

High neurological complication rates for extreme lateral lumbar interbody fusion and related techniques: A review of safety concerns

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Abstract


Background: There are frequent reports of lumbosacral plexus and other neurological injuries occurring with extreme lateral interbody fusions (XLIF) and other related lateral lumbar techniques.

Methods: This review focuses on the new neurological deficits (e.g. lumbosacral plexus, root injuries) that occur following minimally invasive surgery (MIS) XLIF and other related lateral lumbar techniques.

Results: A review of multiple articles revealed the following ranges of new postoperative neurological complications for XLIF procedures: plexus injuries 13.28%; sensory deficits 0–75% (permanent in 62.5%); motor deficits 0.7–33.6%; anterior thigh pain 12.5–25%. Of interest, in a study by Lykissas *et al.*, the frequency of long-term neural injury following lateral lumbar interbody fusion (LLIF) with BMP-2 (72 patients) was much higher than for LLIF performed with autograft/allograft (72 patients). The addition of bone morphogenetic protein led to persistent sensory deficits in 29 vs. 20 without BMP; persistent motor deficits in 35 with vs. 17 without BMP; and persistent anterior thigh/groin pain in 8 with vs. 0 without BMP. They should also have noted the unacceptably high incidence of neural injury occurring with LLIF alone without BMP.

Conclusion: This review highlights the high risk of neural injury (up to 75% for sensory, 33.6% for motor, and an overall plexus injury rate of 13.28%) utilizing the XLIF and other similar lateral lumbar approaches. With such extensive neurological injuries, is the XLIF really safe, and should it still be performed?

Key Words: Comparison with other lateral interbody methods, extreme lateral interbody fusion, minimally invasive surgery, neurological complications, open surgery

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INTRODUCTION

This review focuses on the frequency of neural injuries resulting from extreme lumbar interbody fusion (XLIF) or similar lateral procedures (e.g., direct lumbar interbody fusion (DLIF) and lateral lumbar interbody fusion (LLIF)). The multiple studies analyzed cited the following ranges of new postoperative neurological complications attributed to XLIF: new sensory deficits 0–75% (permanent 62.5%), new motor deficits 0.7–33.6%, new anterior thigh pain 12.5–25%,

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and a plexus injury rate of 13.28%. Because it is well-known that the transpoas approach places the lumbosacral plexus at risk, some authors even concluded these frequent deficits should not be considered “complications,” as they were simply “anticipated” consequences of the procedure. Here, we emphasize the unacceptably high rate of neurological injuries attributed to XLIF and related lateral lumbar procedures, and question whether, with this safety record, it should still be performed?

HIGH FREQUENCY OF NEW NEUROLOGICAL INJURIES WITH XLIF AND RELATED LATERAL LUMBAR PROCEDURES

Multiple authors have reported a high frequency of neurological injuries, including anterior thigh pain, contralateral femoral nerve palsies, new sensory/motor root deficits, and lumbar plexopathies attributed to XLIF and other lateral lumbar procedures. In 2011, Sharma *et al.* evaluated the 1-year outcomes of 43 LLIF addressing degenerative disc disease (DDD), degenerative spondylolisthesis (DS), or scoliosis; 25% of the patients experienced new postoperative anterior thigh pain [Table 1].^[11] Further, in 2011, Papanastassiou *et al.* observed 2 (6.25%) new contralateral femoral nerve root injuries occurring out of a series of 32 XLIF procedures [Table 1].^[10] One of the latter injuries was attributed to the contralateral displacement of an endplate fragment due to “overzealous endplate removal and breaking of the osteophytes in the opposite corner of the intervertebral disc”; the second was due to a failure to pay close attention to cage placement, which extended into the opposite foramen.^[10] In 2013, Ahmadian *et al.* reviewed 18 studies involving 2310 patients undergoing XLIF; 304 (13.2%) patients exhibited plexus injuries, while root injuries led to motor (0.7–33.6%) and sensory (0–75%) deficits.^[11] Of interest, here the authors concluded neural complications for XLIF procedures were being underreported. In 2014, Hrabalek *et al.* analyzed the complication rates for minimally invasive (MIS) anterior lumbar interbody fusions (ALIF) (20 patients) vs. MIS XLIF (88 patients) addressing T12–L5 level pathology [Table 1].^[7] MIS ALIF complications included post-sympathectomy syndrome (19 patients; 15.8%) and 35 minor intra/postoperative complications (32 patients; 26.6%). For XLIFs, 26 complications occurred in 22 patients (25%); one transient L5 root injury (1.1%) and 20 of 25 root/plexus injuries involving transient left groin/anterior thigh pain (11 patients; 12.5%) or numbness (9 patient; 10.2%). Formica *et al.*, in 2014, evaluated the complications of 39 consecutive XLIF performed for degenerative or post-traumatic lumbar pathology over an average postoperative interval of 16 months; 10 (26%) patients exhibited “mild, transient” motor quadriceps deficits that completely resolved [Table 1].^[5] Khajavi *et al.* in 2015 further assessed the outcomes for 160 patients

(197 levels) undergoing MIS XLIF for degenerative lumbar disease [Table 1].^[8] Patients experienced anterolateral thigh/groin sensory deficits (14%) and iliopsoas weakness (9%); notably, they considered these “minor complications.” In a retrospective cohort analysis of the neurological sequelae of 120 XLIF and DLIF, Cheng *et al.*, in 2015, found that 31 (25.8%) patients experienced one or more adverse event (AEs).^[2] Twenty-two patients (18.3%) experienced 24 neurological AEs; 15 (12.5%) complained of anterior/lateral thigh dysesthesias, and there were 6 (5.0%) instances of radiculopathy and 3 (2.5%) cases of postoperative weakness. Interestingly, AEs occurred more frequently following DLIF (28%) vs. XLIF (14.2%). In 2016, Epstein commented on the much higher frequency of root/plexus injuries occurring with MIS XLIF (23.8%) vs. ALIF (15.8%) reported in the Spine Patient Outcomes Research Trial by Desai *et al.*^[3,4] Interestingly, these numbers far exceeded those quoted for open discectomy (0.13% to 0.25%), open laminectomy/stenosis with/without fusion (0%), and open laminectomy/stenosis/degenerative spondylolisthesis with/without fusion (2%). Performing a retrospective review of outcomes 1 year following 108 XLIF, Grimm *et al.* (2016) found a 23% complication rate (25 complications); 21 (19.4%) involved thigh pain paresthesias, whereas the remaining 4 (3.7%) addressed a vertebral body fracture, a contralateral root injury, quadriceps weakness, and residual stenosis; notably 3 patients required additional surgery.^[6] Interestingly, the authors also commented that some patients experienced severe femoral nerve palsies despite the use of intraoperative neurophysiological monitoring (IONM). Certainly, the overall high frequencies of neural/plexus injuries occurring with XLIF and related lateral lumbar procedures should lead to questions regarding the safety of these procedures and whether they should be continued.

EXTREME LATERAL INTERBODY FUSION COMPLICATIONS INCREASED WITH THE ADDITION OF BONE MORPHOGENETIC PROTEIN-2

The study by Lykissas *et al.* in 2014 critically pointed out the potential direct damage of rhMP-2 to the lumbosacral plexus when utilized for LLIF [Table 1].^[9] The authors recognized that bone morphogenetic proteins-2 (BMP-2) contributed to neurological deficits when used for ALIF or transforaminal lumbar interbody fusion (TLIF), however, questioned in their 6-year retrospective series, whether it would have similar adverse effects (e.g., lumbosacral plexus injuries and/or pain) following LLIF. The study included two clinically comparable controlled cohort LLIF populations; 72 LLIF utilized BMP-2 vs. 72 LLIF performed with autograft/allograft. They documented that rhBMP-2 combined with LLIF directly damaged the lumbosacral plexus uniformly in

Table I: Neurological (e.g. Root and Plexus/Other Injuries) Attributed to XLIF

Author Reference Year	Study	Data for Study	Complications (COMP)	Complications (COMP)	Complications (COMP)
Tormenti ^[12] 2010	8 XLIF TLIF/PS Adult TLS	Versus 4 TLIF/PS Adult TLS	COMP: 1 TLIF/PS 1 Revision	XLIF/TLIF/PS COMP: 1 bowel perforation 2 (25%) motor root *1 remained	XLIF/TLIF/PS COMP: 6 (75%) sensory root (5 or 62.5% not resolved) 10.5 months
Papanastassiou ^[10] 2011	2 Femoral Nerve Injuries (contralateral)	32 XLIF levels	COMP: 1 extensive end plate removal	COMP: 1 cage too foraminal (opposite)	COMP: 2/32 XLIF (6.25%) Femoral Nerve (opposite)
Sharma ^[11] 2011	43 LLIF	For DDD DS	For New onset scoliosis	COMP: 25% anterior thigh pain; Resolved	COMP: 25% anterior thigh pain;
Ahmadian ^[1] 2013	XLIF 18 Studies 2310 Patients	COMP: 304 (13.2%) Plexus injuries	Nerve root 0-3.4% (motor 0.7-33.6%), sensory (0-75%)	Injuries underreported with MIS XLIF	COMP: Plexus 13.2% Motor up to 33.6% Sensory up to 75%
Lykissas ^[9] 2014	72 LLIF with BMP 72 LLF with autograft/allograft	COMP: Long-Term: Sensory 29 BMP (40.3%) 20 no BMP (27.8%)	Motor deficit 35 BMP (48.6%) 17 no BMP 23.6% Anterior thigh pain 8 with BMP (11.1%) 0 without (0%)	Direct injury of BMP-2 to lumbosacral plexus Also direct injury LS plexus with LLIF alone	COMP: Sensory + BMP 40.3% -BMP 27.8% Motor +BMP 48.6% -BMP 23.6%
Formica ^[5] 2014	39 XLIF Trauma Degenerative Lumbar	Assessment ODI VAS X-rays	XLIF Followed average 16 months	Improvement VAS Back 6.08 Leg 2.77 ODI 38	COMP: 10 (26%) Transient Quadriceps weakness -regression
Hrabalek ^[7] 2014	MIS ALIF (120 patients) MIS XLIF (88 patients)	Disc Herniations T12-L5 Other Pathology	COMP: ALIF Sympathectomy syndrome 19 (15.8%) Minor 32 (26.6%)	COMP: XLIF L5 root (1.1%) 20/25 Root or plexus	COMP: XLIF 11 (12.5%) Transient groin/anterior thigh pain 9 numbness (10.2%)
Cheng ^[2] 2015	120 Patients DLIF XLIF	31 AE (25.8%) 22 (18.3%) Neurological AE	COMP: 15 (12.5%) thigh dysesthesias	COMP: 6 (5%) radiculopathy 3 (2.5%) weakness	COMP: More AE with DLIF (28%) vs. XLIF (14.2%)
Khajavi ^[8] 2015	160 (197 levels) XLIF For DS DDD, ASD Postoperative	Average age 61 Followed average 19 months	No symptomatic pseudoarthrosis No implant/instrument failures	COMP: 1 (0.6%) major complication 12% minor complications	COMP: Anterolateral groin pain 14% Hip flexor weakness 9%
Grimm ^[6] 2016	108 XLIF	COMP: Major (3.7%) 1 Vertebral fracture 1 Opposite root injury	COMP: Major 1 Dense quadriceps paresis 1 Persistent stenosis (3 Reoperations)	COMP: Minor 19.4% Thigh Pain Paresthesias (Resolved)	COMP: Major complications: 3.7% Minor 19.4%

Contd...

Table I: Contd...

Author Reference Year	Study	Data for Study	Complications (COMP)	Complications (COMP)	Complications (COMP)
Epstein ^[3, 4] 2016	SPORT STUDY Spine Patient Outcomes Research Trial	COMP: Open Discectomy 0.13- 0.25% Laminectomy stenosis +/- fusion 0%	COMP: PLIF 7.8% TLIF 2%	COMP: ALIF 15.8%	COMP: XLIF 23.8%

SPORT: Spine Patient Outcomes Research Trial, TLIF: Transforaminal Lumbar Interbody Fusion, PLIF: Posterior Lumbar Interbody Fusion, ALIF: Anterior Lumbar Interbody Fusion, XLIF: Extreme Lateral Lumbar Interbody Fusion, AE: Adverse Event, LS: Lumbosacral, ODI: Oswestry Disability Index, VAS: Visual Analog Scale, ASD: Adjacent Segment Disease, TLS: Thoracolumbar Scoliosis, PS: Pedicle Screws, COMP: Complications

the long-term; sensory deficits occurred in 29 fused with rhBMP-2 vs. 20 without; motor deficits in 35 fused with rhBMP-2 vs. 17 without; and anterior thigh/groin pain in 8 fused with rhBMP-2 vs. 0 without. In addition, careful reassessment of the extremely high rate of neurological injury occurring secondary to the LLIF procedures alone, even with intraoperative neural monitoring, should lead to reconsideration of whether these procedures should still be offered to patients [Table 1].

COMBINING EXTREME LATERAL INTERBODY FUSION WITH OTHER PROCEDURES FOR ADULT SCOLIOSIS

XLIF procedures combined with additional procedures to address adult scoliosis increased the complication rates [Table 1].^[12] To address adult degenerative thoracolumbar scoliosis, Tormenti *et al.* in 2010, compared the efficacy of performing 8 XLIF, TLIF, and pedicle screw fixation procedures versus 4 TLIF/pedicle screw procedures alone [Table 1].^[12] Of the 8 patients undergoing XLIF/TLIF/pedicle screws, 1 sustained an intraoperative bowel injury requiring a colon resection, 2 (25%) developed new motor radiculopathies (1 resolved; 1 continued at 3 months), whereas 6 (75%) exhibited new thigh paresthesias (note 5 of 6 persisted at 10.5 postoperative months). Of the 4 undergoing TLIF/pedicle screw fixation, 1 required revision of the instrumentation. The authors rightfully concluded the combined procedures carried “significant risks that require further evaluation and proper informed consent.” However, how many surgeons inform their patients prior to XLIF with/without other procedures that they have such a substantial risk of sustaining new postoperative neurological deficits? Let us conclude it is very unlikely because it would certainly curtail the number of XLIF being performed.

CONCLUSION

This review focused on the high frequency of neural injuries resulting from XLIF and related lateral lumbar interbody procedures. New neurological injuries included sensory deficits in 0–75% of cases (permanent 62.5%), motor deficits in 0.7–33.6% of patients, anterior thigh pain

in 12.5–25%, and a 13.28% plexus injury rate. When is the neurological injury rate for XLIF and its related procedures considered unacceptable? And when do we question why, with this safety record, it should still be performed?

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Ahmadian A, Deukmedjian AR, Abel N, Dakwar E, Uribe JS. Analysis of lumbar plexopathies and nerve injury after lateral retroperitoneal transpsoas approach: Diagnostic standardization. *J Neurosurg Spine* 2013;18:289-97.
- Cheng I, Briseño MR, Arrigo RT, Bains N, Ravi S, Tran A. Outcomes of Two Different Techniques Using the Lateral Approach for Lumbar Interbody Arthrodesis. *Global Spine J* 2015;5:308-14.
- Epstein NE. More nerve root injuries occur with minimally invasive lumbar surgery, especially extreme lateral interbody fusion: A review. *Surg Neurol Int* 2016;7(Suppl 3):S83-95.
- Epstein NE. More nerve root injuries occur with minimally invasive lumbar surgery: Let's tell someone. *Surg Neurol Int* 2016;7(Suppl 3):S96-S101.
- Formica M, Berjano P, Cavagnaro L, Zanirato A, Piazzolla A, Formica C. Extreme lateral approach to the spine in degenerative and post traumatic lumbar diseases: Selection process, results and complications. *Eur Spine J* 2014;23(Suppl 6):S684-92.
- Grimm BD, Leas DP, Poletti SC, Johnson DR 2nd. Postoperative Complications Within the First Year After Extreme Lateral Interbody Fusion: Experience of the First 108 Patients. *Clin Spine Surg* 2016;29:E151-6.
- Hrabalek L, Adamus M, Gryga A, Wanek T, Tucek P. A comparison of complication rate between anterior and lateral approaches to the lumbar spine. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub* 2014;158:127-32.
- Khajavi K, Shen A, Lagina M, Hutchison A. Comparison of clinical outcomes following minimally invasive lateral interbody fusion stratified by preoperative diagnosis. *Eur Spine J* 2015;24(Suppl 3):S322-30.
- Lykissas MG, Aichmair A, Sama AA, Hughes AP, Lebl DR, Cammisia FP, *et al.* Nerve injury and recovery after lateral lumbar interbody fusion with and without bone morphogenetic protein-2 augmentation: A cohort-controlled study. *Spine J* 2014;14:217-24.
- Papanastassiou ID, Eleraky M, Vrionis FD. Contralateral femoral nerve compression: An unrecognized complication after extreme lateral interbody fusion (XLIF). *J Clin Neurosci* 2011;18:149-51.
- Sharma AK, Kepler CK, Girardi FP, Cammisia FP, Huang RC, Sama AA. Lateral lumbar interbody fusion: Clinical and radiographic outcomes at 1 year: A preliminary report. *J Spinal Disord Tech* 2011;24:242-50.
- Tormenti MJ, Maserati MB, Bonfield CM, Okonkwo DO, Kanter AS. Complications and radiographic correction in adult scoliosis following combined transpsoas extreme lateral interbody fusion and posterior pedicle screw instrumentation. *Neurosurg Focus* 2010;28:E7.