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Technical note

Minimal invasive lumbar spine revision surgery at distance from the dura and postsurgical scar tissue: Extraforaminal Lumbar Interbody Fusion (ELIF)

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ABSTRACT

Lumbar spine revision surgery is considered as challenging and related to longer operation time and complications because of the loss of anatomical landmarks and the formation of postoperative epidural fibrosis. Minimal invasive lumbar spinal surgery techniques have been refined over the last 5 years but the reexposure of the dura, the formation of postsurgical scar tissue and related dural tears remain a source of complications.

For lumbar spinal revision surgery we advocate the minimal invasive Extraforaminal Lumbar Interbody Fusion (ELIF) technique. It employs a working corridor of 45° relative to the midline. This angle permits bypassing laterally the dural sac and postoperative epidural fibrosis so that dural tears do not occur.

ELIF is performed without an expandable tubular retractor system, it is atraumatic following the natural intermuscular cleavage plane between the multifidus muscle and the longissimus thoracis muscle pars lumborum. Postoperatively the muscles do not show signs atrophy or fatty degeneration. In case of discectomy alone there is no need for the removal of the facets, if intracanalar lesions are targeted the partial removal of the superior facet is sufficient.

ELIF represents an alternative to posterior lumbar interbody fusion (PLIF), conventional open transforaminal lumbar interbody fusion (TLIF), and minimal invasive (MIS) TLIF for lumbar spinal revision surgery.

1. Introduction

Posterior lumbar interbody fusion (PLIF), popularized by Cloward in the 1950s [2,3], and transforaminal lumbar interbody fusion (TLIF), described by Harms in the late1990s [4], are open interbody fusion techniques that expose widely the dura and the paraspinal muscles resulting in the formation of postoperative epidural fibrosis and iatrogenic soft tissue morbidity [6,7,19–21]. The minimal invasive (MIS) TLIF technique, introduced in 2005 by Schwender et al. [17], still exposes the dura but allows less soft tissue exposure. The extent of the resulting muscle trauma with this approach, however, is still under debate [1,11].

In case of lumbar spinal revision surgery the PLIF, conventional open TLIF and MIS TLIF techniques need to reexpose the dura that is covered with postsurgical scar tissue. Incidental dural tears remain a source of complications and the operation time of the revision surgery is generally prolonged [5,8,18].

For lumbar spinal revision surgery we propose the minimal invasive Extraforaminal Lumbar Interbody Fusion (ELIF) procedure [9,10,13] that bypasses laterally the postero-lateral dura and allows the insertion of two interbody cages.

2. Methods

We describe the ELIF technique with intraoperative photos exemplarily at level L4-L5:

A skin incision of 8 cm of length is placed at 10 cm lateral from the midline along the iliac crest (Fig. 1). It is of paramount importance to maintain a 45° angle relative to the midline throughout the operation (Fig. 2). The subcutaneous tissue and the thoracolumbar fascia (Fig. 3A) are uncovered and incised. The underlying erector spinae aponeurosis (ESA) (Fig. 3B) is then incised at a length of 5 cm (Fig. 3 C) to target the underlying intertransverse L4-L5 space. The natural fatty cleavage plane between the multifidus muscle and the longissimus thoracis muscle (Fig. 3D) is then bluntly dissected to expose the lateral part of the facet joint, the neuroforamen L4-L5 and the transverse processes L4-L5 (Fig. 3E).

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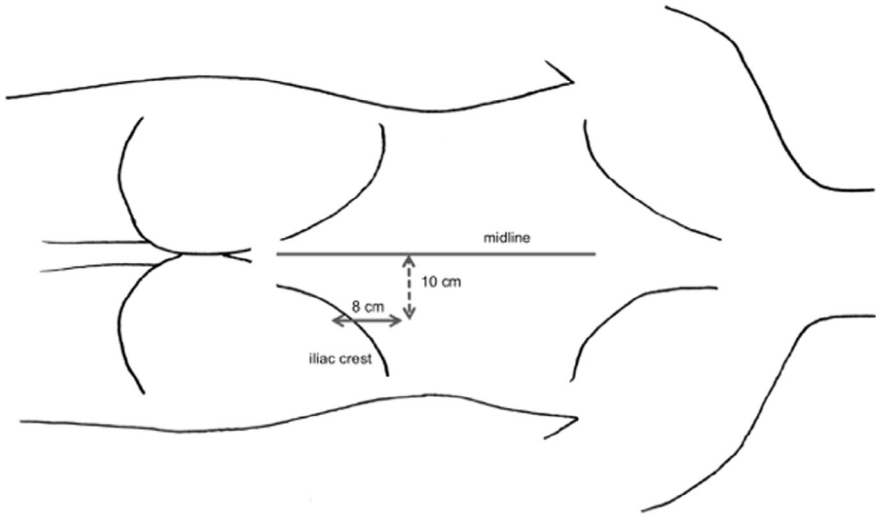

Fig. 1. Illustration showing the patient in prone position. The skin is incised at a length of 8 cm at 10 cm from and parallel to the midline passing over the iliac crest.

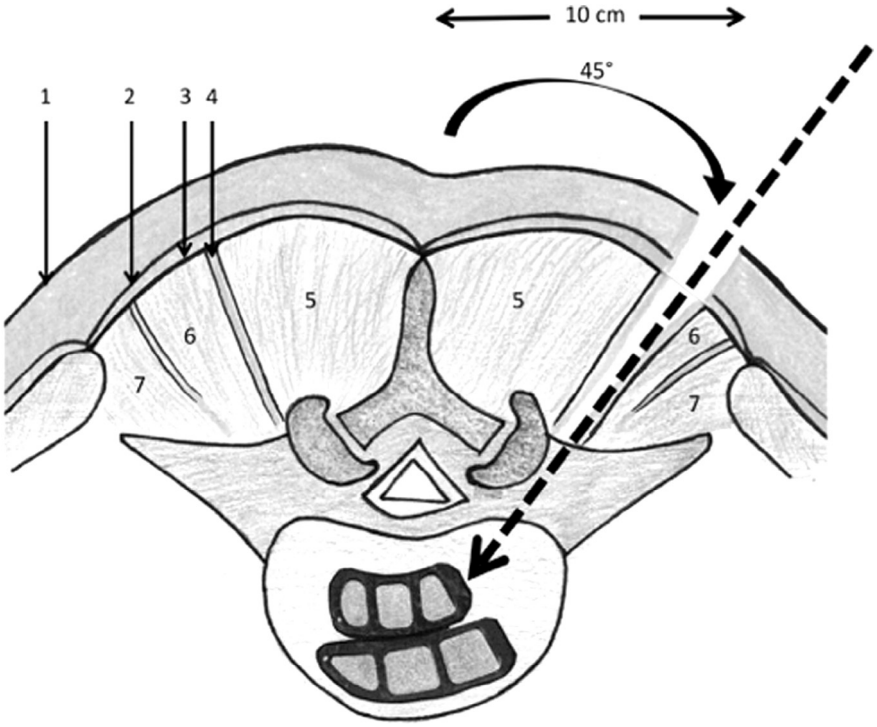

Fig. 2. Illustration depicting the extraforaminal lumbar interbody fusion (ELIF) procedure: The intervertebral disk is targeted laterally from the dural sac with a working channel angled at 45° relative to the midline (*dashed black arrow*) exploiting the cleavage plane (4) between the multifidus (5) and the longissimus thoracis muscle pars lumborum (6). Two C-shaped cages are inserted. 1: skin with subcutaneous tissue, 2: thoracolumbar fascia, 3: erector spinae aponeurosis (ESA), 7: ilicostalis muscle.

Unilateral pedicle screws are placed in the pedicles L4 and L5 guided by fluoroscopy or navigation and then extraforaminal discectomy is performed under distraction. Bone marrow can be harvested from the exposed iliac crest. For fusion we insert two special for this approach designed C-shaped carbon composite cages (Coligne AG, Zurich, Switzerland) filled with the harvested bone marrow (Figs. 2, 3F and G, 4). The first and bigger cage (length: 30 mm, width: 11.3 mm, height: 7, 9, 11 or 13 mm) is inserted close to the anterior longitudinal ligament. This cage is pushed to its definitive position by insertion of a second and smaller cage (length: 23 mm, width: 11.6 mm, height: 7, 9, 11or 13 mm). The pedical screws are connected with a carbon composite plate or titanium rod (Fig. 3H).

The extraforaminal approach makes also foraminal and intracanalar lesions accessible: Their treatment needs partial removal of the superior facet [15]. ELIF is also feasible at L5-S1 level [10].

Fig. 5 shows the radiological imaging of a patient operated with the ELIF technique at level L4-L5 as revision surgery.

3. Discussion

We reported the extraforaminal approach to the intervertebral disk in 1985 [15] and its application to lumbar interbody fusion in 2000 [13]. Recently we refined this technique and demonstrated its feasibility at level L5-S1 [10]. This technique meets the criteria

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