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Migrated XLIF Cage: Case Report and Discussion of Surgical Technique

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Abstract

Extreme lateral interbody fusion (XLIF; NuVasive, Inc, San Diego, California) is a minimally invasive technique developed to avoid complications associated with traditional or minimally invasive anterior or posterior approaches to lumbar interbody fusion. It uses a direct lateral, retroperitoneal, transpsoas approach for placement of an interbody cage. To date, no reports of cage-related complications or procedures for revising an XLIF have been published.

This article describes a case of a complication unique to this procedure and the surgical technique used to treat it. A 49-year-old woman underwent XLIF at L3-4 with supplemental posterior pedicle fixation for treatment of a pseudarthrosis of a previous fusion performed for junctional degeneration below an old scoliosis construct. One month postoperatively, she reported increasing leg pain, and imaging studies demonstrated the cage to have extruded laterally. The cage was revised using a mini-open lateral approach. The presence of neurologic symptoms (leg pain) necessitated the cage to first be reimpaired before it could be safely extracted. A new cage was placed with the addition of a lateral plate. The patient's leg pain resolved shortly after the revision, and at 1-year follow-up, she appeared to have a solid fusion with no further complications.

If required, XLIF may be safely and effectively revised through a minimally invasive or mini-open lateral approach. Use of a lateral plate as a buttress should be considered in cases associated with significant coronal deformity or lateral listhesis, even when planning use of supplemental posterior instrumentation.

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Extreme lateral interbody fusion (XLIF; NuVasive, Inc, San Diego, CA) uses a true (90°) lateral, retroperitoneal, transpsoas surgical approach to the intervertebral disk space.¹ It was developed to provide a minimally invasive alternative to standard open or endoscopic anterior or posterior approaches to lumbar interbody fusion. These approaches are associated with complications such as damage to intra-abdominal viscera; injuries to major blood vessels; retrograde ejaculation; ureteral injury anteriorly; and dural tears, neuropraxia, and muscle denervation posteriorly. Extreme lateral interbody fusion has also been described as a salvage and revision technique for failed lumbar disk arthroplasty in order to avoid the risk of complications from a scarred-in anterior approach.²

The technique for primary XLIF involves placement of the patient in a lateral decubitus position, localization of the disk space fluoroscopically, lateral retroperitoneal dissection, blunt dilation of the psoas muscle using a triggered electromyography nerve avoidance system, discectomy performed using a specialized minimally invasive retractor system, and placement of an interbody cage. The construct may then be secured by placement of percutaneous pedicle screws posteriorly or through placement of rigid fixation (plate or screw-rod construct) laterally.¹⁻³

As with any surgical technique, failures are bound to occur. The most likely mechanism of failure in the follow-up period for any interbody fusion is either pseudarthrosis or displacement of the interbody cage. To date, there have been no descriptions of a technique to revise failed XLIF. In fact, there are no reports in the literature of cage-related complications associated with XLIF. This article presents a case of a migrated XLIF cage that was subsequently revised from a lateral approach.

Case Report

An otherwise healthy 49-year-old woman presented with a long surgical history. In 1977, she underwent posterior spinal fusion with Harrington instrumentation from T6 to L4 for adolescent idiopathic scoliosis. She subsequently developed adjacent segment degeneration below her fusion and underwent a posterior L4-L5 instrumented fusion in 1995. In 2003, she underwent anterior-posterior L5-S1 instrumented fusion (and removal of L4-5 instrumentation) for adjacent segment degeneration. From 2004, she experienced continued low back pain and spasm with radiation of pain to her right buttock. Having failed nonoperative management, she was referred to our clinic for surgical evaluation of a suspected pseudarthrosis at L3-L4 (Figure 1). Computed tomography (CT) confirmed the pseudarthrosis, and a diskogram of the L3-L4 disk was positive for concordant pain.

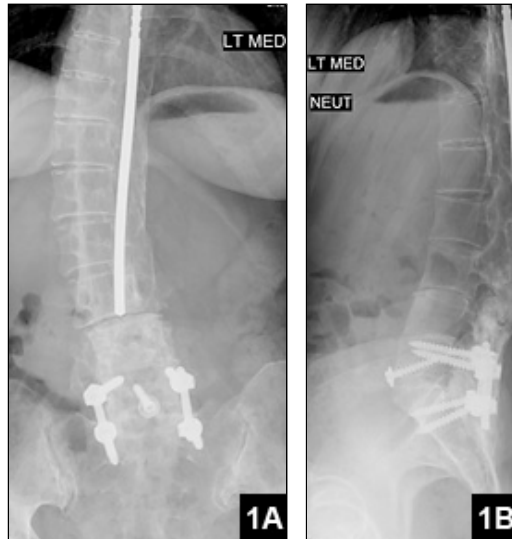


Figure 1: Preoperative AP (A) and lateral (B) radiographs of a patient who underwent multiple anterior and posterior procedures. She had symptomatic pseudarthrosis and diskogenic pain at L3-4. Note the residual coronal plane deformity.

Given her previous history, we recommended an L3-L4 XLIF procedure with supplementary posterior instrumented fusion. This would allow placement of an interbody fusion through a clean surgical field, rather than traversing a previously exposed anterior or posterior approach. The procedure was performed from a left-sided approach (Figure 2). Because of the planned use of posterior pedicle fixation, we opted not to use a lateral plate. She was discharged home on postoperative day 2 in stable condition, with resolution of her right-sided buttock pain and mild left thigh discomfort.



Figure 2: Postoperative AP (A) and lateral (B) radiographs following L3-4 XLIF with posterior fusion.

She did well during the first postoperative month and steadily increased her activities of daily living. At follow-up, however, she noted continued worsening left buttock and thigh pain. She reported no

specific new injury. Radiographic examination demonstrated the intervertebral cage to be approximately 50% displaced laterally to the left, protruding into the psoas (Figure 3). Because of her clinical and radiographic findings, we elected to revise the XLIF. Preoperative CT scan confirmed the location of the cage and was negative for any new fractures or other obvious causes for the displacement.

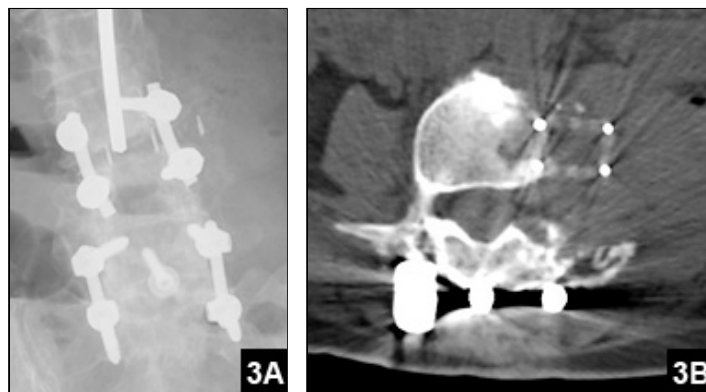


Figure 3: One month postoperatively, the patient reported left-sided thigh and buttock pain. AP radiograph (A) and axial CT (B) demonstrate approximately 50% lateral displacement of the interbody cage. Note the radio-opaque markers of the cage in the lateral soft tissue space.

We performed the revision using the same approach as the primary XLIF. The patient was positioned in a lateral decubitus position and, using her previous incisions, a standard direct lateral retroperitoneal approach was performed. We encountered no significant scar tissue compromising the approach. Given her clinical evidence of irritation of the lateral femoral cutaneous nerve, we felt the safest approach would be to identify the partially extruded cage, dock the minimally invasive retractor on it, reimpact it into the disk space (so as not to risk further traction injury to the nerve), then redock the retractor flush to the disk space, extract the cage, and replace it with a larger one. Because of difficulty docking the retractor on the cage through a 2-cm minimally invasive approach, we connected her 2 previous incisions and proceeded via a mini-open approach. The cage was palpated within the belly of the psoas and, using nerve stimulation, the initial dilator was placed through the psoas and docked in the hole on the lateral side of the cage to which the impactor connected. A Kirschner wire was then placed through the initial dilator to stabilize it in this location. Using the nerve avoidance system, a series of stimulated blunt dilators was passed over the initial dilator and the retractor was placed and locked in place, exposing the lateral aspect of the extruded cage. The retractor was placed only as deep as the lateral aspect of the extruded cage. The cage impactor was affixed to the cage and the cage was gently reimpacted into the disk space. The retractor was removed and the psoas allowed to fall back flush with the lateral vertebral body.

Using an identical series of steps, the initial dilator and K-wire were reinserted into the hole in the cage, the psoas was dilated, and the retractor placed flush with the lateral vertebral body and the disk space. With the disk space now safely exposed, the original 9-mm lordotic cage was extracted using the inserter and a slap hammer. Exploration of the vacant disk space demonstrated adequate prior discectomy and showed that the contralateral annulus fibrosus had been released at the time of the first procedure. A new, larger cage (10 mm, neutral) was then inserted. A lateral plate (XLP; NuVasive, Inc) was then added to act as a buttress to prevent repeat dislodgement. Placement of this plate required minimal dissection of the psoas muscle from the lateral vertebral bodies and insertion of the inferior screw obliquely to avoid the L4 pedicle screw.

Postoperatively, the patient noted rapid improvement of her left leg pain, although she had moderate groin pain likely secondary to the psoas dissection. This improved gradually through her hospitalization, and she was discharged home in stable condition on postoperative day 4.

By her first postoperative follow-up at 3 weeks, she reported near complete resolution of her left leg pain and mild groin discomfort. At 1-year follow-up, radiographs confirmed stable placement of the cage with no evidence of screw loosening or cage movement (Figure 4).

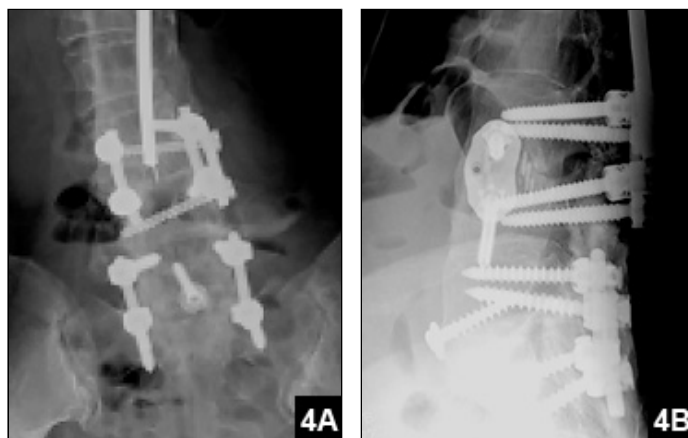


Figure 4: One year postoperative AP (A) and lateral (B) radiographs after revision XLIF with placement of a larger cage and lateral plate. The L4 lateral bolt was placed obliquely to avoid the posterior pedicle screw. Healing of the fusion is evident.

Several minimally invasive techniques for lumbar fusion have been described with the goal of decreasing the morbidity associated with standard open techniques.⁴ Investigators have reported an increased risk of complications with such approaches, particularly laparoscopic anterior lumbar interbody fusion.^{5,6} Minimally invasive posterior pedicle screw fixation is limited in the ability to add a traditional posterolateral fusion. Schwender et al⁷ reported good initial results with minimally invasive transforaminal lumbar interbody fusion, although 4 of 49 patients in their series had associated complications. The XLIF technique was developed to avoid the complications noted in other minimally invasive techniques while allowing placement of an interbody graft.

Extreme lateral interbody fusion is particularly useful in cases such as ours, in which previous anterior and posterior exposures have left a potentially scarred-in approach or a large fusion mass that would need to be traversed to perform interbody fusion. Unfortunately, as with any procedure, complications are bound to occur. To date, there have been no published reports of cage migration complications following XLIF. The true lateral surgical approach is designed to avoid major neurovascular structures, and the use of a nerve avoidance system contributes to the safety of the approach. Thus, major neurovascular complications are less likely. Although there is a reported 27% to 30% incidence of transient lateral thigh or groin paresthesia and pain in lateral procedures where the psoas muscle is retracted posteriorly (likely due to stretch of the lateral genitofemoral nerve as it passes through the fibers of the psoas muscle),⁸ XLIF-specific reports reference significantly lower rates of neurological complications, however transient.^{3,9} Given the relative safety of the approach, mechanical complications (eg, displaced cage or pseudarthrosis) appear more likely than iatrogenic injury.

Several options exist for surgical treatment of symptomatic pseudarthrosis following XLIF. The details of the initial procedure (eg, stand-alone XLIF, use of lateral plate, or use of posterior fixation), patient-specific factors (eg, previous lumbar surgeries), and surgeon comfort and preference will ultimately

dictate the necessary treatment. If the initial procedure was performed in a stand-alone fashion or with use of a lateral plate, posterior fusion may be the most appropriate revision procedure. If, however, multiple anterior and/or posterior procedures have been performed, resulting in a challenging or dangerous surgical approach, a lateral approach—either through the same or contralateral side—may be best. If a contralateral approach is used, one should remember that although the contralateral annulus is released at the time of the index procedure, it is not removed, and may need to be excised to gain access to the interbody space. In this case, the first dilator should be used to localize the disk space, and the K-wire may need to be inserted through the remaining annulus into the lateral hole of the cage to secure the dilators.

The options for treating a displaced cage are more limited. As part of the preoperative evaluation, CT scan should be performed to assess not only the location of the cage, but also to evaluate potential causes of the extrusion (eg, pedicle fractures or failure of supplemental fixation). The lateral approach must be made from the side to which the cage is displaced. The use of a nerve avoidance system makes localizing the displaced cage relatively safe. Because the cage may be placing the genitofemoral nerve or other nerves of the lumbar plexus under traction, it should be reimpacted into the disk space prior to extracting it. Extraction of a partially extruded cage without first reimpacting it may place the nerve under further risk of traction injury. By reimpacting the cage, not only is any tension on the nerve relieved, but the surgeon may then reset the retractor at the level of the disk space flush with the bone to facilitate placement of the new cage. With the cage remaining in the disk space, the surgeon may localize the disk space and dilate without risking placement of a dilator or K-wire through the empty disk space and into the contralateral soft tissue structures.

A fully displaced cage presents a different set of challenges, which may not be amenable to minimally invasive revision. If a cage is completely extruded, it cannot be safely reimpacted into the disk space, as the space may have collapsed. In addition, the cage may have rotated within the space between the vertebra and the psoas such that it is perpendicular to the disk space. In this case, a formal anterior approach should also be considered as it may be the safest way to retrieve the cage.

In our case, we opted for an XLIF because of the patient's multiple previous surgeries. We felt that additional posterior fusion would be appropriate to treat her pseudarthrosis, and therefore elected to use bilateral pedicle screw fixation rather than a lateral plate to augment the interbody fusion. Previous studies have reported good results with either pedicle screw or lateral fixation.^{1,3} Either construct should provide adequate stabilization, although bilateral pedicle screw constructs are stiffer.^{10,11}

One possible reason for extrusion of a cage is inadequate release of the contralateral annulus during the primary XLIF procedure. This could prevent proper positioning of the cage, which is designed to be supported by the ring apophysis, causing uneven seating and asymmetric force distribution. This did not appear to be a factor in our case. More likely, the extrusion of the cage may have been due to the patient's residual coronal imbalance (Figure 2), fused distal segments, and possible failure of the posterior instrumentation to provide maximal compression across the construct. In a cadaveric study, Buttermann and Beaubien¹² examined variations in intradiskal pressure at levels below a scoliosis fusion. They found that in comparison to disk levels below spines instrumented in a neutral alignment, those disks below spines instrumented in a scoliotic curve demonstrated increased and asymmetric pressures, particularly when the disks were degenerated. Peak loads ranged up to 4.4 times greater along the inner annulus on the concave side of the curve compared to the convex side.¹²

Interestingly, in the case described, the cage extruded despite supplemental posterior fixation. Theoretically, compression applied across the posterior screws should have loaded the intervertebral cage, essentially locking it in place. We suspect, however, that maximal compression may have been

impeded by residual bone from the patient's prior fusion mass. In the presence of a lordotic cage, as was initially placed, any blockage of posterior compression could result in uneven loading of the cage, with the posterior half essentially unloaded. In the early postoperative period (before the new posterior fusion mass had time to mature), this could allow micromotion around the disk space. Lastly, because all levels below the operative site had been surgically fused, any forces acting across the operative level could not have been dissipated across residual motion segments and were instead concentrated at the L3-L4 disk space. We hypothesize that in this case, the patient's residual coronal imbalance, slight lateral listhesis, and significant lever arm created by the long fusion above caused unequal loading of the cage on 1 side, which failed by extrusion through the path of least resistance, namely the annulotomy defect. As a result, we now consider application of a lateral plate to act as a buttress in cases involving significant coronal plane deformity or lateral listhesis adjacent to prior fusions, even when supplemental posterior instrumentation is also used.

Despite its many advantages, complications may occur with XLIF. Revision of an extruded interbody cage may be safely and effectively performed using a minimally invasive lateral approach or a mini-open approach, as in our case. For revision of a pseudarthrosis that requires access to the cage, an approach from the original side or, optionally, a contralateral approach through virgin tissue offers the ability to perform the procedure minimally invasively. Although we did not encounter significant scar tissue in our case, because of the potential risk of peritoneal adhesions and scar tissue, we recommend having a surgeon well versed in anterior spinal approaches available for assistance.

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