



Instrumented Circumferential Fusion in Two Stages for Unstable Lumbar Fracture: Long-Term Results of a Series of 74 Patients on Sagittal Balance and Functional Outcomes

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■ **OBJECTIVE:** To report the radiologic and functional results of a multicenter, prospective case series of patients with comminuted lumbar fractures treated with 2-stage circumferential arthrodesis.

■ **METHODS:** A multicenter prospective case series of 74 patients with comminuted lumbar fractures was analyzed. The strategy entailed initial posterior osteosynthesis, followed by physical replacement with an expandable titanium cage filled with autologous bone via retroperitoneal lumbotomy. The mechanism of lesion formation and epidemiologic characteristics were recorded. Clinical and quality-of-life analyses (visual analog scale [VAS], Oswestry Disability Index [ODI], Short Form 12 [SF-12]) were performed over a minimum observation period of 1 year. Radiologic parameters, including deformity measurements, were recorded at each evaluation. Fusion was analyzed by means of a 1-year monitoring scan.

■ **RESULTS:** The mean patient age was 38.1 years, and median duration of follow-up was 2.1 years (interquartile range, 1.3–2.9). The distribution of fractures according to the Magerl classification scheme was as follows: A, 64.8%; B, 16.7%; C, 18.5%. At the last follow-up, fusion was considered certain in 57 cases (77%). The mean VAS score was 2.1 ± 1.3 , mean ODI was 14.7 ± 8.0 , mean SF-12 Physical Component Summary score was 43.2 ± 9.3 , and mean SF-12 Mental Component Summary score was

50.8 ± 5.9 . Correction of the regional sagittal deformity was significant during the postoperative period, with a mean increase in lordosis of 9.0° ($P < 0.0001$). The loss of mean correction at the last follow-up (-2.9°) was not significant.

■ **CONCLUSIONS:** Circumferential arthrodesis, including posterior osteosynthesis and physical replacement with an expandable cage and autologous graft, is applicable to the treatment of comminuted lumbar fractures. A high rate of fusion was obtained with significant and long-lasting correction of the sagittal deformity. Functional scores measured at 1 year suggest mild disability. The ODI, SF-12, and VAS scores were positively correlated with fusion at the last follow-up.

INTRODUCTION

Various therapeutic strategies for treating comminuted fractures of the thoracolumbar spine have been described.¹ In the absence of consensus, surgery can be performed via posterior (traditional or invasive), anterior, or combined approach.² The most commonly performed technique is posterior transpedicular fixation and reduction.³ In this approach, neurologic decompression can be obtained directly by laminectomy or indirectly by ligamentotaxis.⁴ The anterior

Key words

- Expandable cage
- Functional outcome
- Fusion
- Sagittal balance
- Thoracolumbar fracture

Abbreviations and Acronyms

- AIS:** American Spinal Injury Association Impairment Scale
ASA: American Society of Anesthesiologists
BMI: Body Mass Index
IQR: Interquartile Range
MCS: Mental Component Summary
ODI: Oswestry Disability Index

PCS: Physical Component Summary

VAS: Visual Analog Scale

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approach allows an additional autologous bone graft and reconstruction of the weight-bearing anterior column.⁵ The extent of the comminuted fracture and instability may justify the use of circumferential arthrodesis, combining posterior arthrodesis and anterior corpectomy with replacement with an expandable titanium cage.⁶

The choice of a combined anterior–posterior strategy involving 2 surgical procedures is not systematic. In published series, up to 38% of patients underwent both procedures at the same time.⁶ The idea of deferring the anterior procedure is based on the desire to avoid the acute peritraumatic period, which can induce more bleeding.

The purported advantages of combined procedures include increased primary stability, optimal reduction capability, decreased postoperative correction loss,⁷ and decreased risk of pseudoarthrosis.⁸ The results of this surgical strategy in terms of sagittal balance and the impact on functional scores have not been well documented.⁸

The main objective of this paper is to describe the radiologic results in terms of pelvic–spinal sagittal balance and fusion in addition to the functional clinical results of a multicenter, prospective case series of comminuted fractures of the thoracolumbar spine treated with circumferential arthrodesis. Epidemiology, surgical indications, and factors influencing the quality of results were analyzed as well.

MATERIALS AND METHODS

Between January 2011 and January 2014, 85 patients treated for an unstable fracture of the lumbar spine (Magerl type A.3.2, A.3.3, B.2, and C fractures) were included in this prospective multicenter study conducted at 3 teaching hospitals in France (2 orthopedic surgery sites and 1 neurosurgery site). The strategy involved the systematic performance of 2-stage surgery, with posterior osteosynthesis followed by vertebral corpectomy together with reconstruction using an expandable titanium cage (VLIFT Vertebral Body Replacement System; Stryker, Kalamazoo, Michigan, USA). In this cohort, the number of levels fused was always the same according the level of fracture. The number of vertebrae included in the fusion was 4 (2 above + 1 below) for L1 and L2 and 3 (1 + 1) for L3 fractures and distal fractures. In patients with a preoperative neurologic disorder, laminectomy was performed.

Patients with pathological and/or osteoporotic fractures were excluded from the study, as were patients with a history of thoracic or lumbar spinal arthrodesis.

Preoperative and postoperative clinical and radiographic evaluations were performed, with a minimum follow-up of 1 year. The duration of follow-up was defined as the time between the second surgical intervention and the last clinical and radiologic follow-up.

Epidemiologic Parameters

Demographic and morphological characteristics, including age, sex, and body mass index (BMI), in addition to mechanisms of injury, were collated.

Clinical Parameters

Each patient's initial neurologic status and clinical course were evaluated according to the American Spinal Injury Association

Impairment Scale (AIS),⁹ Frankel classification.¹⁰ At the last follow-up, pain evaluation using a visual analog scale (VAS), functional evaluation using the Oswestry Disability Index (ODI), and quality of life evaluation with the SF-12 were undertaken.

Radiographic Parameters

At the start of treatment, a thoracolumbar scan was performed to evaluate the fracture according to the Magerl classification scheme¹¹ and to measure the lesioned vertebral and regional kyphosis. After the initial surgery, another scan evaluated residual stability, according to the McCormack Load-Sharing Classification.¹² Supplementary anterior surgery was indicated according to the results and recommendation of this classification. At the last follow-up, fusion was evaluated via computed tomography scan (Figure 1) by a single independent observer as “achieved,” “doubtful,” or “absent” according to the criteria of Tan et al.¹³

After each surgical procedure, at 1 year and the last follow-up, full spinal X-rays were obtained in a standard position (Figure 2). The sagittal spinal pelvic alignment parameters measured were vertebral kyphosis, regional kyphosis, lumbar lordosis, thoracic kyphosis, pelvic incidence, pelvic tilt, and sagittal C7 section. Following the usual convention, kyphosis and lordosis values were expressed as negative and positive values, respectively. Any movement of implants was specified.

Surgical Parameters

For each procedure, the posterior osteosynthesis technique used (traditional or percutaneous), the performance of laminectomy, and the time interval between the procedures were specified. The duration of surgery and perioperative bleeding were quantified, and preoperative and postoperative complications were recorded.

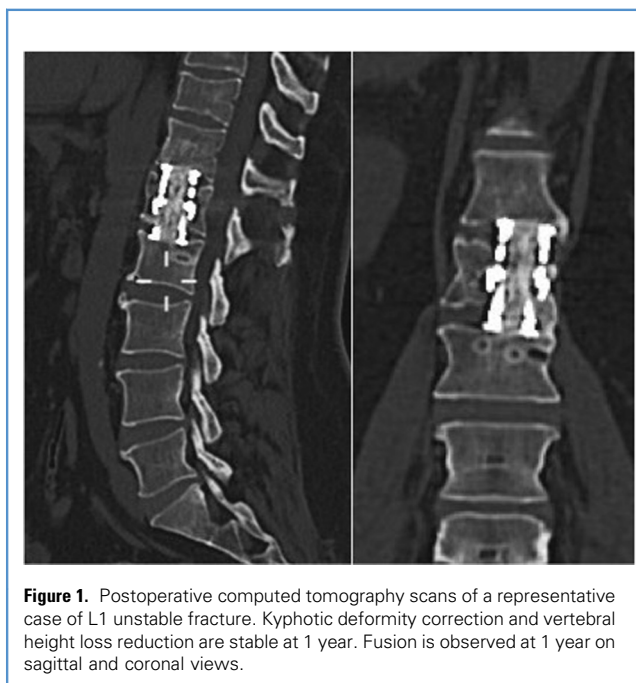


Figure 1. Postoperative computed tomography scans of a representative case of L1 unstable fracture. Kyphotic deformity correction and vertebral height loss reduction are stable at 1 year. Fusion is observed at 1 year on sagittal and coronal views.

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