Combined Stabilization of Thoracolumbar Spine Fractures

Georg Gradl[1]

Abstract

Introduction: Isolated dorsal instrumentation in thoraco-lumbar spine fractures may lead to loss of reduction after implant removal and subsequent re-kyphosing. Thus, reconstruction of the anterior body defect using expandable cages or allografts in addition to dorsal stabilization may enhance stability.

Patients and Methods: In the following study we report on 89 patients (30 female, 59 male) with a mean age of 46.5 ± 20.6 years (MW ± SEM) who sustained unstable fractures or tumor destruction of the thoraco-lumbar spine. Fracture care included primary dorsal stabilization by internal fixator. All patients received in a second step ventral corporectomy and vertebral body replacement by expandable titanium cages (n = 75; Ulrich, Germany) or iliac crest bone grafts (n = 14). From T3 to L1 a thoracoscopic anterior approach was performed; L3 to L5 region was assessed by lumbotomy. In addition, the anterior column was stabilized by a fixed-angle plate (MACS, Aesculap, Germany) since 2002.

Results: The operating time for the anterior approach averaged 160 ± 42 min. Patients tolerated the thoracoscopic approach well. We experienced no cage dislocation in the group of patients with fixed-angle plate fixation (before 2002 n = 4). There were n = 11 (9.8%) complications (aortic injury n = 1, iliac vein injury n = 1, cerebrospinal fluid leak n = 4, wound infection n = 5).

Conclusion: Combined posterior–anterior stabilization of the thoraco-lumbar spine allows for a meticulous reconstruction and stabilization of graduated height of the anterior column. Primary dorsal instrumentation leads to tension stability and simplifies reduction. An additional anterior fixed-angle plate system may help to prevent cage dislocation.

Key Words

Thoracoscopy · Spine · Fracture · Fixed-angle plate · Cage

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Introduction

Unstable injuries of the thoraco-lumbar spine ranging from T4 to L5 with concomitant injury of the intervertebral disk, pathologic fractures as well as tumors that all result in a reduced load-bearing capacity of the anterior column qualify for a combined dorso-ventral stabilization [1]. Isolated dorsal instrumentation with or without additional transpedicular grafting often fails to induce intercorporal fusion leading to insufficient long time correction of kyphosis [2, 3]. The ventro-dorsal load distribution occurs in a ratio of 80:20 and the stability of one segment of the vertebral column depends on up to 60% of the integrity of the ventral column [4]. These anatomic principals should have an impact on reconstructive surgery of the spine in all cases of bony instability due to fracture, tumor or inflammation. Restoration of the physiological biomechanic comprises both dorsal tension rigidity and ventral compression rigidity [5]. Herein we report on our experience in dorso-ventral instrumentation of unstable spinal pathologies employing thoracoscopy, expandable cages or bone grafts as well as fixed-angle plates for anterior stabilization.

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Patients and Methods

In a prospective series from 2001 to 2005 we evaluated our operative technique of a combined dorso-ventral approach in the therapy of unstable thoraco-lumbar spinal pathologies. Preoperative planning included conventional X-rays of the spine in two planes and a CT-scan of the injured region. A two-stage operative procedure was performed. After primary dorsal instrumentation with fracture reduction and maintenance of reduction using an internal fixator system (USS, Synthes, USA), reconstruction of the anterior column was carried out between 3 and 10 days post-surgery. Prior to the second operation pedicle screws were analyzed for adequate position via CT scans. From T3 to T10 patients were suited in the left lateral position, from T11 to L1 in the right lateral position for subsequent thoracoscopy. The lumbar spine L2–L5 was assessed via lumbotomy in the supine position. Detailed preoperative planning under fluoroscopic control preceded both operative approaches (Figure 1).

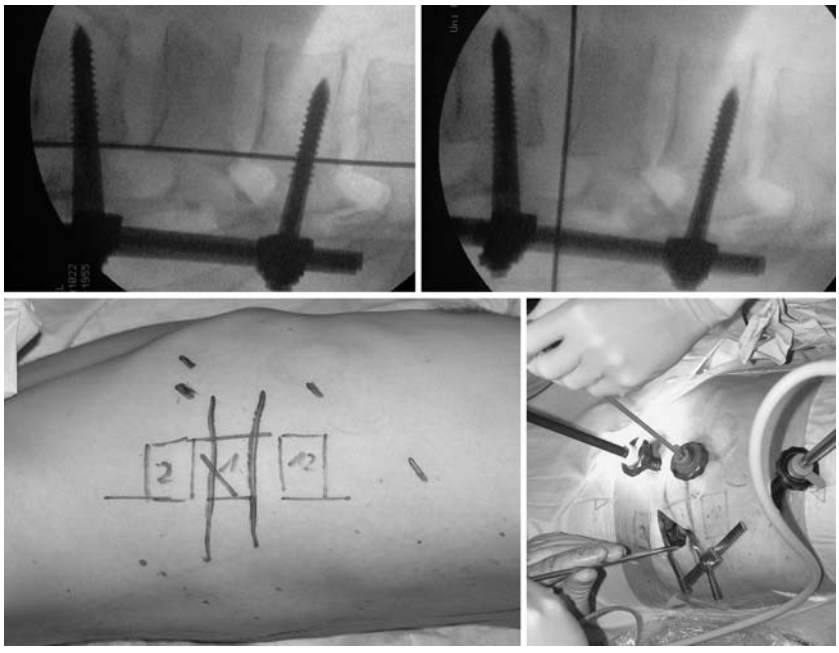

Figure 1. Preoperative planning for the surgical therapy (hemicorporectomy, expandable cage, fixed-angle plate system) employing video-assisted thoracoscopy in an anterior approach to a patient suffering from an L1 fracture. The two-stage operative procedure included a primary dorsal instrumentation with an internal fixator (USS, Synthes, USA).

Video-assisted thoracoscopy in terms of tro car placement and hemicorporectomy was performed in a technique described by Beisse et al. [6, 7]. For monoseg-

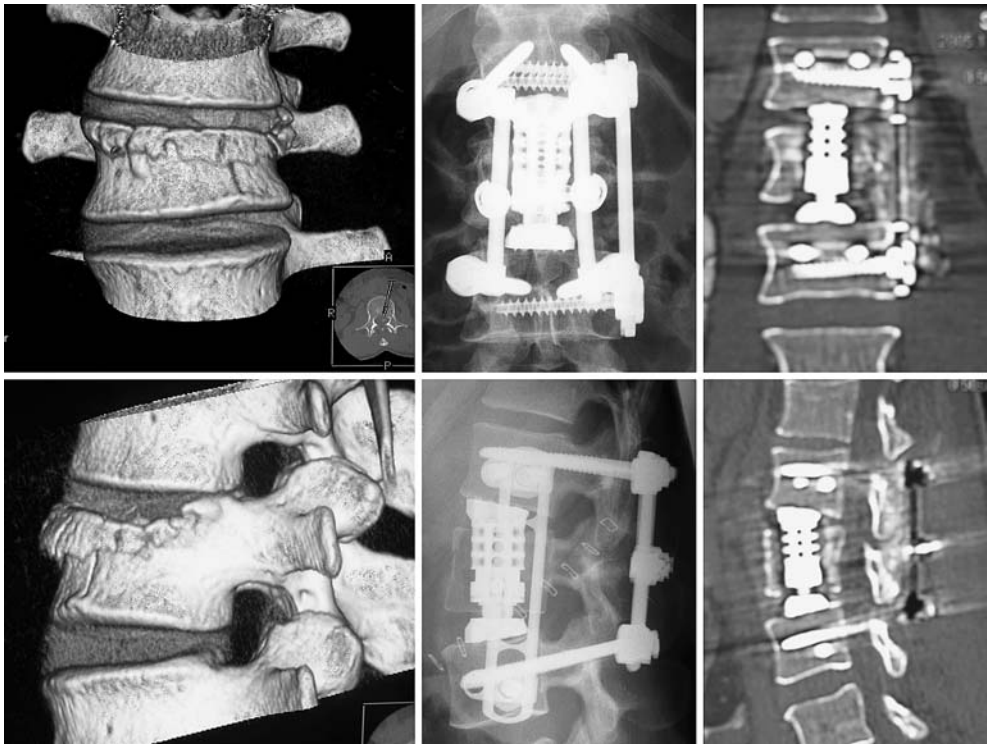

Figure 2. Clinical example of a patient with an L2 incomplete burst fracture, treated by primary dorsal instrumentation and subsequent stabilization of the anterior column using an expandable cage (obelisc®, Ulrich, Germany) and a fixed-angle plate system (MACS, Aesculap, Germany).

mental instrumentation, iliac crest bone grafts were harvested and incorporated; for bisegmental reconstruction an ex-pandable cage (VBR® from 2001 to 2003 and obelisc® from 2003 to 2005, Ulrich, Germany) was implanted.

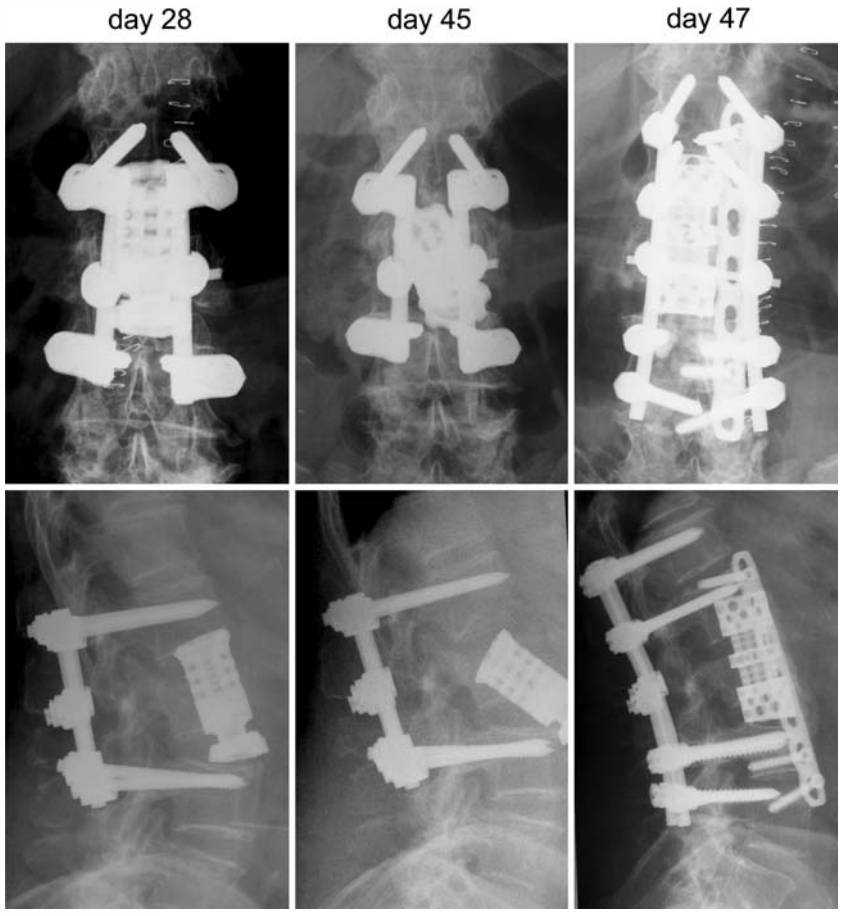

Figure 3. Clinical example of a patient with L3 fracture and combined dorso-ventral stabilization without additional plate system. Increasing dislocation of the cage with subsequent reoperation and plate osteosynthesis.

Results

Eighty-nine consecutive patients (30 female, 59 male) with a mean age of 46.5 ± 20.6 years (MW ± SEM) who sustained unstable fractures (92%) or tumor destruction (8%) of the thoraco-lumbar spine were enrolled in the study. Fracture care included primary dorsal stabilization by internal fixator (n = 89) and second-stage ventral corporectomy and vertebral body replacement by expandable titanium cages (n = 75; Ulrich, Germany) or iliac crest bone grafts (n = 14). Figure 2 shows an example of an L2 incomplete burst fracture, with a combined dorso-ventral stabilization employing an obelisc® cage, a fixed-angle plate system (MACS) and a dorsal internal fixator. The operating time for the anterior approach averaged 160 ± 42 min. Patients tolerated the thoracoscopic approach well and the median hospitalization time did not exceed 20 days. In the first series of patients until 2002, we experienced four cage dislocations. Two of these patients had to be reoperated with a subsequent uncomplicated course (Figure 3). The majority of patients, however, received an additional fixed-angle plate fixation using the MACS-system. In this group no further cage dislocation took place. There were n = 11 (9.8%) complications (aortic injury n = 1, iliac vein injury n = 1, cerebrospinal fluid leak n = 4, wound infection n = 5). One thoracal bleeding occurred after a primary uncomplicated course during mobilization and required rethoracotomy. One iliac vein injury occurred during lumbotomy and was immediately repaired. Two cerebrospinal fluid leaks and five wound infections required reoperation.

Discussion

The range of therapeutic strategies in the management of thoracolumbar spine fractures with their different surgical approaches, grafts and techniques remains wide. Traditional anterior-access procedures, thoracotomy and thoracoabdominal approaches are associated with significant complications, whereas endoscopy-guided spinal access avoids causing these morbidities [8].

In this study a combined dorso-ventral stabilization was applied using an internal fixator for the primary dorsal approach. In a two-stage technique the anterior column was reconstructed within 10 days with the aid of autogenous grafts or expandable cages as reported by others [5, 9–11]. This is regarded by many authors as being sufficient in terms of load bearing and stability [5, 11, 12]. In a prospective multicenter trial Knop et al. [9], analyzed an almost identical operative procedure of combined dorso-ventral stabilization and found the combined procedure superior to an isolated dorsal or anterior approach. In this study, however, an additional fixed-angle plate was inserted to provide better stability

and reduce sharing forces to either bone graft or cage [6]. Thus, no secundar cage dislocations occurred in the group with additional plate osteosynthesis.

The load-bearing anterior column in the thoraco-lumbar spine is often reconstructed by autogenous bone grafts [9]. This is of special value for incomplete burst fractures with involvement of only one intervertebral disc. On the contrary, osseous integration of bone grafts occurs in only 65% of cases according to Briem et al. [10]. The authors did not experience implant loosening of additional fixed-angle plates (MACS) or relevant short-term loss of correction. In line with our results this speaks in favor of adding an additional load carrier like a fixed-angle plate to the anterior column. However, delayed osseous fusion or non-fusion may lead to implant fatigue and long-term rekyphosing [10] Thus, bisegmental fusion with the aid of expandable cages may also be favorable in incomplete burst fractures.

The complications that occurred in this series included one major thoracic bleeding after a free interval of 24 h. Intraoperative evaluation presented a small hole in the aorta close to the sharp edge of the MACS-screw. Although the reason for bleeding remains unclear one might speculate, that the pulsatile movement of the aorta may have led to contact between screw and vessel wall during insertion, which was not visualized by the surgeon. After aortic repair the patient had a further uncomplicated course. Other complications comprised cerebrospinal fluid leak, cage dislocation and wound infections and were generally rare, comparing nicely to the results reported by Knop et al. [13].

In conclusion, combined posterior–anterior stabilization of the thoraco-lumbar spine allows for a meticulous reconstruction and stabilization of graduated height of the anterior column. Primary dorsal instrumentation leads to tension stability and simplifies reduction. An additional anterior fixed-angle plate system may help to prevent cage dislocation.

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