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Original article

Posterior surgery in high-grade spondylolisthesis



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ABSTRACT

Introduction: High-grade L5-S1 spondylolisthesis alters sagittal spinopelvic balance, which can cause low back pain and progressive neurologic disorder. The present study assessed spondylolisthesis reduction and maintenance over time with L4-S1 versus L5-S1 fusion using a lever-arm system and posterior fusion combined with lumbosacral graft.

Materials and methods: Forty patients were operated on for symptomatic high-grade spondylolisthesis, 34 of whom had full pre- and post-operative radiological analysis, with a mean follow-up of 5.4 years. There were 9 L5-S1 and 25 L4-S1 instrumentations. Analysis of spinopelvic and slippage parameters and the evolution of segmental lordosis compared results between L5-S1 and L4-S1 instrumentation.

Results: Mean Taillard spondylolisthesis index decreased from 64% to 37% ($P=0.0001$). Overall sagittal spinopelvic balance was not significantly changed. Overall L1-S1 and segmental L4-L5 lordosis were not affected by instrumentation. Mean L5-S1 segmental lordosis increased from 11° to 18°. There was loss of reduction from 19° to 14° with L5-S1 instrumentation, in contrast to maintained reduction with L4-S1 instrumentation ($P=0.006$).

Conclusion: The lever-arm system provided anterior-posterior reduction of spondylolisthesis and corrected slippage. Postoperative change in overall sagittal spinopelvic balance was slight and constant. Posterior L4-S1 fusion provided better long-term control of L5-S1 lordosis reduction than the shorter L5-S1 fusion.

Retrospective study of level IV.

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1. Introduction

Spondylolisthesis consists in a vertebra slipping over the underlying one, and involves the L5-S1 segment in 80% of cases. It is graded on the Meyerding classification [1]. It can be totally asymptomatic, but may also evolve, inducing low back pain and progressive neurologic disorder [2–4]. High-grade spondylolisthesis involves slippage exceeding 50% (grades III and IV). Lower back pain and onset of radiculalgia are indications for surgery in adults. There are presently several anterior or posterior fusion techniques to achieve reduction and intervertebral fusion by posterolateral and intersomatic grafting [3,5–8]. Fusion between the L5 body and sacrum and posterolateral bone graft are essential in severe deformity. Circumferential fusion ensures long-term lumbosacral junction stability, limiting L5-S1 shear stress, which could

otherwise lead to loosening of the osteosynthesis and reduction loss. In the early postoperative course, this risk is increased by L5 radicle release when the posterior L5 arch is resected in the isthmic lysis, creating considerable unstable continuity between L5 and S1.

Reduction seeks to restore lumbosacral sagittal balance in case of strong pelvic tilt, sacral slope and lumbar lordosis [2,9,10]. Morphology and sagittal balance affect the form of the lumbar spine and hence the mechanical stress at the lumbosacral junction. In high-grade spondylolisthesis, the deformity must therefore be reduced and aligned so as to restore balance and reduce stress in order to optimize fusion.

The usefulness of long L4-S1 rather than short L5-S1 instrumentation is controversial, as it sacrifices the L4-L5 disc. However, shear stress on L5 screws is considerable, incurring a risk of reduction loss or loosening with short instrumentation. Supplementary L4 anchorage spreads stress and enables instrumentation to end on a more horizontal vertebra, reducing the stress on the individual pedicle screws.

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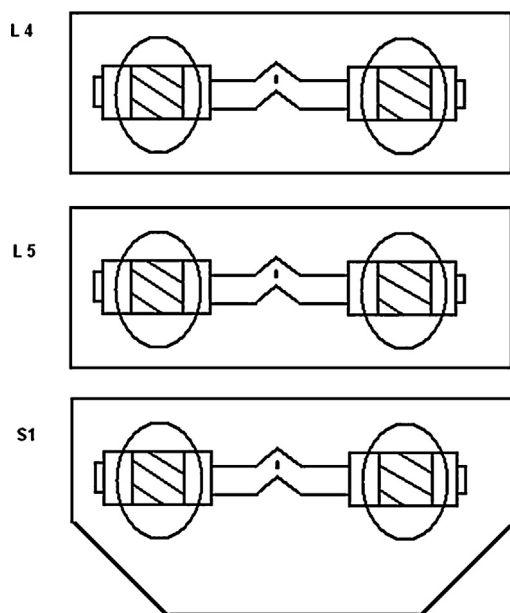


Fig. 1. L5 and S1 pedicular screws connected up by reduction plates.

The present study assessed and compared the durability of reduction with L5-S1 versus L4-S1 assembly.

2. Material and methods

Between 2002 and 2009, 40 consecutive patients were operated on for symptomatic high-grade spondylolisthesis in our department. Only complete imaging files were analyzed: i.e., 34 patients, mean age 30.2 years (range, 13–44 years). Mean follow-up was 5.4 years (range, 3–11 years). On preoperative Meyerding classification, there were 23 grade III and 11 grade IV cases. Surgery involved 9 L5-S1 and 25 L4-S1 instrumentations. Lumbosacral screwing was performed in 30 cases and fibular grafting in 4.

Radiography comprised AP and lateral lumbar spine views and lateral full-spine view taken preoperatively and at 3 months, 6 months, 1 year and at last follow-up (minimum, 3 years). Radiologic evolution was analyzed for Meyerding grade, percentage slip on the Taillard index, Dubousset lumbosacral angle, pelvic tilt, pelvic version, sacral slope, thoracic kyphosis and sagittal vertical axis (SVA). To limit error induced by sacral dome deformity, a line was drawn through the widest part of S1, perpendicular to the vertical axis of the sacrum. L1-S1 lordosis and L4-L5 and L5-S1 segmental lordosis were measured between adjacent vertebral plates.

Our treatment strategy comprised 1 week's preoperative gentle halo traction, which was maintained intraoperatively. A posterior approach allowed canal release and L5 root neurolysis following Gill [11]. Pedicular screws were positioned in L5 and S1, connected up by reduction plates (Fig. 1). During reduction, a lever-arm maneuver progressively drew and pivoted L5 over the sacrum, lowering S1 (Fig. 2). Reduction was maintained by posterior instrumentation. Systematic posterolateral bone graft was performed, with an associated posterior lumbosacral graft using a hollow modular anchorage (HMA) screw or an autologous fibular graft. The entry point was between S1 and S2, oriented toward the anterosuperior plate of L5. Posterior instrumentation was applied at L5-S1 or L4-S1 according to the surgeon's preference (Figs. 3 and 4).

Balance was assessed on R software (version 2.15.1). Assembly-related effects were compared on a mixed covariance model.

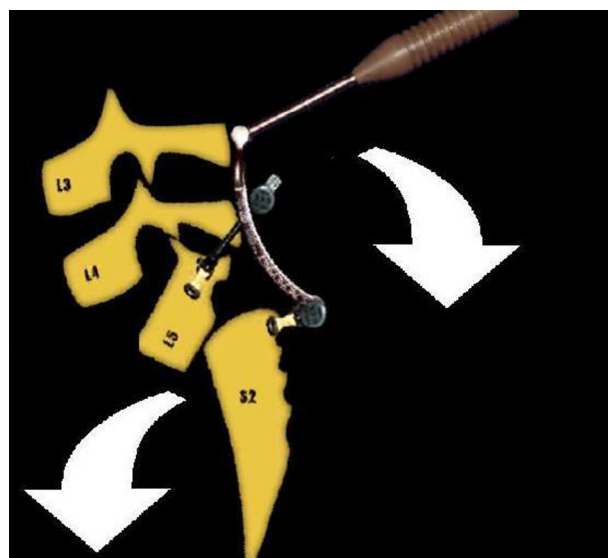


Fig. 2. Reduction mechanism with L5 traction and pivot and lowering of S1.

Parameter stability over time was assessed on ANOVA plus post-hoc Tukey or Dunnett test.

3. Results

Table 1 presents the parameters of vertebral slippage correction: Meyerding grade and Taillard index showed enduring significant reduction between preoperative deformity values and last follow-up (from Meyerding grade III to grade II). In 1 patient, reduction from grade V to grade IV was not maintained, with subsequent return to grade V. Dubousset angle increased significantly and durably, from a mean 84° preoperatively to 106° at end of follow-up.

Table 2 presents change in sagittal spinopelvic balance, thoracic kyphosis and SVA. Pelvic tilt remained around a mean 77°; pelvic version showed no significant change, remaining around 26°; thoracic kyphosis and SVA likewise remained stable and within normal limits.



Fig. 3. Preoperative CT scan showing anterior displacement.

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