



Comparison of three different posterior fixation techniques in transforaminal lumbar interbody fusion for two-level lumbar degenerative diseases: At a mean follow up time of 46 months



Fubing Liu¹, Yuanwu Cao¹, Zhenzhou Feng, Xiaogang Zhou, Chun Jiang, Xilei Li, Zixian Chen, Zheng Li, Yun Liang, Xiaoxing Jiang*, Jian Dong*

Department of Orthopaedics, Zhongshan Hospital of Fudan University, 180 Fenglin Road, Shanghai, China

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ABSTRACT

Objectives: This study sought to retrospectively compare three different posterior fixation techniques in transforaminal lumbar interbody fusion for two-level lumbar degenerative diseases.

Patients and methods: This was a retrospective single-center study including 84 patients who underwent TLIF instrumented with unilateral pedicle screws (UPS), unilateral pedicle screws plus contra-lateral translamina facet screws (UPSFS), or bilateral pedicle screws (BPS) between June 2008 and May 2012. These patients were divided into three groups: UPS ($n = 22$), UPSFS ($n = 28$) and BPS ($n = 34$) group. Operative time, blood loss, length of hospital stay, hospital bill, fusion status and complications were recorded and analyzed statistically. Visual analog scale (VAS), Oswestry Disability Index (ODI), and Japanese Orthopaedic Association Scores (JOA) were used to assess the preoperative and postoperative pain and functional outcome. Sagittal alignment was evaluated by the segment lordosis (SL) and whole lumbar spine lordosis (LL).

Results: The mean follow up duration was 46.2 (ranging from 36 to 60) months. A significant decrease occurred in operative time, blood loss and hospital bill in UPS and UPSFS group, compared with BPS group ($p < 0.05$). The average postoperative VAS, ODI and JOA scores improved significantly in each group than the preoperative counterparts ($p < 0.05$), however, there were no significant difference between groups at any follow-up time point ($p > 0.05$). No statistically difference was detected regarding fusion rate and complication rate between groups ($p > 0.05$), except the screw/rod failure rate ($p < 0.05$). Radiographic analysis showed that the LLs in all these groups got improved ($p < 0.05$) and the SLs maintained ($p > 0.05$). **Conclusion:** UPS or UPSFS instrumented TLIF could achieve satisfactory mid-term clinical outcome comparable to BPS's, with less surgical time, less blood loss, and lower cost; UPS should be prudently performed for two-level cases in case of lower fusion rate, and cannulated screws should be replaced by stronger solid screws in UPSFS to reduce facet screw breakage.

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1. Introduction

Over the past thirty years, transforaminal lumbar interbody fusion (TLIF) has become a popular and well-established surgical procedure in the treatment of lumbar degenerative diseases (LDD), since its first use by Harms and Rolinger [1]. It can achieve a solid arthrodesis of spinal segments, maintain proper disk space height, preserve foraminal dimensions, and restore sagittal align-

ment [2–4]. Traditionally, bilateral pedicle screws (BPS) fixation is supposed to be the “gold standard” supplementation to TLIF, which could enhance stability and improve fusion rate. However, the excessive rigidity of BPS fixation is also suspected to cause device-related osteoporosis, absorption of grafted bone and degeneration of adjacent segments degeneration [5–7]. Recently, several modified fixation techniques, such as unilateral pedicle screw (UPS), UPS plus contra-lateral translamina facet screw (UPSFS) has come into use, and acquired good clinical outcome and satisfied fusion rate [8–11].

To our best knowledge, most of the studies mainly focus on one-level TLIF, and fewer two-level cases have been reported, or reported by mixing with the one-level's. Besides, none of the past

* Corresponding authors. Fax: +86 021 64041990.

E-mail addresses: matthewtx@163.com (X. Jiang), dong.jian@zs-hospital.sh.cn (J. Dong).

¹ Both authors contributed equally in this paper.

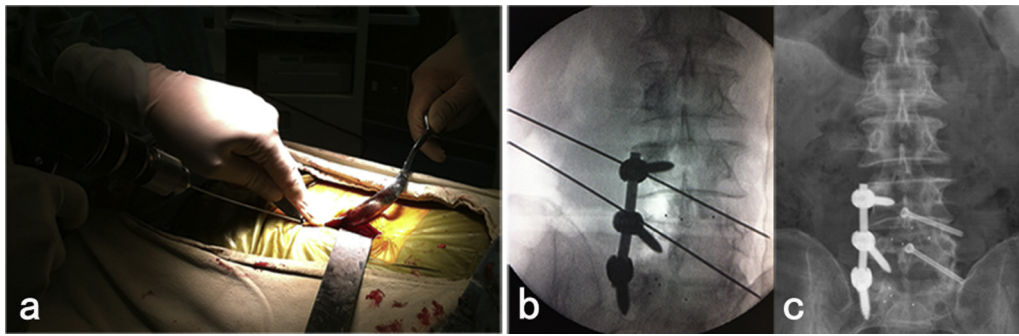


Fig. 1. Placement of TLFSs. Photograph (a) showed a passage was created by a 1.5 mm K-wire mounted on an electric drill; (b) was the intra-operative fluoroscopy when the K-wires had been placed; (c) was the post-operative image of UPSFS.

studies have investigated more than two fixation techniques at the same time. Thereby, we conduct this retrospective comparative study at our single center, the purpose of which is to make a comparison of three different posterior fixation techniques in TLIF for two-level LDD.

2. Materials and methods

This is a retrospective monocentric study including 84 patients, who underwent TLIF instrumented with UPS, UPSFS or BPS fixation between June 2008 and May 2012. The study was approved by the Ethics Committee of our Hospital and all patients had given written informed consent for the surgical procedures.

2.1. Patient population

From June 2008 to May 2012, 118 consecutive patients suffering from lumbar degenerative diseases were operated in our hospital. All of them had chief complaints of low back pain, radicular leg pain/numbness, and/or intermittent claudication before operation, without any improvement of at least six months of conservative treatment. Among them, 84 (71.2%) patients accomplished a mean of 46.2 (ranging from 36 to 60) months' follow-up, while the others were lost owing to various reasons. The medical records, operation notes and follow-up materials of these patients were all collected. According to the fixation techniques, they were divided into three groups: UPS group ($n=22$), UPSFS group ($n=28$) and BPS group ($n=34$). The demographic data were listed in Table 1. Indications for surgery were: two-level severe spinal stenosis with instability; two-level spondylolisthesis, or one-level spondylolisthesis with adjacent spinal stenosis requiring facetectomy and fusion; one-level recurrent lumbar disc herniation with adjacent spinal stenosis requiring facetectomy and fusion. Instability was defined as more than 3 mm of translation or 15° of angular motion on preoperative flexion–extension radiographs [12]. Spondylolisthesis included were all degenerated and low-grade (Meyerding Grade I or II). Patients who had active infection, previous spinal fusion, trauma, severe osteoporosis or spinal malignancy were excluded.

2.2. Surgical procedure

Under general anesthesia, the patient was placed in a prone position on a radiolucent operation table. The involved segments were identified via a C-arm machine and then marked on the skin of the patient. The choice of fixation techniques was primarily based on patients' preference and surgeons' preference and experience. The patients from UPS and UPSFS group were operated by Prof. Jiang, while the patients from BPS group were operated by Prof. Dong independently.

2.3. UPS and UPSFS group

UPS and UPSFS group shared the same procedures except the translaminar facet screw (TLFS) placement. For both, a single paramedian incision 2–3 cm away from the midline was made overlying the involved segments at the symptomatic side, or the more severe one if both sides were symptomatic. A trans-muscular approach was performed to expose the facet joints, transverse processes, and vertebral laminae, then ipsilateral facetectomy and partial laminectomy were performed to decompress the nerve roots after the pedicle screws placement. Complete discectomy was conducted and the vertebral endplates were carefully prepared with disc space reamers and shavers. The resected facets and lamina were crushed into small pellets, one part of which was impacted into the anterior disc space, and the other part was filled in a PEEK cage. For each segment, a single PEEK cage filled with autologous bone was inserted obliquely across the disc space. If the patient suffered from bilateral symptoms, the contralateral decompression could be performed via the laminectomy window. The contralateral ligamentum flavum, ventral side of the lamina, and medial part of the contralateral facet joints were removed until the dural sac and contralateral nerve root were totally decompressed.

The placement of translaminar facet screws in UPSFS group was performed as Magerl did [13]. First, a passage was created by a 1.5 mm K-wire mounted on an electric drill, starting from the base of spinous process, crossing through the contra-lateral lamina, penetrating the facet joint and ending at the base of the transverse process of the lower vertebra (Fig. 1). A cannulated screw was then inserted over the guiding K-wire till its head reached the base of spinous process.

2.4. BPS group

For BPS group, a midline approach was applied and paraspinal muscles at both sides were split from spinal processes. As the standard TLIF procedure indicated [4], pedicle screws placement, decompression, cage placement were performed sequentially. If the patient had bilateral symptoms, bilateral decompression was required.

For all patients, a drain was placed routinely and the incision was closed in a standard fashion finally. Patients were allowed to ambulate at 2–3 days postoperatively, and a brace was recommended for 2–3 months after surgery.

2.5. Clinical and radiographic assessment

The operation time, estimated blood loss (EBL), length of hospital stay, hospital bill and complications were recorded. All the patients were followed up at three, six, and twelve months after operation and annually thereafter. Leg and back pain was quan-

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