of a transpedicular new Schanz Screw system (USS Fracture MIS, DePuy Synthes).
Methods: A total of 26 patients with fractures of the thoracic and lumbar spine were operatively treated with bi-segmental dorsal instrumentation between January and December 2012. Radiological data acquisition was performed pre- and postoperatively, after six weeks, three, six, and twelve months. The radiological parameter of interest was the bi-segmental kyphotic end plate angle (Cobb angle). The Chronic Disability Index (CDI), the Oswestry Disability Index (ODI), and the Spine Tango Core Outcome Measurement Index (COMI) were applied to investigate the clinical outcome.
Results: The clinical follow-up was completed by 22 patients (84.6%), and the radiological follow-up by 21 (80.8%) patients. Our patient population had a mean age of 47.4 ± 4.1 years. Twelve patients received dorsal instrumentation, and 14 patients were treated with an additional ventral reconstruction. Intraoperative reduction was 11.5 ± 1.5° among all patients ($p < 0.01$). A considerable amount of the operative correction was lost after six weeks with a loss of reduction of 4.6 ± 1.4° ($p < 0.01$). At one year follow-up, the measured loss of reduction was significant in comparison to the postoperative state, 6.9 ± 1.3° among all patients, 8.7 ± 2.1° after dorsal and 4.9 ± 1.1° after dorsoventral stabilisation (all $p < 0.01$). Moreover, all patients had minimal to moderate disability with a CDI of 1.8 ± 0.4 (0 - 7), and an ODI of 15.6 ± 3.6 (0 – 60).
Conclusion: The new transpedicular Schanz screw system can deliver a correction and stabilization of thoracic and lumbar spine fractures. Patients report minimal to moderate disability as a result of their severe injury one year after trauma. We advocate the use of the transpedicular Schanz screw system to correct posttraumatic kyphotic deformity, with secondary anterior fusion in our treatment strategy of thoracolumbar incomplete burst fractures in patients without a neurologic deficit.

Introduction

Despite the introduction of several classification systems [1-3], optimal treatment guidelines for fractures of the thoracic and lumbar spine have not been established. Surgical management of thoracolumbar trauma involves placement of transpedicular instrumentation, correction of posttraumatic deformity, and fusion. Additional ventral measures may be considered for reconstruction of the ventral column, or for removal of fragments from the spinal canal.

A historic multicenter trail revealed a mean reduction potential of posttraumatic kyphotic deformity of 10° using various implants and an open approach [4]. However, the dorsal procedure demonstrated denervation and ischemia of the paraspinal muscles, and therefore constitutes a predisposition to development of pain [5-7]. Wild et al. compared for the first time a minimally invasive approach with an open approach for posterior instrumentation using the same implant, and demonstrated identical operating time, X-ray exposure and loss of correction at significantly reduced intra- and postoperative blood loss with the minimally invasive approach [8]. As a result, the invention and continued evolution of spinal instrumentation gave rise to innovative minimal-invasive surgical techniques and implant designs. Several percutaneous systems have recently been investigated for reducing posttraumatic kyphosis [9-12]. Therefore, it is well accepted that minimally invasive posterior instrumentation

* Corresponding author at: Department of Trauma Surgery, Regensburg University Medical Center, Franz-Josef-Strauss-Allee 11, 93042 Regensburg, Germany.
Tel.: +49 (0)941-944 6805; fax.: +49 (0)941-944 6806.
E-mail address: markus.loibl@ukr.de (Markus Loibl).

for fractures of the thoracic and lumbar spine is associated with less approach-related morbidity, decreased postoperative pain, and more rapid mobilization of patients. The most common drawbacks of percutaneous systems have been reduced angular stability of polyaxial screws, and lesser potential to correct posttraumatic kyphotic deformity. Most recently, Weiß et al. demonstrated an intraoperative reduction of kyphotic deformity of fractures of the thoracolumbar junction of 6.8° using two different percutaneous systems [9]. However, the authors emphasized that monoaxial screws and reduction tools are required to accomplish and maintain long-term reduction.

The aim of this prospective non-randomized cohort study was to generate first results reflecting the clinical and radiological outcome of patients treated with percutaneous dorsal (and dorsoventral) instrumentation for fractures of the thoracic and lumbar spine with the use of a new transpedicular Schanz Screw system (USS Fracture MIS, DePuy Synthes, Synthes, Oberdorf, Switzerland). Primary outcomes were amount of fracture reduction and extent of loss of reduction over the course of one year after surgery. Secondary outcomes were clinical scores one year after surgery to assess the clinical outcome.

We paid special attention to investigate the influence of purely posterior surgery, or additional anterior surgery on all outcomes. We hypothesized good clinical results and similar radiological outcome in comparison to posterior stabilization of the spinal column with a conventionally open approach as reported in the literature.

Materials and methods

Ethics statement

This study was approved by the Ethics Committee of the University of Regensburg (Institutional Review Board Number 13-101-0158). Written informed consent was obtained from every patient in accordance with the declaration of Helsinki.

Inclusion and exclusion criteria

Between January and December 2012, 40 patients with acute vertebral fractures of the thoracic and lumbar spine were operatively treated in our department (level I trauma) with a minimal invasive percutaneous transpedicular Schanz Screw internal fixator. All patients were above the age of 18. Twenty-six patients, who were operatively treated with bi-segmental dorsal instrumentation, were included in this study, excluding patients with multi-segmental dorsal instrumentation and patients residing outside of Germany (Fig. 1).

Clinical and radiological data acquisition

We prospectively identified all included patients and followed them during the first year postoperatively. Clinical outcome scores were assessed at the last follow-up visit and included the Chronic Disability Index of Waddell and Main (CDI) to determine the severity of back pain [13]. To assess the primary clinical outcome, we applied the Oswestry Low Back Pain Disability Index (ODI) [14] and the Spine Tango Core Outcome Measurement Index (COMI) [15]. COMI included questions concerning overall satisfaction with treatment (very satisfied, satisfied, neither nor, dissatisfied, very dissatisfied) and additional surgeries at the spine (such as implant removal or revision). Visual Analog Scale (VAS) for pain (with 0 representing „no pain“ and 10 representing „maximal imaginable pain“) was used to assess secondary outcome. In addition, reintegration to work, engagement in sports activities, pain medication and physiotherapy at the time of follow-up were also investigated.

Radiological data acquisition was performed pre- and postoperatively, after six weeks, three, six, and twelve months. The radiological parameters of interest were the bi-segmental kyphotic end plate angles (Cobb angle). The bi-segmental Cobb angle is defined as the angle between a line drawn parallel to the superior endplate of one vertebra above the fracture, and a line

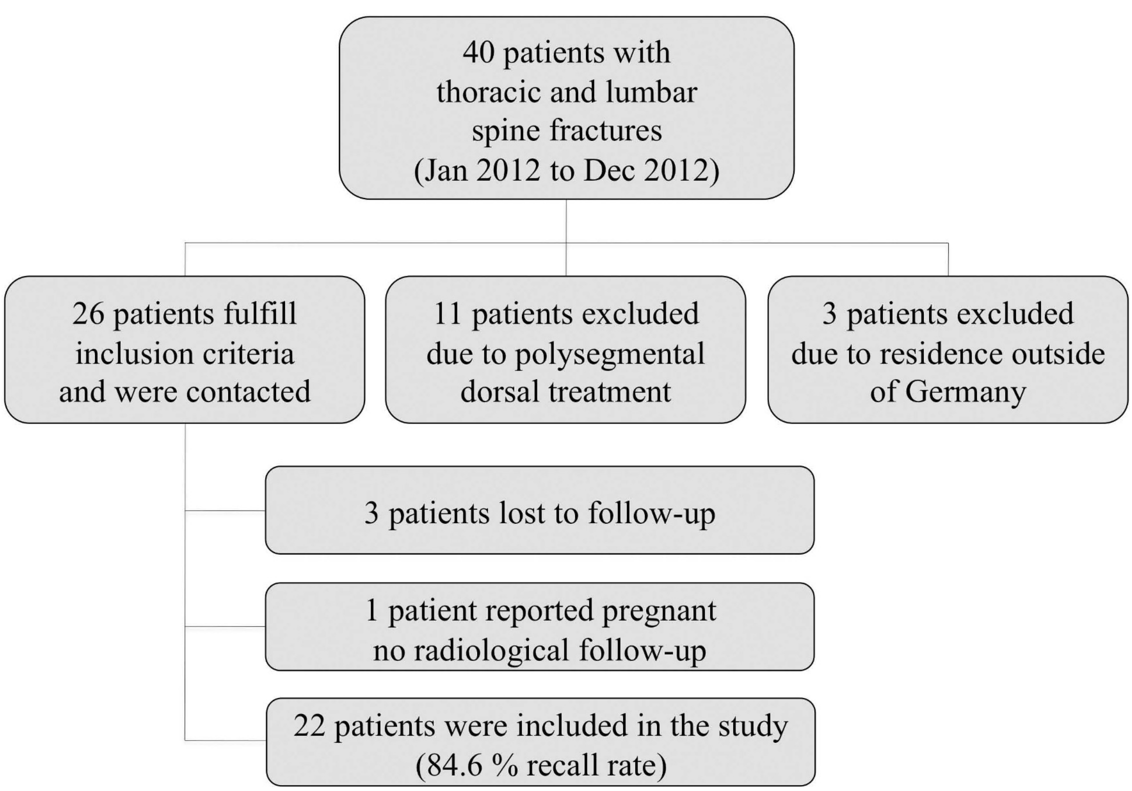

Fig. 1. Patient flow diagram.