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Clinical Study

Intraoperative reduction does not result in better outcomes in low-grade lumbar spondylolisthesis with neurogenic symptoms after minimally invasive transforaminal lumbar interbody fusion—a 5-year follow-up study

Kae Sian Tay, MBBS, MRCSEd, Anupreet Bassi, MBBS, M.S., William Yeo, BASc (Physiotherapy), Wai Mun Yue, MBBS, FRCSEd, FAMS (Ortho Surg)*

Department of Orthopaedic Surgery, Singapore General Hospital, 20 College Rd, Academia, Level 4, Singapore 169865

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Abstract

BACKGROUND CONTEXT: Intraoperative reduction of low-grade lumbar spondylolisthesis (LGLS) remains disputed. There is currently no published data comparing midterm outcomes of reduction versus in situ fusion.

PURPOSE: This study aimed to compare mid-term clinical, radiological, and perioperative outcomes for reduction versus in situ fusion in LGLS with neurogenic symptoms.

STUDY DESIGN/SETTING: A retrospective review of prospectively collected spine registry data in a single institution was carried out.

PATIENT SAMPLE: All patients who underwent minimally invasive transforaminal lumbar interbody fusion (MIS TLIF) for LGLS with neurogenic symptoms with a minimum 5-year follow-up comprised the patient sample.

OUTCOME MEASURES: Self-reported measures were Oswestry Disability Index, North American Spine Society Neurogenic Symptom Score, Health Outcomes Survey Short Form-36 score, and Numerical Pain Rating Scale (back and leg pain). Radiological outcomes were fusion grading, adjacent segment degeneration (ASD), and implant failure or loosening. Perioperative outcomes were fluoroscopic time, operative time, intraoperative blood loss, opioid analgesia usage, time to ambulation, duration of hospitalization, and complication rate. Functional outcomes were patient satisfaction rate and rate of return to full function.

METHODS: A retrospective review was performed on prospectively collected registry data of patients undergoing MIS TLIF for LGLS with neurogenic symptoms, from 2004 to 2009. The operative technique and postoperative protocol were standardized. Two groups were formed based on complete reduction of the spondylolisthesis (reduction group [RG]) or the lack thereof (non-reduction group [NRG]) in the immediate postoperative radiograph. Outcomes at baseline, 6 months, 2 years, and 5 years postsurgery were compared.

RESULTS: There were 56 patients included (RG=30, NRG=26). The two groups had comparable baseline characteristics: demographics, body mass index, spondylolisthesis etiology, spinal level involved, bone graft and bone morphogenetic protein used, and all self-reported outcome measures. Perioperative outcomes were not significantly different. The early complication rate (RG=3.3%, NRG=19.2%, p=.086) and late complication rate (RG=10%, NRG=23.1%, p=.184) were similar. All patients achieved Bridwell grade 1 fusion from 2 years onward. Adjacent segment degeneration rate

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* Corresponding author. Department of Orthopaedic Surgery, Singapore General Hospital, 20 College Rd, Academia, Level 4, Singapore 169865. Tel.: +65 63214063.

E-mail address: yuewm@singnet.com.sg (W.M. Yue)

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at 5 years was similar (RG=10%, NRG=0%, p=NS). Both groups showed significant postoperative improvement in all self-reported measures with no significant differences between the two groups at all follow-up points. Functional outcomes were equivalent.
CONCLUSIONS: Intraoperative reduction does not improve outcomes in LGLS with neurogenic symptoms after MIS TLIF. Adequate decompression and solid fusion are likely the keys to good mid-term outcomes.

Keywords: Correction; Decompression; Fusion; Instability; Spine deformity; TLIF; MIS; Instrumentation

Introduction

The surgical management of spondylolisthesis historically involved decompressive laminectomy only, as described by Gill [1]. Lumbar fusion was later recognized to considerably improve clinical outcomes and has been subsequently adopted as the standard of care [2–4].

Various surgical techniques have been described to achieve fusion in the management of spondylolisthesis, from the classic posterolateral fusion (PLF), to anterior lumbar interbody fusion (ALIF), posterior lumbar interbody fusion (PLIF), and transforaminal lumbar interbody fusion (TLIF). No particular method has been shown to be superior in terms of clinical outcomes [5].

The advent of minimally invasive transforaminal lumbar interbody fusion (MIS TLIF), pioneered by Foley, represents the latest technical advancement in the surgical management of lumbar spondylolisthesis [6,7]. This technique has been shown to achieve comparable outcomes to open TLIF. In addition, by significantly reducing muscle and tissue injury, many advantages over the open technique have been reported, such as decreased intraoperative blood loss, less postoperative pain, less postoperative analgesic usage, earlier rehabilitation, and decreased length of stay in hospital [8–11].

There remains dispute over the necessity and the benefit, if any, of surgical reduction of the slip, in low-grade spondylolisthesis. There is an abundance of descriptive studies on the outcomes of myriad surgical techniques, with or without reduction [5,12–17]. However, we found few comparative studies with regard to the benefits of reduction. Of these few, follow-up has been limited to between 1 and 3 years only [18–20].

We present here a comparative study with a 5-year follow-up looking at the effects of reduction on clinical, perioperative, and radiological outcomes in patients undergoing single-level MIS TLIF for low-grade lumbar spondylolisthesis (LGLS) with neurologic symptoms. We hypothesize that complete surgical reduction will not result in significantly better mid-term clinical and radiological outcomes.

Materials and methods

This study was a retrospective review of the spine registry data of patients with LGLS who underwent MIS TLIF at a single institution from January 2004 until December 2009. The clinical outcome data had been prospectively collected at the respective follow-up visits. Institutional Review Board approval was obtained before the commencement of the study.

We included all patients with the following criteria: (1) single-level LGLS (Meyerding grade 1 or 2) [21]; (2) neurologic symptoms; (3) refractory to conservative therapy for at least 6 months; (4) correlated positive radiological findings on plain radiographs, magnetic resonance imaging (MRI), or computed tomography (CT) myelograms; and (5) underwent MIS TLIF with a minimum 5-year complete follow-up (clinical and radiological). Patients with multiple-level or high-grade lumbar spondylolisthesis (grade 3 or grade 4), previous lumbar surgery, tumors, infections, and acute trauma were excluded.

The patients were all operated on by two fellowship-trained spine surgeons with at least 5 years of post-fellowship surgical experience. Prior conservative therapy consisted of physiotherapy, analgesia, and activity modification.

The patients were divided into two groups based on the immediate postoperative radiograph: The reduction group (RG) had complete reduction of the spondylolisthesis, whereas the non-reduction group (NRG) did not achieve complete reduction. Complete reduction was defined as no residual spondylolisthesis according to Meyerding Grading.

Patient factors assessed included age, sex, race, body mass index, comorbidities, and spondylolisthesis etiology, grade, and level. The type of bone graft and bone morphogenetic protein used were compared as well.

Radiological findings included fusion grade, presence of implant failure or loosening, adjacent segment degeneration (ASD), and preoperative and terminal follow-up sagittal parameters (slip angle, segmental lordosis, L1–S1 lordosis). These were evaluated on static (anterioposterior and lateral) and dynamic (flexion or extension) plain lumbar spine radiography. The MRI and CT myelograms were used if symptomatically indicated. Fusion rates were assessed using the criteria of Bridwell et al. (Table 1) [22]. Screw or cage loosening was defined as a radiolucency of ≥1 mm around the screw or the cage. Adjacent segment degeneration was diagnosed on plain radiographs, CT, or MRI as described by Bae et al. and Cheh et al. [23,24]. The ASD was grouped into radiographic ASD and symptomatic ASD as described by Kim et al. [25]. Measurements were performed before surgery, 6 months, 2 years, and 5 years postoperatively by independent assessors (authors KST and AB, who were involved in neither the surgery nor the clinical follow-up).

Perioperative outcomes were compared based on fluoroscopic time, operative time, blood loss, amount of intravenous morphine or analgesia (if pethidine was used, it was