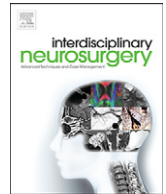




Interdisciplinary Neurosurgery: Advanced Techniques and Case Management



Technical Notes & Surgical Techniques

Reduction of high-grade lumbosacral spondylolisthesis by minimally invasive transforaminal lumbar interbody fusion: A technical note[☆]



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ABSTRACT

Objective: To demonstrate the feasibility and efficacy of reduction of high-grade lumbosacral spondylolisthesis via a minimally invasive approach.

Summary of background data: Reduction of high-grade spondylolisthesis remains controversial and technically challenging. Although minimally invasive transforaminal lumbar interbody fusion (MI-TLIF) has gained wide acceptance in recent years, it still has not been reported to achieve complete reduction of high grade slips.

Methods: In this technical note, the authors present a case of L5/S1 Meyerding Grade III fixed spondylolisthesis managed by MI-TLIF with percutaneous screws. Surgical techniques and key steps for reduction are described in detail. **Results:** A 50-year-old woman had low back pain for 8 years. She also presented with radiculopathy of lower limbs and frequency/urgency of urination. The radiographs and computed tomography (CT) of the lumbar spine demonstrated degenerative spondylolisthesis, Meyerding grade III, at the level of L5/S1. The slippage was fixed on dynamic radiographs and there was neuroforaminal stenosis on the magnetic resonance image. The patient underwent MI-TLIF with percutaneous pedicle screw-rod fixation for arthrodesis at L5/S1. Her symptoms subsided after the operation. The one-and-half year follow-up radiographs, including CT, demonstrated complete reduction of the high-grade slippage and fusion of the lumbosacral spondylolisthesis.

Conclusion: Minimally invasive TLIF is a viable option for reduction of high-grade spondylolisthesis at L5/S1.

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Introduction

Arthrodesis has become a widely accepted option for surgical management of symptomatic lumbosacral spondylolisthesis. Meyerding classification, one of the most commonly used grading systems, grades the slippage in accordance to the vertebra below [1]. Various surgical approaches have been applied to treat low-grade spondylolisthesis (Meyerding grade I and II), including open and minimally invasive procedures [2–7]. However, the surgical procedure of choice for high-grade spondylolisthesis is still uncertain [8–10]. Fusion in situ, partial, or complete reduction has been reported. Reduction of high-grade lumbosacral spondylolisthesis and arthrodesis with interbody graft remain controversial. Attempts to reduce the slippage are technically challenging and usually achieved via a standard open

approach. Minimally invasive transforaminal lumbar interbody fusion (TLIF) has not been reported to reduce high-grade slip.

In this report, we present a case of high-grade lumbosacral spondylolisthesis managed by minimally invasive TLIF, which achieved complete reduction and fusion. The technique is described in detail.

Illustrative case

A 50-year-old woman (157 cm, 54 kg, BMI: 21.9 kg/m², non-smoking), who did not have any systemic diseases and trauma, had suffered from low back pain for 8 years. She started to have radicular pain and numbness of the bilateral lower limbs three months prior to presentation. There were also frequency and urgency of urination. These symptoms were refractory to medical treatment and rehabilitation. The radiographs and computed tomography (CT) of the lumbar spine demonstrated degenerative spondylolisthesis, Meyerding grade III, at the level of L5/S1 (Fig. 1). The slippage was fixed on dynamic radiographs and there was neuroforaminal stenosis on the magnetic resonance image (MRI). She had a normal score (T-score = 0.2) on dual-energy X-ray absorptiometry.

The patient underwent minimally invasive TLIF for arthrodesis at L5/S1. The peri-operative course was uneventful and her symptoms

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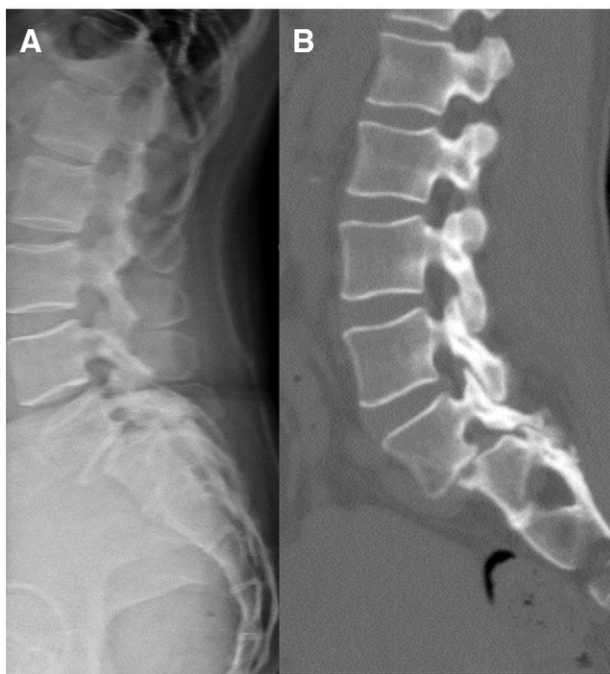


Fig. 1. Pre-operative radiographs: Degenerative lumbar spondylolisthesis, Meyerding grade III, L5/S1. (A) Lateral radiograph (B) Computed tomography, sagittal view.

improved after the operation. She no longer took narcotics and benzodiazepines afterwards. One month after the operation, the wounds healed well (Fig. 2). The one-and-half year follow-up radiographs demonstrated complete reduction of the high-grade slippage and fusion of the lumbar spondylolisthesis without any adjacent lucencies (Fig. 3). The surgical techniques are described below.

Surgical TECHNIQUE

After general anesthesia and intubation, the patient was placed in a prone position on the radiolucent operating table (Allen Spine, Allen Medical System, MA). Natural lumbar lordosis was maintained with

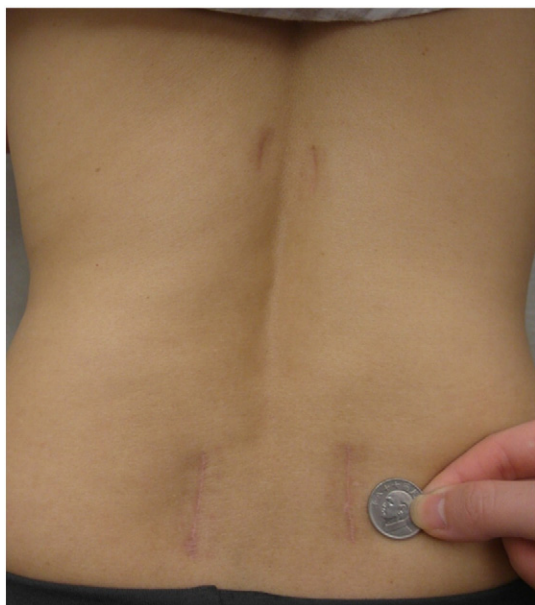


Fig. 2. Post-operative photo, one month post-operation, the wounds healed well.

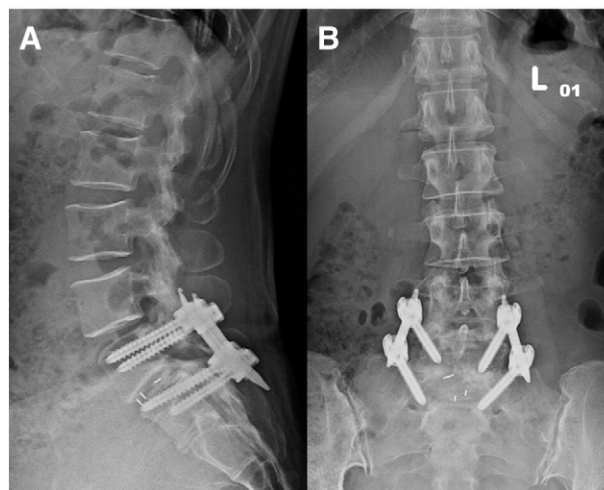


Fig. 3. One-and-half year post-operative radiographs, demonstrating complete reduction of lumbar spondylolisthesis by minimally invasive TLIF. (A) Lateral radiograph (B) Antero-posterior radiograph.

adequate cushion. Bi-planar fluoroscopy was used to identify and mark the skin overlying the indexed facet complex. The C-arm was slightly angled (approximately 15° – 20°) to obtain optimal visualization of the targeted pedicles and disc spaces on an anteroposterior view of the L5/S1 level. An initial skin incision was made approximately 35 mm from the midline, the length of which contained the upper and lower levels of the targeted pedicles. The incision was then made deep in to the superficial fascia of the paraspinal muscles. Using progressively larger dilator tubes from the METRx set (Medtronic Spine and Biologics, Memphis, TN), a muscle sparing surgical corridor (Wiltse approach) was created, and a final 26-mm diameter tubular retractor was set up. Under operating microscopes, a facetectomy was carried out using high-speed drills and Kerrison rongeurs through the working channel. The removed bone was later used for interbody fusion graft material. After the targeted annulus and the exiting/traversing nerve roots were identified, a discectomy was performed. Osteophytes and bony spurs which obstructed the disc space were resected with shavers and Kerrison rongeurs. Serial disc space distractors were used to facilitate opening of the disc space. The endplates of the superior and inferior vertebrae were meticulously prepared for subsequent interbody fusion. Visualization of adequate discectomy and parallel endplates was confirmed under microscopes. Local bone chips, harvested from the facetectomy, together with Grafton demineralized bone matrix putty (Osteotech, Medtronic Spine and Biologics, Memphis, TN) were then placed into the anterior disc space and pushed toward the opposite side to maximize the amount of graft. After insertion of an appropriately sized trial cage, a Capstone cage (Medtronic Spine and Biologics, Memphis, TN) 22 mm in length and 8 mm in height filled with locally harvested autologous bone and demineralized bone matrix, was inserted. The position of the interbody cage was then confirmed by lateral fluoroscopy. In the contralateral side, similar procedures were performed, including skin incision, muscle dilation, and facetectomy for foraminal decompression, but there was no need for discectomy or interbody work.

Percutaneous screws and rods were subsequently placed for reduction and fixation of the L5/S1 spondylolisthesis. In the following steps, the trajectory/position of each instrument was checked by C-arm fluoroscopy (both angled anteroposterior and lateral views), and each step was performed at both sides simultaneously by the surgeon and the first assistant. A simple PAK (Pedicule Access Kit) needle was advanced at the intersection of the lateral facet and the

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