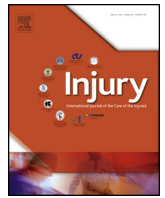




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Which patients risk segmental kyphosis after short segment thoracolumbar fracture fixation with intermediate screws?

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ABSTRACT

Introduction: The use of intermediate screws in fractured vertebrae has been proposed to decrease the number of fused levels in thoracolumbar fractures and to enable short fixations. The aim of this study was to evaluate the results of this technique and to establish predictive factors involved in loss of segmental kyphosis correction (LKC).

Methods: Forty-three patients who underwent short-segment spinal fixation with intermediate screws for a thoracolumbar spine fracture in a two-year time period were enrolled in the study. Patients had AO-type A3, A4 and B2 thoracolumbar fractures. Radiological parameters included segmental kyphosis (SK), vertebral wedge angle (VWA) and loss of anterior and posterior vertebral body height. Patients were evaluated up to one-year follow-up. The correlation between LKC and potential risk factors, such as smoking habit, sex, age, neurological status and BMI was evaluated.

Results: Mean preoperative SK was $16.5^\circ \pm 6.5^\circ$, and it decreased to $3.4^\circ \pm 3.5^\circ$ postoperatively ($P < 0.01$). At the one-year follow-up mean SK dropped to $5.5^\circ \pm 3.9^\circ$ ($P < 0.01$). Mean preoperative VWA was $20.0^\circ \pm 8.1^\circ$, and significantly improved to $6.3^\circ \pm 3.1^\circ$ after surgery ($P < 0.01$). There was a mean LKC of $1.8^\circ \pm 2.1^\circ$ at one year. LKC mildly correlated with body mass index (BMI, $r: +0.31$), and obese patients (BMI > 30) had an increased risk of LKC at the one-year follow-up ($P = 0.03$; odds ratio [OR] = 3.2).

Discussion: Analysis of the radiological data at one-year follow-up showed that all the evaluated parameters were associated with a mild loss of correction, with no impact on the clinical outcomes or implant failure. These findings confirm the trends reported in the literature. The correlation between LKC and clinical features, such as BMI, age, sex, smoking habit and preoperative neurological status was investigated. Interestingly, a positive correlation was observed between BMI and LKC, and obese patients with BMI > 30 had an increased risk of LKC at one-year follow-up (OR 3.2); to our knowledge this finding has never before been reported.

Conclusion: Short-segment fixation with intermediate screws is a viable technique with positive clinical and radiological outcomes at one-year follow-up. However, surgeons should be aware that in obese patients (BMI > 30) this technique is associated with an increased risk of LKC.

Level of evidence: 3.

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Introduction

Thoracolumbar spine fractures are one of the most common types of traumatic injury, with approximately 90% of spinal fractures occurring at the thoracolumbar segment [1,2]. Typically, two-thirds of these fractures occur in men, and there is a peak of

occurrence between 20 and 40 years of age [3–7]. Injuries at the thoracolumbar spine are usually the result of a high-energy trauma and tend to be associated with injuries to other skeletal segments [8–11]. The presence of a neurological deficit ranges from 20% to 36% of the fractures at the thoracolumbar junction; however, even in patients who do not experience any complications, chronic pain and limitation of daily activities with difficulty to return to work are often encountered [12–14].

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The optimal surgical management of this type of fracture has not yet been determined conclusively and it still remains controversial: the presence of many surgical techniques for this condition reflects the absence of superiority of one technique over the others [15–22]. Stabilisation with posterior pedicle screws or hybrid constructs has gained a wide popularity among surgeons [23]. Typically, it is performed by long-segment posterior instrumentation (two levels above and two below the fractured vertebra) and therefore implies the immobilisation of several motion segments to provide segmental correction and a stable fixation. The performance of posterior short-segmental fixation (one level above and one below the injured vertebra) provides sufficient fixation and is associated with good clinical results, but it is more often associated with common complications, such as the recurrence of kyphosis and failure of the instrumentation if it is not associated with an anterior support [10,20,24–28]. The anterior support has undeniable advantages from a mechanical point of view, but it is associated with specific morbidity. The use of screws at the level of the fractured vertebra, the so-called “Intermediate Screw”, has been popularised to keep the instrumentation short without the use of anterior supports. Since Dick et al. performed biomechanical studies on this kind of fixation, the technique has been extensively applied, and it has been associated with positive clinical and radiological results; however, only a few clinical trials evaluating the mid-term results of this surgical approach in the management of thoracolumbar fractures are available [29–31]. Moreover, no data are available about risk factors for loss of correction after vertebral fracture stabilisation by short constructs with bilateral intermediate screws. Therefore, the aim of this study was to evaluate the clinical and radiological results of short-segment thoracolumbar fracture fixation with intermediate screws and to determine which patients are at risk of loss of segmental kyphosis correction (LKC) at one-year follow-up.

Materials and method

Seventy-six consecutive patients affected by thoracolumbar fractures from January 2012 to December 2013 were included in the study. Of these, 43 patients were managed by short-segment instrumentation with bilateral intermediate screws at the fracture level. Indications for management with intermediate screws were: 1) fresh burst unstable fractures (AO-type A3, A4) or combined fractures with posterior ligamentous complex injuries (AO-type

B2); 2) thoracolumbar fractures between T9 and L4; 3) integrity of the pedicles at the fracture level allowing for the insertion of the bilateral intermediate screws. Exclusion criteria were: 1) stable thoracolumbar fracture (AO-type A1, A2); 2) vertebral injury pattern involving the pedicles; 3) skeletal immaturity or osteoporotic vertebral fractures. Demographic characteristics of the patients were recorded, these included age, sex, body mass index (BMI) and baseline comorbidities, together with the neurological grade compromise according to the American Spinal Injury Association (ASIA).

Preoperative X-Rays and CT study of the thoracolumbar spine were obtained at admission to the emergency department. Fractures were classified according to the AO spine classification system, the Load Sharing Classification and by injury mechanism [28]. The following radiological parameters were evaluated: segmental kyphosis (SK) and vertebral wedge angle (VWA) were determined using the Cobb method. The loss of anterior and posterior vertebral body height, respectively, was defined as the percentage of anterior or posterior vertebral wall height loss compared to the average of the adjacent intact vertebrae above and below the fractured vertebrae [32]. Associated injuries, time to surgery, time to ambulation and hospital stay were other variables considered in the study.

Back pain and functional status were evaluated preoperatively according to a Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI) in the latest available Italian version [33]. All the patients were evaluated clinically and radiographically at up to one-year follow-up.

Forty-three patients with a total of 45 fractured vertebrae were included in the study. Five patients had coexistent fractures: pelvic ring and malleoli trauma in one patient, tibial plateau fractures in two patients, tibial shaft injury in one patient and proximal humeral fracture in one patient. The population demographic distribution was: 27 male (62.8%) and 16 female (37.2%), with a mean age of 44.8 years (range 23–61 years) and a mean BMI of 26.7 kg/m² (range 18.4–33.1 kg/m²). Forty-one patients underwent a three-level fixation with pedicle screws at the level above, below, and at the fractured level (Fig. 1); in two patients short fixation included four levels because of coexistent fractures at two adjacent vertebrae (T12–L1). Baseline comorbidities and risk factors included tobacco use (n = 18, 41.9%) and diabetes mellitus (n = 5, 11.6%). Ten patients were defined as obese with a BMI greater than 30. L1 was the most commonly affected level (n = 16), followed by

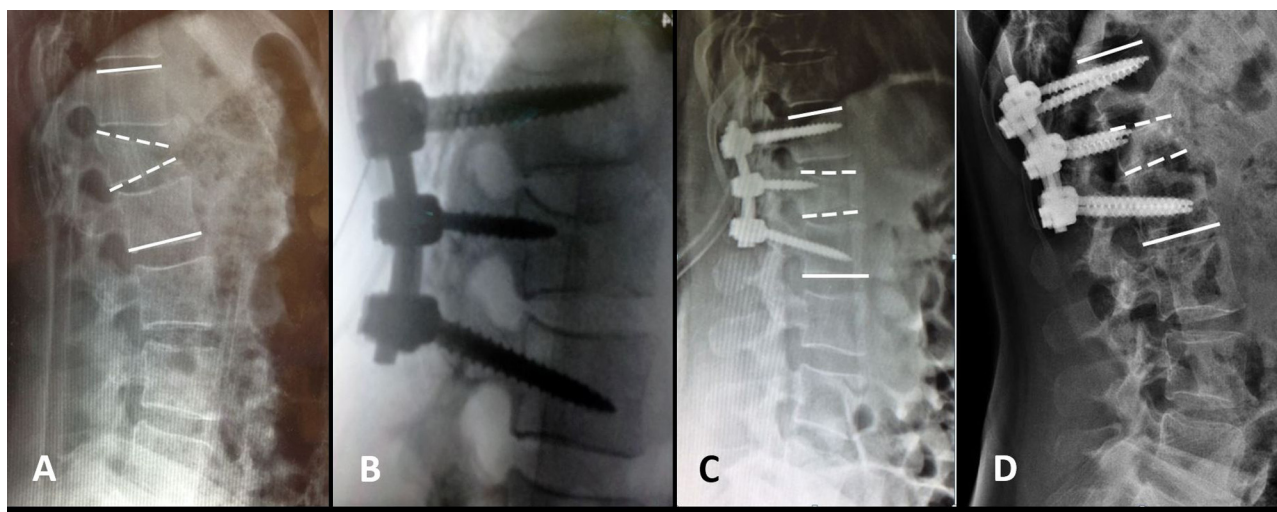


Fig. 1. A) Preoperative lateral X-ray showing an AO-type B2 fracture of L1. Straight lines represent the segmental kyphosis. Dashed lines depict the wedge angle. B) Intraoperative fluoroscopy showing fracture reduction and fixation with short segment stabilisation and bilateral IS. C) Postoperative X-rays show the correction of segmental kyphosis and wedge angle. D) Lateral X-ray at 1-year follow-up showing the bone healing without major loss of correction.

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