Mini-Open (Less Invasive) TLIF Procedure with Unilateral Pedicle Screw Fixation

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ABSTRACT
In recent years, minimally or less invasive techniques (mini-open) in spinal surgery are increasing in popularity due to numerous potential advantages, including reduced length of stay, blood loss and requirements for postoperative analgesia as well as earlier return to work. Herein we describe a personal technique for mini-open transforaminal lumbar interbody fusion (MO-TLIF) using unilateral pedicle screws for degenerative disc disease and lumbar instability. The procedure is described in a step-by-step way, indications and surgical details are presented. Although the present data reflect only an author experience, I believe that this is a straightforward procedure which may be more advantageous in terms of short operation time, less invasion, less blood loss, and fast recovery. We discuss potential indications for less or less invasive unilateral fusion for lumbar instability and support these with descriptions of illustrative case.

KEY WORDS: Less invasive, lumbar interbody fusion, mini-open, unilateral fixation

INTRODUCTION
Harms and Jeszenskky were the first to describe transforaminal lumbar interbody fusion (TLIF) technique with cage in 1998 (11). The TLIF technique has gained popularity in the management of many lumbar degenerative conditions requiring fusion. TLIF is routinely performed with the support of pedicle screws, both bilaterally and unilaterally (1-4,10,13).

Generally, bilateral pedicle screw fixation after Minimal Invasive (MIS) TLIF is accepted as a standard procedure for treating symptomatic spinal pathologies, such as degenerative spinal stenosis, spondylolisthesis, recurrent disc herniation, postlaminectomy instability, and deformity (10). Some authors have recently demonstrated that unilateral pedicle screw fixation is as effective for spinal fusion as bilateral screw fixation after MIS TLIF; and spinal stenosis without instability can be a good indication for MIS TLIF with unilateral pedicle screw fixation.

Recently, TLIF has been performed without the pedicle screw, but is not popular nowadays (7).

TLIF procedure is Mainly advantaged into the intervertebral segment;

1. Decompress the dural sac and nerve roots
2. Immobilize the unstable intervertebral disc
3. Maintain load-bearing to the anterior structures

In addition, this procedure has demonstrated both minimization of surgical exposure and lower tissue morbidity. Compared to conventional lumbar arthrodesis, the main benefit of mini-open technique is significant reduction of muscle injury and systemic inflammatory reactions during the acute postoperative period, which has been credited with playing an important role in preventing medical morbidity after lumbar fusion surgery (5).

The mini-open approach or minimal invasive approach may be selected as the best approach for patients who require a unilateral, single level approach.

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Indication for lumbar interbody fusion
1. G1-2 spondylolisthesis
2. Discogenic degenerative disk disease
3. Recurrent lumbar disk herniation with mechanical back pain
4. Postdiscectomy syndrome (interbody disc collapse with neuroforaminal stenosis)
5. Recurrent (third or more) lumbar disc herniation with radiculopathy
6. Treatment of pseudoarthrosis
7. Treatment of postlaminectomy kyphosis
8. Treatment of lumbar deformity with coronal and sagittal imbalance

Unilateral screw fixation with TLIF minimal invasive spine surgery for arthrodesis has several advantages, including quicker patient recovery, less postoperative pain, and less destruction of adjacent tissue (9,14,15).

In this paper, the unilateral approach for the fusion using TLIF is presented for minimally invasive surgery.

**Patient position**

Optimal intraoperative positioning of the patient is critical to achieving success with the mini-open TLIF or less invasive TLIF. The operating table is placed in the reverse position with the base of the table under the patient's knees. In addition, rolls recreate physiological lumbar lordosis. The surgeon must avoid placing the patient in a flat-back or kyphotic position before performing TLIF. This allows for intraoperative lateral fluoroscopy while avoiding the collision of the fluoroscope with the base of the operating table (1).

For L4-5 level fusion, we keep the operating table parallel to the floor. However, for L5-S1 fusions, we typically position the operating table in 20 degrees of reverse Trendelenburg to allow the surgeon to have a more convenient view of the inferiorly angled L5-S1 level. Before the skin incision, patients are given a perioperative IV 2 gr cefazolin.

**Surgical technique**

The incision is planned using biplanar fluoroscopy to identify the facet complex. The incision must be done at the interpediccular line. This incision is two fingerbreadths off the midline and allows for a paraspinal muscle splitting (Wiltse) approach to be performed. For patients with bilateral nerve root compression, we plan to perform the TLIF with a midline classic approach. The proper site for the incision is marked, a 3-4 cm skin incision was made, and exposure is with both tubular retractor and Meyerding retractor in all cases. Under microscopic view, total facetectomy is performed using a high-speed drill and Kerrison rongeurs. After removing the ligamentum flavum, decompression of the ipsilateral exiting and traversing roots is performed. Then discectomy and endplate preparation are carried out according to the conventional method. After thorough decompression of bilateral exiting and traversing roots, cages filled with autograft material are inserted to the central zone. Pedicle screw fixation is performed by the conventional method under fluoroscopy, unilaterally or bilaterally. The contralateral pedicle screws, however, can either be placed through a contralateral paramedian incision using a Meyerding retractor or can be placed percutaneously.

**Endplate preparation**

On one side of the planned cage placement, the posterior lip of the superior and inferior endplate is removed using an interbody cutter. Care is taken to protect the exiting nerve root and lateral thecal sac during this maneuver. Endplates are scraped with angled curettes to debride cartilagenous surfaces until bleeding cancellous bone is exposed. This maneuver must not be done in osteoporotic spine and diabetic patients.

**Interbody fusion**

The most effective arthrodesis is achieved with an iliac crest autograft. Local autograft from the lamina or facet joint does not have the osteoinductive capability of iliac crest autograft and may not be sufficient to create solid interbody fusion. At the present time, the use of rh-BMP2 in combination with local autograft has been reported to be an excellent alternative to iliac crest autograft to create interbody arthrodesis with a TLIF approach. To avoid foraminal new bone formation, the rh-BMP2 sponge is not placed posterior to the cage, only anterior (8). To avoid foraminal new bone formation, the graft is not placed in the foraminal area.

**Unilateral construct placement**

After the interbody graft is placed, the unilateral pedicle screws are attached to and mildly compressed on appropriately sized rods. It is important not to overdo the pedicle screw compression, because this may create a contralateral compression or stenosis in cases where no unilateral approach with bilateral decompression has been performed. If the surgeon desires, posterolateral arthrodesis may be done for solid arthrodesis. After this prosedre,
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Figure 1A,B: Case report of a 50-year-old man presented with moderate back and right lower extremity pain. Imaging revealed a L4-L5 herniated disc. The patient underwent mini-open TLIF procedure with unilateral pedicle screw fixation.

Figure 2: A) The figure shows the skin incision length, that is very small at about 3 cm, B) both the skin incision and drain are shown after closure.

Figure 3: Intraoperative figures. A) interdisc spacer or dilatator is inserted after the pedicle screw placement, B) After the pedicle screw placement.
patients are encouraged to ambulate on the first postoperative day and discharged the same or the next postoperative day.

Complications and management

Nerve root injury

Excessive nerve root retraction can result in radix edema or injury such as iatrogenic neuropraxia. If the disc space is narrowed, the nerve roots may be damaged. For thus, these cases is placed to unilateral pedicle screws, after the placement, the intervertebral disc space is opened. This procedure may be performed in these cases.

We typically perform a minimal amount of retraction on the lateral thecal sac and, in patients with typically sized nerve roots, we protect the exiting root with a small

![Figure 4A,B: The figures show AP direct x-ray and Lateral CT scan demonstrating that fusion tissue and pedicle screws are in optimal position.](image1)

![Figure 5: Lumbar dynamic X-ray, A) Flexion, B) Extension; No instability after 23 months.](image2)
Mini-open (Less invasive) TLIF Procedure with Unilateral Pedicle Screw Fixation

Cerebrospinal fluid leaks: Intraoperative durotomy rarely occurred.

Malposition of the implants. In this technique, a misplaced implant may occur, but is very rare due to intraoperative x-ray checks.

Infection is rarely seen. We have been using this technique for a long time and 110 cases were operated by the mini-open technique, but we did not see infection in our cases.

Pseudoarthrosis is seen in approximately 5-15% of the cases but symptomatic cases are very rare (3%).

DISCUSSION

Circumferential lumbar fusion has typically required extensive soft tissue damage. Intraoperative soft tissue dissection of retraction leads to subsequent denervation and atrophy, and may contribute to postoperative pain syndromes (6). The physiological effect of retractor blade pressure on the paraspinal muscles was investigated by Kotil et al. (6). They found that elevated serum creatine phosphokinase MM isoenzyme levels, a measure of skeletal myocyte injury, were directly related to retractor pressure and duration (6).

In light of increasing concern on the part of the surgeons and patients regarding the morbidity of open dorsal approaches to the lumbar spine, a number of advances in technique and instrumentation for minimally invasive surgery have recently been developed. These techniques have been increasing in popularity and, in particular, less invasive or mini-open TLIF has been adopted because of the ease of workflow, the ability to provide neural decompression as well as fusion, and the circumferential stabilization conferred to the spine.

In addition, few comparison studies with open or bilateral surgery have been published in the peer-reviewed literature, leading many to the conclusion that the advantages of minimally invasive TLIF are currently only theoretical (12).

There were several patients in the open group who underwent iliac crest graft harvest—which can undoubtedly affect estimated blood loss, operative time, and possibly length of stay, in addition to long term pain and morbidity. We also performed fusion with facet bone fragment, and no any donor place morbidity.

In lateral bending, the elastic zone of spines treated with uni- and bilateral PS differed significantly. In rotation, the stiffness values of bilateral PS were significantly higher than the others.

Bilateral PS augmentation offers significantly more stability than unilateral PS. There are many new studies with scientific messages. Xie et al and Suc and et al showed that unilateral pedicle screw fixation was as effective as bilateral fixation when performed in addition to 1- or 2-level lumbar interbody fusion. The authors recommend the use of unilateral fixation in lumbar interbody unique cage for lumbar degenerative diseases without major instability (14,15). In addition, Kotil and at al reported the TLIF technique without pedicle screw, and the fusion rate was excellent (90%). In their paper, one-level without pedicle screw instrumented TLIF provided similar radiological and clinical outcomes to bilateral pedicle screw instrumented TLIF. In this study, the patient who did not have preoperative instability. This study showed that TLIF without pedicle screw fixation would be sufficient in the management of preoperatively stable patients with lumbar degenerative disease (7).

Ultimately, Mini-open TLIF with unilateral pedicle screw fixation may prove to be a good option for degenerative lumbar disc disease that is not associated with instability,
because the number of metal implants is small, the insertion wound is very small, operation time is shorter, the blood loss is little, and the fusion rate is acceptable.

**KEY POINTS**

- Single level unilateral TLIF with mini-open yielded good clinical and radiological outcome
- Low complication rate,
- Good technique for the elderly patient
- Complications are nerve root injury, pseudoarthrosis, dura injury and malposition, but they are rarely seen
- Revision surgery is very rare
- MI-TLIF with unilateral pedicle screw fixation is a valuable option for primary or revision lumbar surgery.

**REFERENCES**


