Can Minimally Invasive Transforaminal Lumbar Interbody Fusion Create Lordosis from a Posterior Approach?

Neel Anand, MD*, Christopher Kong, MD

KEYWORDS

• Minimally invasive surgery • Transforaminal lumbar interbody fusion • Lordosis • Spine surgery

KEY POINTS

- Lordosis obtained with a minimally invasive Transforaminal Lumbar Interbody Fusion (TLIF) is comparable to that achieved with an open TLIF.
- The multiple available protocols for MIS TLIF contribute to the range of reported outcomes and successes with deformity correction.
- Regardless of the protocol chosen, steps critical to lordosis correction include maintaining the patient in a lordotic position while prone, avoiding endplate violation when preparing the disk space, maximizing disk space height with an interbody device, and placing the graft under the apophyseal ring.
- If high-magnitude (eg, >10°) lordosis correction is required, alternative interbody fusion methods or surgical procedures should be considered.

INTRODUCTION: NATURE OF THE PROBLEM

The transforaminal lumbar interbody fusion (TLIF) was first introduced by Harms and Rollinger in 1998.[1] The procedure was novel in its ability to allow for a 3-column fusion to be obtained through a unilateral, transforaminal corridor via a single posterior approach. Compared with its predecessor, the posterior lumbar interbody fusion, the TLIF required less retraction of the neural elements. This in turn resulted in a decreased rate of postoperative radiculitis.[2]

The TLIF has gained tremendous popularity among spine surgeons over the past 2 decades. This has exposed it to significant study, reworking, and evolution. Among the most significant enhancements of the procedure is its ability to be performed in a minimally invasive fashion. The term, *minimally invasive*, however, is nonspecific and has been applied equally to a variety of different protocols. As a result, reported outcomes for the MIS TLIF have been varied as well.[3–5]

One of the most highly scrutinized determinants of postoperative success after a TLIF is the restoration or improvement of lordosis. Failure to adequately address this goal can either perpetuate or lead to the development of flat back syndrome, where lumbar hypolordosis causes painful sagittal imbalance and increases the rate of adjacent segment degeneration.[6–11]

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Department of Orthopaedic Surgery, Cedars-Sinai Medical Center, 444 South San Vicente Boulevard, Suite 800, Los Angeles, CA 90048, USA
* Corresponding author.
E-mail address: neel.anand@cshs.org

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Some MIS TLIF techniques have been shown capable of reproducibly inducing good lordosis correction.[4,12] One of those techniques is discussed in this article. Recent literature on other techniques that optimize lordosis when performing a TLIF is also reviewed. Variations in protocol or equipment that are not aimed at affecting lordosis, such as spacer material selection, are not discussed.

INDICATIONS/CONTRAINDICATIONS

Indications for the MIS TLIF are identical to those for open TLIF. These currently include symptomatic lumbar spondylolisthesis with or without neurologic symptoms, intractable pain from degenerative disease, and scoliosis.[13] An intervertebral disk space that is unable to accommodate distraction is considered a contraindication.[14]

Despite the deformity-correcting abilities of the TLIF, it has been described by many investigators that alternative interbody fusion methods can offer superior sagittal alignment correction. This includes anterior lumbar interbody fusion (ALIF) and lateral lumbar interbody fusion (LLIF). Both have been compared with the TLIF in multiple studies and found superior at inducing lordosis.[3,15,16]

Lumbar lordosis is seldom the only goal of surgery, however. There are, therefore, many circumstances under which a TLIF still presents itself as the best surgical option. Some of its advantages over other interbody fusion methods include decreased blood loss, cost, operative time, and complication rates.[17–19] The posterior approach allows for direct visualization and confirmation of neural decompression, while avoiding the abdominal organs and great vessels. Additionally, the unilateral placement of the cage combined with ipsilateral facetectomy is capable of imposing a coronal deformity correction superior to ALIF cages.[16]

One of the reasons that the TLIF remains so widely used today is that it is a versatile procedure. It can be performed with varying levels of resources, using open or minimally invasive techniques, and be easily incorporated into longer fusion constructs. This flexibility in technique has unfortunately led to significant inconsistencies in outcomes when reporting on postoperative lumbar lordosis.[4,12,20–22]

Some of the described advantages of MIS TLIF have been decreased postoperative radiculitis, hematoma formation, wound infection, and requirement for revision surgery.[12] Disadvantages have included increased radiation exposure to both patient and surgeon, learning curve, and requirement for special (bayonetted) instruments. Although not necessarily more common, cerebrospinal fluid leaks can also be more difficult to manage when performing an MIS TLIF.

SURGICAL TECHNIQUE/PROCEDURE

Preoperative Planning

The facetectomy is planned on the side with the more severe radiculopathy. Central and contralateral decompression can still be performed an MIS approach; thus, their necessity does not preclude the use of this technique. The MRI and CT are examined closely to identify anatomic variances, such as facet cysts, disk herniations, and pars fractures. Pedicle sizes are measured on cross-sectional imaging as well. If coronal deformity is identified on upright plain films, this can be used to dictate final placement of the interbody cage in the coronal plane. Severe osteoporosis identified on preoperative dual-energy x-ray absorptiometry scan should be corrected prior to surgery and managed postoperatively as well. In the setting of multilevel surgery or deformity correction involving long construct fusion, full-length upright scoliosis films are obtained. The spinopelvic and sagittal alignment parameters are calculated, and the accompanying corrective surgery/construct is planned.

Preparation, Positioning, and Equipment

The patient is positioned prone on a Jackson table. This table is preferred by the authors over a Wilson frame. Hips are maintained in extension. When positioned appropriately, the anterior superior iliac spine is freely palpable, proximal to the bolsters supporting the hips and thighs. Altogether, this helps to maximize a patient's lordosis on the operating table. Bony prominences are padded. Care is taken to avoid over-padding patients to the point where they are able to slip or lose position when the table is tilted intraoperatively. Other investigators have described using breaking Jackson tables to induce additional lordosis before final tightening of the posterior construct.[5,23] The authors have not found this necessary. Cases of fracture associated with table extension greater than 10° have been documented.[23]

The patient's operative site is draped wide to avoid introducing any draping material into the wound with percutaneous instruments.

A tubular retractor and microscope is used for the approach and exposure. Fluoroscopy is used for localization. Bayonetted, long instruments are required. For a single-level fusion, the authors typically use 5 mL of allograft demineralized bone