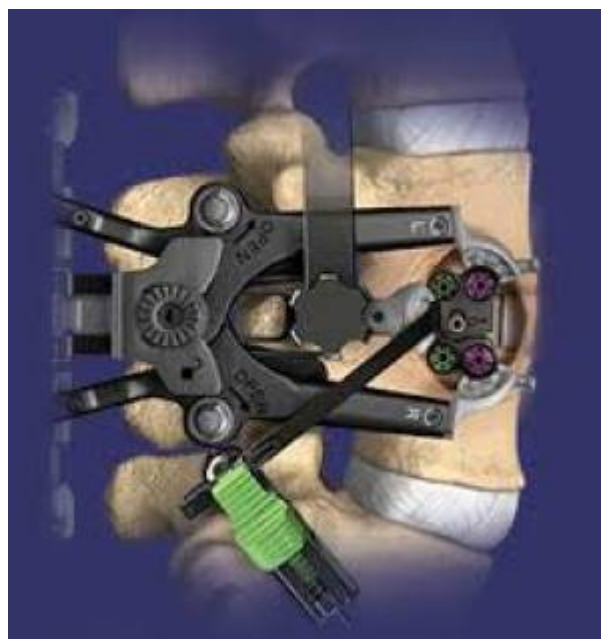


XLIF



see also [Lateral lumbar interbody fusion \(LLIF\)](#)

The [XLIF](#) (eXtreme [Lateral Lumbar Interbody Fusion](#)) is an [approach](#) to [spinal fusion](#) in which the surgeon accesses the [intervertebral disc](#) space and fuses the [lumbar spine](#) (low back) using a surgical [approach](#) from the side (lateral) rather than from the front (anterior) or the back (posterior).

The XLIF approach allows for anterior access to the disc space without an approach surgeon or the complications of an anterior intra-abdominal procedure ¹⁾.

Indications

The XLIF is one of a number of spinal fusion options that a surgeon may recommend to treat specific types of lumbar [spinal disorders](#), such as [lumbar degenerative disc disease](#), [spondylolisthesis](#), [scoliosis](#) and [deformity](#) and some recurrent [lumbar disc herniations](#) and types of lumbar stenosis. It cannot be used for all types of lumbar conditions for which [spinal fusion](#) is a treatment option. For example, it cannot treat conditions at the lowest level of the spine, L5-S1 or for some people at L4-L5.

Whilst the available data is limited, minimally invasive XLIF procedures appear to be a promising alternative for the treatment of scoliosis, with improved functional VAS and Oswestry disability index outcomes and restored coronal deformity. Future comparative studies are warranted to assess the long term benefits and risks of XLIF compared to anterior and posterior procedures ²⁾.

A study suggests that XLIF may be a safe and effective alternative to [ALIF](#) for the treatment of spondylodiscitis ³⁾.

Fusion rate

Reports of XLIF fusion rate in the literature vary from 85 to 93 % at 1-year follow-up ⁴⁾.

Complications

Transient ipsilateral thigh numbness, pain and/or hip flexor weakness is a frequent post-operative finding most commonly when the L4-5 level is instrumented. Dense femoral nerve palsy is a debilitating complication that may occur despite intra-operative neurophysiologic monitoring ⁵⁾.

A anatomical study suggests that positioning the dilator and/or retractor in a posterior position of the disc space may result in nerve injury to the lumbosacral plexus, especially at the L4-5 level. The risk of injuring inherent nerve branches directed to the psoas muscle as well as injury to the genitofemoral nerve do still exist ⁶⁾.

Videos

see [XLIF Videos](#)

Case series

A retrospective review found six patients who met strict operative criteria including instability, intractable pain, neurological deficit, and disease progression. All patients were non-ambulatory before surgery because of intractable back pain. The patients underwent standard lateral minimally invasive surgery using either the extreme lateral interbody fusion (NuVasive, San Diego, CA, USA) or direct lateral interbody fusion (Medtronic Sofamor Danek, Memphis, TN, USA) system. The patients underwent debridement with a discectomy and partial or complete corpectomy, with polyetheretherketone or titanium cage placement. Two patients had additional posterior fixation with percutaneous pedicle screws, and none had immediate perioperative complications. The postoperative CT scans demonstrated satisfactory debridement and hardware placement. All patients experienced significant pain improvement and could ambulate within a few days of surgery. So far, the 1year follow-up data have demonstrated stable hardware with solid fusion and continued pain improvements. One patient demonstrated hardware failure secondary to refractory infection, 2months postoperatively, and required additional posterior decompression and debridement with pedicle screw fixation. The lateral transpsoas approach permits debridement and fixation coupled with percutaneous pedicle screw fixation to further stabilize the spine in a minimally invasive fashion. Due to the significant comorbidities in this patient population, a minimally invasive approach is a suitable surgical technique. A close follow-up period is necessary to detect early hardware failure which may necessitate more extensive treatment ⁷⁾.

Literature

Related to the development and diffusion of ALIF and XLIF, it is possible to correct [sagittal malalignment](#) in selected cases of [lumbar degenerative discopathy](#) with relatively low invasiveness. Still, the [malposition](#) or the inappropriate size of the implanted [cages](#) may lead to the [subsidence](#) of the [vertebral endplates](#) with loss of [correction](#) as well as a decrease in the potential to restore [spinal biomechanics](#) in the long run. The aim of a study of Tartara et al. was to evaluate the [safety](#), [feasibility](#), and preliminary clinical and radiological results when using [custom-made, trabecular titanium cages](#) in ALIF and XLIF procedures.

They [prospectively](#) evaluated 18 consecutive [patients](#) who underwent either an ALIF or an XLIF procedure with the implant of a custom-made, trabecular titanium cage for [lumbar degenerative disease](#) with [sagittal imbalance](#), with a minimum of 1-year clinical and radiological follow-up.

After a mean follow-up of 14 months, the [Oswestry](#) score dropped to a mean of 13 from a preoperative value of 48 ($p < 0.0001$). [Lumbar lordosis](#) was significantly improved, especially in the lower lumbar segment L4-S1 ($+ 11 \pm 7^\circ$; $p < 0.0001$). No cases of subsidence were noted.

Custom-made, trabecular titanium cages allowed a segmental, steady, durable sagittal correction via ALIF and XLIF approaches. The absence of cage subsidence at 1 year encourages further studies on a larger cohort with longer follow-up ⁸⁾.

To compare imaging indicators and clinical effects of [extreme lateral lumbar interbody fusion](#) (XLIF) using [allogeneic bone](#), [autologous bone marrow + allogeneic bone](#), and rh [BMP2 + allogeneic bone](#) as [bone graft](#) materials in the treatment of [degenerative lumbar diseases](#). This was a [retrospective](#) study of 93 patients with [lumbar interbody fusion](#) who underwent the extreme lateral approach from May 2016 to December 2017. According to the different bone graft materials, patients were divided into allogenic bone groups (group A, 31 cases), rhBMP-2 + allogeneic bone (group B, 32 cases), and autologous bone marrow + allogeneic bone (group C, 30 cases). There were no significant differences in gender, age, lesion segment, preoperative intervertebral space height, and preoperative Oswestry Dysfunction Index (ODI) and [visual analog scale](#) (VAS) scores among the 3 groups ($P > .05$). Intervertebral space height, bone graft fusion rate, and ODI and VAS scores were compared immediately after surgery, and at 3, 6, and 12 months after surgery. All groups were followed up for 12 months. The intervertebral space height was significantly higher in the 3 groups immediately after surgery and at 3, 6, and 12 months after surgery, in comparison to before surgery ($P < .05$). There was no significant difference in the intervertebral space height among the 3 groups immediately after surgery and at 3, 6, and 12 months after surgery ($P > .05$). The fusion rate of group B and C was higher than that of groups A at 3, 6, and 12 months after surgery ($P < .05$). In the 3 groups, the VAS and ODI scores at 3, 6, and 12 months after surgery were significantly improved compared with the preoperative scores ($P < .05$). The VAS and ODI scores in groups B and C were significantly higher than those in group A ($P < .05$), but there was no significant difference between groups B and C ($P > .05$). The rhBMP-2 + allograft bone combination had good clinical effects and high [fusion rate](#) in XLIF ⁹⁾.

Lateral lumbar interbody fusion (LLIF) and bilateral percutaneous pedicle fixation are valuable, minimally invasive lateral approaches used to treat symptomatic degenerative disc disease. In the current procedure, the patient's position on the operating table is changed after LLIF surgery from the lateral decubitus to the prone position. The ability to perform both approaches with the patient in the same position should reduce operation time. Use of a guide wire is problematic during percutaneous pedicle screw (PPS) insertion using fluoroscopy with the patient in the lateral decubitus position. A

new guide wire-less PPS system may solve this problem and reduce operation time. Here, we evaluated the operative data and efficacy for this technique.

This study included 30 patients (aged 70.8 ± 8.5 years; 17 men, 13 women) who underwent a combined operation (indirect decompression) using extreme lateral interbody fusion (XLIF) with only a single level for lumbar spinal canal stenosis and lumbar degenerative spondylolisthesis. Patient demographics and operative data were compared between two groups: patients who remained in the lateral decubitus position for pedicle screw fixation (L group) and those turned to the prone position (P group). Radiographic assessment was performed using pre- and postoperative anteroposterior and lateral lumbar films with measurement of lumbar lordosis, segmental lordosis, and segmental translation.

RESULTS: We analyzed 18 patients in the P group and 12 in the L group. Age, sex, height, body weight, body mass index, estimated blood loss, and length of stay did not differ between groups. The operation time was 34 min shorter for the L group (P group 111.9 ± 25.0 vs. L group 77.5 ± 22.2 min, $p < 0.01$). Pre- and postoperative lordosis, segmental lordosis, and segmental translation did not differ significantly between groups.

CONCLUSIONS: A single position after XLIF surgery is a feasible modification to the standard procedure when used with fluoroscopy and a guide wire-less PPS system. The time saved is the main advantage of inserting the PPS with the patient in the lateral decubitus position without repositioning. Use of the lateral PPS with a guide wire-less technique may help improve operative efficiency and reduce cost ¹⁰⁾.

Prospective cohort study.

OBJECTIVES: Evidence on predicting the success of indirect decompression via extreme lateral interbody fusion (XLIF) is scarce. The authors investigated if patients who could achieve a pain-free position preoperatively would derive clinical benefit from XLIF without direct decompression.

METHODS: Data from 50 consecutive patients who underwent XLIF with and without direct decompression by a single surgeon from January 2014 to August 2017 was collected. Primary outcome is the rate of failure of patients who underwent XLIF without direct decompression, characterized by persistence of pain postoperatively that required reoperations within 6 months postoperatively. Secondary outcomes are clinical outcomes and patient-reported quality of life outcome data, including visual analogue scale for leg (VASL) and back (VASB) pain, Oswestry Disability Index (ODI), and Physical Component Score (PCS) and Mental Component Score (MCS) of SF-12, for up to 2 years postoperatively.

RESULTS: One patient with preoperative [dynamic posture-related pain](#) who underwent XLIF without direct decompression subsequently had a reoperation due to persisting pain. Statistically significant improvement was achieved across all patient reported outcomes ($P < .05$): improvement of 68% for VASL, 61% for VASB, 50% for ODI, 33% for PCS, and 11% for MCS of SF-12 at last follow-up. Six patients had thigh symptoms that resolved.

CONCLUSION: The simple clinical criterion based on postural pain status preoperatively may help clinicians in patient selection for indirect decompression of XLIF without the need for direct decompression. Further studies with larger cohorts are warranted to establish the validity of the algorithm ¹¹⁾.

Hiyama et al. examined the ability of the [extreme lateral interbody fusion \(XLIF\)](#) procedure to restore coronal and [sagittal alignments](#) for patients with [adult spinal deformity \(ASD\)](#) using [computed tomography multiplanar reconstruction \(CT-MPR\)](#). Thirty-eight patients with ASD undergoing correction and fixation with XLIF at 114 levels were studied. The coronal segmental [Cobb angle](#), coronal regional Cobb angle (L1-5), sagittal segmental Cobb angle, sagittal regional Cobb angle (L1-5), intervertebral disc height and, vertebral body rotation (VBR) were measured before and after of XLIF surgery using CT-MPR. The mean sagittal segmental Cobb angle, the coronal segmental Cobb angle, and VBR were corrected from 5.0° to 9.0°, from 6.3° to 4.3° and from 12.2° to 10.8°, respectively. The mean of the intervertebral disc heights increased significantly from 6.0 mm to 10.4 mm postoperatively. Although increases in coronal segmental Cobb, sagittal segmental Cobb, and intervertebral disc height at each level were significant, there were no significant differences in each parameter acquired by spine levels. The results also showed that it was difficult for L4/5 level to obtain the most postoperative coronal Cobb, sagittal Cobb and intervertebral disc height. This study evaluated the alignment improvement effect of stand-alone XLIF in ASD patients using CT-MPR. For the lower lumbar spine, it is difficult to obtain a lordosis more than 10 degrees with stand-alone XLIF for correcting ASD. Therefore, it is thought that correction such as [osteotomy](#) or compression technique to the posterior fusion may be necessary during the 2nd stage surgery ¹²⁾.

Nomura et al. sought to quantify the results of clinical and radiological analyses of [extreme lateral interbody fusion \(XLIF\)](#) plus [percutaneous pedicle screw \(PPS\)](#) fixation for patients with [lumbar spinal stenosis \(LSS\)](#) by focusing on the distinct mechanism of indirect decompression.

Data obtained from a total of 37 patients with 47 surgical sites were retrospectively analyzed. Clinical outcomes for all patients were evaluated using the [Japanese Orthopaedic Association \(JOA\)](#) score and the improvement rate of the JOA score. Preoperative and postoperative magnetic resonance images were used to measure the transverse areas of both the dural sac (DS area) and ligamentous flavum (LF area) in the axial sections and the length of the intervertebral [disc bulge \(DB length\)](#) in sagittal sections. Then, the rate of change (RC) of the DS area (RC-DS), the RC of the LF area (RC-LF), and the RC of the DB length (RC-DB) from the preoperative period to the postoperative period were calculated. Furthermore, we divided all surgical sites into the small expansion group (SE group; RC-DS <150%) and large expansion group (LE group; RC-DS ≥200%) according to the degree of RC-DS.

Preoperative clinical symptoms improved significantly after surgery for all patients regardless of whether the RC-DS was large or small. RC-DS, RC-LF, and RC-DB were approximately 203%, 74%, and 37%, respectively. Moreover, we found that the bulging was significantly shorter in the LE group than in the SE group, although there was no difference in the RC-LF between the LE group and SE group.

They suggest that indirect decompression after XLIF is particularly influenced by the degree of reduction in DB ¹³⁾.

The goal of the current study was to compare the perioperative and post-operative outcomes of eXtreme lateral trans-psoas approach (XLIF) versus anterior lumbar interbody fusion (ALIF) for single level degenerative spondylolisthesis. The ideal approach for degenerative spondylolisthesis remains controversial.

Consecutive patients undergoing single level XLIF (n=21) or ALIF (n=54) for L4-5 degenerative spondylolisthesis between 2008-2012 from a single academic center were retrospectively reviewed. Groups were compared for peri-operative data (estimated blood loss, operative time, adjunct procedures or additional implants), radiographic measurements (L1-S1 cobb angle, disc height, fusion grade, subsidence), 30-day complications (infection, DVT/PE, weakness/paresthesia, etc.), and patient reported outcomes (leg and back Numerical Rating Scale, and Oswestry Disability Index).

Estimated blood loss was significantly lower for XLIF [median 100; interquartile range (IQR), 50-100 mL] than for ALIF (median 250; IQR, 150-400 mL; $P<0.001$), including after adjusting for significantly higher rates of posterior decompression in the ALIF group. There were no significant differences in rates of complications within 30 days, radiographic outcomes, or in re-operation rates. Both groups experienced significant pain relief post-operatively.

The lateral trans-psoas approach is associated with diminished blood loss compared to the anterior approach in the treatment of degenerative spondylolisthesis. We were unable to detect differences in radiographic outcomes, complication rates, or patient reported outcomes. Continued efforts to directly compare approaches for specific indications will minimize complications and improve outcomes. Further studies will continue to define indications for lateral versus anterior approach to lumbar spine for degenerative spondylolisthesis ¹⁴⁾.

A literature search was performed on Pubmed and Web of Science using combinations of the following keywords and their acronyms: lateral lumbar interbody fusion (LLIF), oblique lateral interbody fusion (OLIF), anterior-to-psoas approach (ATP), direct lateral interbody fusion (DLIF), extreme lateral interbody fusion (XLIF), and minimally invasive surgery (MIS). All results from January 2016 through January 2019 were evaluated and all studies evaluating complications and/or outcomes were included in the review.

The transient neurological deficit, particularly sensorimotor symptoms of the ipsilateral thigh, remains the most common complication seen in LLIF. Best available current literature demonstrates that approximately 30-40% of patients have postoperative deficits, primarily of the proximal leg. Permanent symptoms are less common, affecting 4-5% of cases. Newer techniques to reduce this rate include different retractors, direct visualization of the nerves, and intraoperative neuromonitoring. OLIF may have lower deficit rates, but the available literature is limited. Subsidence rates in both LLIF and OLIF are comparable to ALIF (anterior lumbar interbody fusion), but further study is required. Supplemental posterior fixation is an active area of investigation that shows favorable biomechanical results, but additional clinical studies are needed. Minimally invasive lumbar interbody fusion techniques continue to advance rapidly. As these techniques continue to mature, evidence-based risk-stratification systems are required to better guide both the patient and clinician in the joint decision-making process for the optimal surgical approach ¹⁵⁾.

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