Article published online: 2024-09-11

Original Article

Perioperative Complications of Oblique Lumbar Interbody Fusion (OLIF): 5 Years of Experience with OLIF

Alex T. Johnson[1] Ganesh Kumar[1] Bibhudendu Mohapatra[1] Rajat Mahajan[1]

[1] Department of Spine Services, Indian Spinal Injuries Centre, New Delhi, India

Address for correspondence Ganesh Kumar, MS, Department of Spine Services, Indian Spinal Injuries Centre, Vasant Kunj, New Delhi 110070, India (e-mail: sgk.ortho@gmail.com).

Asian J Neurosurg

Abstract

Objective The objective of this study was to share our early experience with oblique lumbar interbody fusion (OLIF), with emphasis on the perioperative complications and determine clinical outcomes following OLIF.

Materials and Methods It was a retrospective prospective study performed at a single institute from March 2019 to August 2023. A total of 56 consecutive patients who had undergone OLIF for degenerative spine disorders were enrolled in the study. Pre-, intra-, and postoperative data on these patients were collected. All the patients were followed up at regular intervals with an evaluation of Visual Analog Scale (VAS), Oswestry Disability Index (ODI), neurological parameters, and X-rays to look for fusion, screw loosening, pseudoarthrosis, and cage slippage. Statistical analysis was done with the odds ratio, chi-square test, and Student's *t*-test. A *p*-value of < 0.05 was considered significant.

Results The overall incidence of complications was 25%, with no mortality. Intraoperative complications were noted in 10.7% of cases. This included endplate fractures ($n = 3$), peritoneal lacerations ($n = 2$), and ureteric injury ($n = 1$). The most common early postoperative complications were postoperative ileus ($n = 6$), followed by anterior thigh or groin numbness ($n = 3$), ipsilateral psoas weakness ($n = 2$), and superficial surgical site infection ($n = 2$). Of the late postoperative complications, cage subsidence was the most common, which occurred in 4 patients, followed by adjacent segment degeneration ($n = 2$) and loss of indirect decompression ($n = 1$). The mean ODI and VAS scores showed significant improvement ($p < 0.05$) at the final follow-up.

Conclusion OLIF is a promising surgical technique with the potential to treat a variety of degenerative conditions of the lumbar spine with a good clinical outcome. Despite its various benefits, OLIF can lead to complications in rare instances, which every spine surgeon should be aware of.

Keywords

- lumbar interbody fusion
- oblique lumbar interbody fusion
- OLIF
- perioperative complications of OLIF

DOI https://doi.org/10.1055/s-0044-1790515.
ISSN 2248-9614.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

Introduction

Spinal fusion has become one of the most performed spine surgery since it was first described by Dr. Russell A. Hibbs in 1911 for scoliosis[1,2] and then by Dr. Fred H. Albee for tuberculosis.[3] There has been a global increase in the overall number of spinal fusion procedures over the last few decades.[4] Initially, developed as an alternative to posterolateral fusion, Briggs and Milligan in 1944, described a posterior approach to lumbar interbody fusion.[5] Since then, many other methods using different approaches have been developed, such as anterior lumbar interbody fusion (ALIF)[6] and transforaminal lumbar interbody fusion (TLIF).[5,7–9] Further advances have been made to access disc space through the retroperitoneal approach, circumventing the challenges and morbidities of the anterior and posterior approach for interbody fusion, named lateral lumbar interbody fusion (LLIF).[10,11] Since then, many modifications of this technique have been described.

In 2012, Silvestre et al described a new minimally invasive technique called oblique lumbar interbody fusion (OLIF),[12] which uses the anatomical corridor between anterior great vessels and psoas muscle to access disc space. With less muscle damage, bleeding, decreased rate of nerve injury, and faster recovery compared with posterior surgery, OLIF has attracted much attention from spine surgeons.

Despite its above-mentioned advantages, it has a unique set of complications like hip flexion weakness, neurological injury, vascular injury, visceral injury, and pseudohernia (paresis and bulging of the abdominal wall). Hence, it is essential to also analyze the complications also, which would not only help the surgeon adopt adequate preventive measures but also aid in proper patient selection and counseling regarding the expected outcomes and possible complications. In this study, we share our early experience with OLIF, with emphasis on the perioperative complications of OLIF.

Materials and Methods

It was a retrospective prospective study performed at a single institute from March 2019 to August 2023. We conducted this study in compliance with the principles of the Declaration of Helsinki. The study's protocol was reviewed and approved by the Institutional Review Board. Written informed consents were obtained from all study participants.

A total of 56 patients had undergone OLIF for degenerative lumbar spine disorders (degenerative lumbar canal stenosis and/or degenerative/isthmic spondylolisthesis, degenerative scoliosis) during this study period. Three fellowship-trained spine surgeons with more than 15 years of experience in the field performed all the surgeries included in the study while following the same preoperative evaluation and postoperative mobilization protocols.

Data from 56 patients were analyzed. Preoperative information like demographic (age, sex, body mass index), level of fusion, clinical (Visual Analog Scale [VAS] and Oswestry Disability Index [ODI], neurology), medical comorbidities, and radiological data was evaluated and recorded (►**Table 1**).

Table 1 Patient demographic data

Parameters	OLIF ($N = 56$)
Age (in years), mean ± SD	48.5 ± 12.2
Sex (M/F), *n*	34/22
BMI, kg/m^2, mean ± SD	28.5 ± 3.4
Duration of symptoms (in months), mean ± SD	8.4 ± 2.6
Mean follow-up (in months), mean ± SD	28 ± 5.7
Comorbidities, *n*	
Single	6
Two or more	8

Abbreviations: BMI, body mass index; F, female; M, male; OLIF, oblique lumbar interbody fusion; SD, standard deviation.

Intra- and postoperative parameters like operative time, blood loss, intra- and postoperative adverse events, and hospital stay were collected from medical records and reviewed. All the complications were evaluated by two independent observers, other than the operative surgeon, who have more than 10 years of experience in spine surgery. All the patients with and without complications were followed up with an evaluation of VAS, ODI, and neurological parameters at regular intervals of 1, 3, 6, 12, and 24 months. During their follow-up visit X-rays were done to look for fusion, screw loosening, pseudoarthrosis, and cage slippage.

Surgical Technique

After proper preoperative evaluation, under general anesthesia, the patient is positioned in the right lateral decubitus position on a radiolucent table. After C-arm confirmation of level, a 3- to 4-cm oblique down and forward skin incision centered on the target disc level and parallel to the external oblique muscle is made. Blunt dissection of the external and internal oblique and transverse abdominis muscle fibers is performed along the direction of its fibers.

Once the transverse abdominis muscle is crossed, the retroperitoneal fatty tissue is visible and is pushed back toward the midline along with the peritoneal sac by tampons until the psoas becomes visible. After blunt dissection, the peritoneum and vascular structures are mobilized anteriorly, and the psoas is retracted posteriorly. The spine is visualized on the medial side of the psoas. Care is taken to protect the genitofemoral nerve in the angle between the spine and the psoas. Electrocoagulation is not used on the anterolateral side of the spine to protect the sympathetic plexus that descends along this region.

The intervertebral disc space is then exposed through the corridor between the aorta and the psoas, and the retractor system is docked. The incision is given on the anterolateral side of the annulus, followed by discectomy and endplate preparation. A cage of appropriate size is then inserted in the frontal plane, perpendicular to the disc space. A sliding window technique was applied to access the disc spaces for multilevel fusion without any major expansion of the initial incision. Wound closed and the patient is positioned prone and percutaneous posterior instrumentation was performed under fluoroscopic guidance.

Statistical Analysis

Statistical analysis was done with odds ratio, chi-square test, and Student's *t*-test. All tests were tested for $p < 0.05$ for significance. The tests were done using NCSS statistical software.

Results

General Characteristics

The mean age was 48.5 ± 12.2 years which comprised 34 male and 22 female with mean body mass index of 28.5 ± 3.4. The mean duration of symptoms was 8.4 ± 2.6 months. The most common indication was lumbar canal stenosis (42.8%), followed by degenerative spondylolisthesis (33.9%), isthmic spondylolisthesis (17.8%), and degenerative scoliosis (5.3%). The most operated level was L4-L5 (50%), followed by L3-L4 (39.2%). The mean operative time was 150 ± 40 minutes, and the mean blood loss was 98.5 ± 30 mL. The mean period of hospital stay was 3.7 ± 1.7 days (►**Table 2**).

Complications

The overall incidence of complications was 25% with no mortality (►**Table 3**). The initial period for the learning curve included 20 patients with a complication rate of 42.1% and the past 2 years comprised 36 patients with a complication rate of 15.7%. Note that 42.8% (6/14) patients had developed single complications, 28.5% (4/14) had developed two complications, and 28.5% (4/14) had three complications. The complications were classified as intraoperative and postoperative. Postoperative complications were classified as early (≤ 1 month postsurgery) and late (> 1 month postsurgery).

Table 2 Patient clinical data

Clinical parameters	Value
Indication for surgery, *n*	
LCS	24
Spondylolisthesis – Degenerative	19
Spondylolisthesis – Isthmic	10
Degenerative scoliosis	3
Fusion level, *n*	
L1-L2	2
L2-L3	4
L3-L4	22
L4-L5	28
Operative time (in minutes), mean ± SD	150 ± 40
Operative blood loss (in mL), mean ± SD	98.5 ± 30
Hospital stay (in days), mean ± SD	3.7 ± 1.7

Abbreviations: LCS, lumbar canal stenosis; SD, standard deviation.

Table 3 Perioperative complications related to OLIF

Complications of OLIF	Number of cases
Endplate fracture	3
Peritoneal laceration	2
Ureteric injury	1
Postoperative ileus	6
Anterior thigh or groin numbness	3
Superficial surgical site infection	2
Major motor deficit	1
Cage subsidence	4
Cage back out/displacement	1
Adjacent segment degeneration	2
Reoperations	1

Abbreviation: OLIF, oblique lumbar interbody fusion.

Intraoperative complications were noted in 10.7% of cases. This included endplate fracture ($n = 3$), peritoneal lacerations ($n = 2$), and ureteric injury ($n = 1$).

The most common early postoperative complications were postoperative ileus ($n = 6$), followed by anterior thigh or groin numbness ($n = 3$), ipsilateral psoas weakness ($n = 2$), and superficial surgical site infection ($n = 2$). Groin numbness and psoas weakness were transient and recovered in 3 months, except in one patient the groin numbness persisted beyond 1 year. Superficial surgical site infections were managed with regular dressing and antibiotics without any further morbidity. None had deep infections.

Of the late postoperative complications, cage subsidence was the most common which occurred in 4 patients. One patient had an anterior displacement of the cage identified on a routine follow-up X-ray, which was not symptomatic, and hence did not require any intervention, and the patient was kept on regular follow-up (►**Fig. 1**). One patient had bilateral foot drop immediately after surgery due to cage displacement into spinal canal (►**Fig. 2**). This patient underwent reexploration and cage was repositioned. However, patient had complete recovery of motor power at 3 months in the right side with partial recovery in the left side.

One patient needed surgery after 1 year due to the recurrence of symptoms of lumbar canal stenosis. The patient initially had good symptomatic relief following OLIF, but later reported a recurrence of symptoms. One-year follow-up X-ray demonstrated cage subsidence with loss of indirect decompression. Magnetic resonance imaging showed narrowing of the spinal canal at the same level (►**Fig. 3**). Patient was reoperated through a posterior approach with decompression using laminectomy and ligamentum flavum excision at the same level, with good relief in symptoms. Two patients had radiological adjacent segment disease (ASD) on follow-up but continued to remain asymptomatic. The mean ODI and VAS scores showed significant improvement ($p < 0.05$) at the final follow-up (►**Table 4**).

Fig. 1 Two months postoperative anteroposterior (**A**) and lateral (**B**) X-rays of a patient who had undergone L3–4 and L4–5 oblique lumbar interbody fusion (OLIF) with L5-S1 transforaminal lumbar interbody fusion (TLIF) showing inadequate size and anterior positioning of the cage at L4–5 level. Four months postoperative X-ray image (**C**, **D**) showing further anterior displacement of the cage. Computed tomography (CT) done at 8 months' follow-up (**E**, **F**) shows cage malposition and subsidence. This patient remained asymptomatic and hence kept under close follow-up.

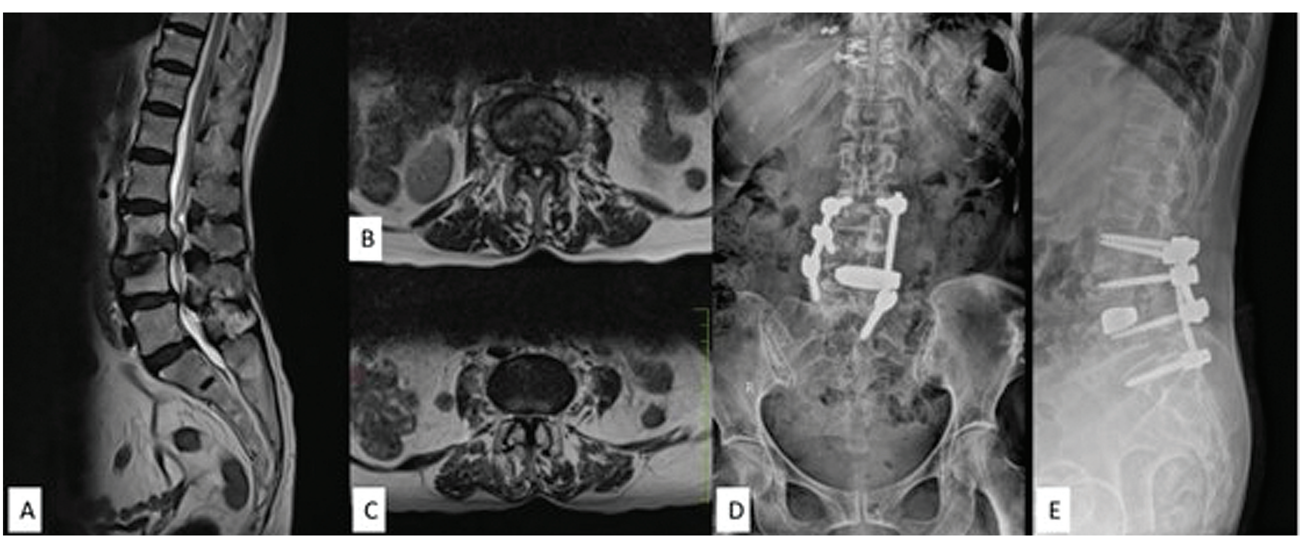

Fig. 2 Preoperative T2-weighted image (T2WI) midsagittal (**A**) and axial sections at L3–4 (**B**) and L4–5 (**C**) levels showing severe canal stenosis. Patient developed bilateral lower limb weakness immediately following the surgery. Immediate postoperative anteroposterior (**D**) and lateral (**E**) X-ray showing a posterior and left lateral position of the cage.

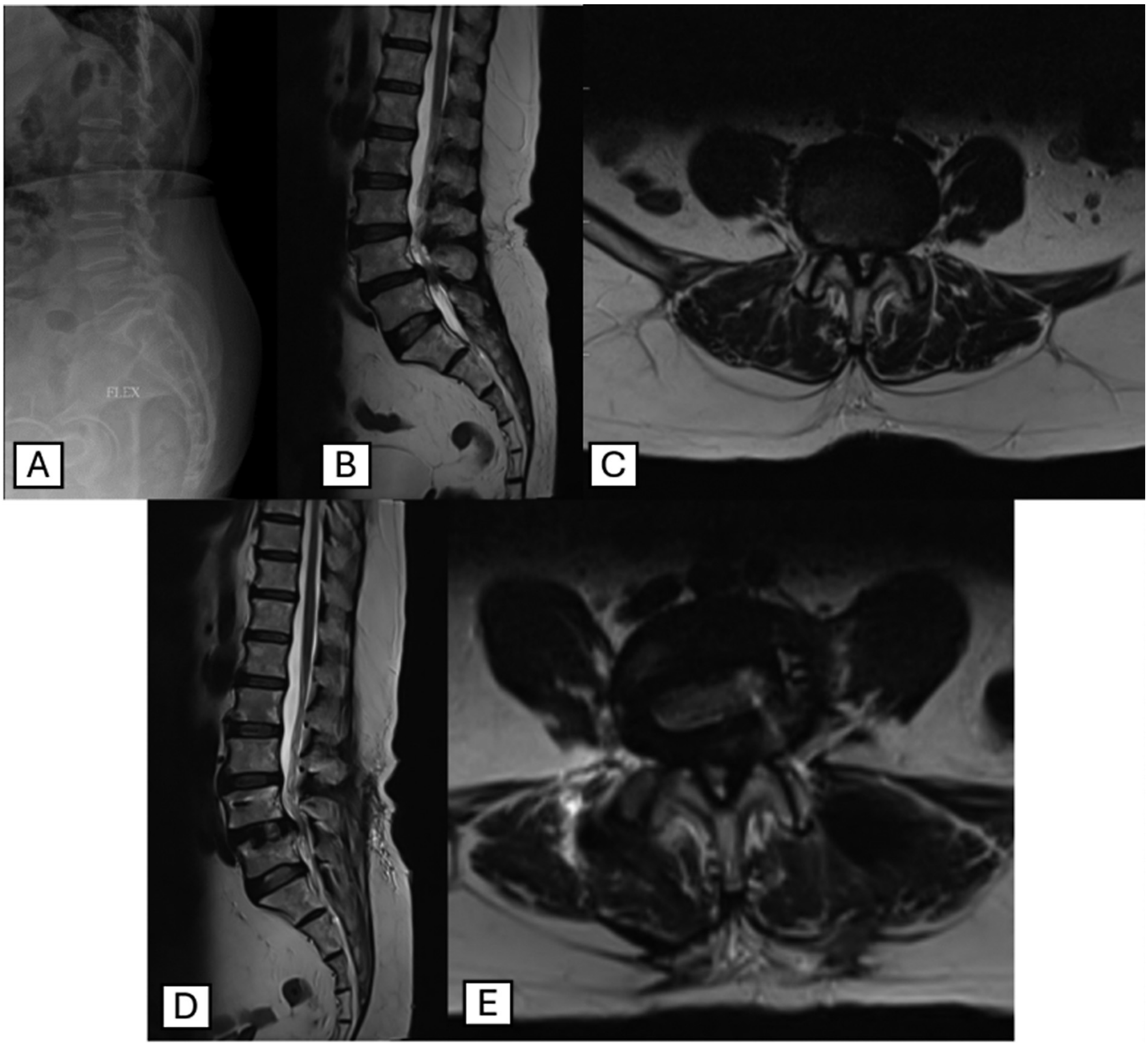

Fig. 3 Preoperative lateral X-ray (**A**) and T2-weighted (T2W) magnetic resonance imaging (MRI)—midsagittal section (**B**) and axial section at L4–5 level (**C**) who underwent L4–5 transforaminal lumbar interbody fusion (TLIF), showing grade 1 degenerative spondylolisthesis with severe lumbar canal stenosis (LCS). Patient developed recurrence of claudication symptoms after 1 year of surgery. T2-weighted midsagittal (**D**) and axial MRI images at L4–5 level (**E**) done at 1-year follow-up showing recurrence of stenosis. Revision posterior decompression was done after 1 year of initial surgery.

Table 4 Clinical outcomes at final follow-up

Outcome	Preoperative	Postoperative	*p*-Value
Visual Analog Scale	7.8 ± 1.8	2.7 ± 1.5	0.036
Oswestry Disability Index	77.18 ± 8.16	16.82 ± 8.62	0.027

Discussion

Many studies have demonstrated satisfactory short-term clinical and functional outcomes of OLIF but studies evaluating perioperative complications are still lacking. The study by Silvestre et al remains the largest cohort study so far describing the outcomes of the OLIF procedure.[12] They reported 20 complications with incisional pain being the most common followed by sympathetic chain injury. Our series had an overall incidence of 25% perioperative complication with no mortality. All these complications occurred over a period of 5 years with most of the complications occurring during the initial 2 years of learning curve and afterward there was a substantial reduction in complications.

Decreased endplate volumetric bone mineral density and standalone status without posterior screws experienced subsidence nearly 2.5 times higher than patients with no risk factors.[13] Despite all patients having undergone posterior instrumentation in our series, we had a high number of cage subsidence with one patient developing recurrence of

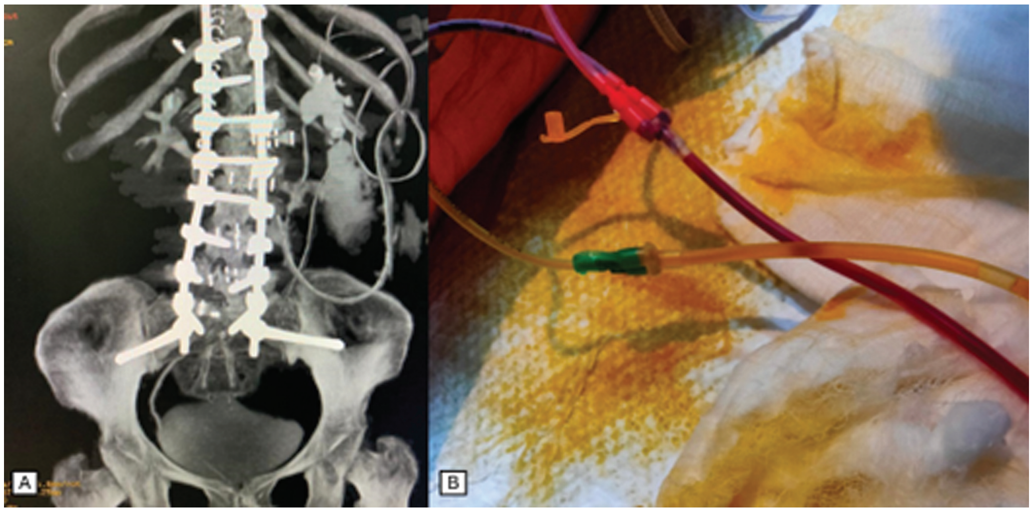

Fig. 4 Computed tomography (CT) urography (A) showing nonvisualization of left ureter in a patient who sustained ureteric injury during multilevel oblique lumbar interbody fuison (OLIF). Postoperative clinical images (B) showing separate drainage tubes for the surgical wound and drainage of urine (note the color of the urine due to pyridium tablet) from the ureter. Delayed repair of the ureter was performed after 1 month.

symptoms due to loss of indirect decompression necessitating reoperation at 1 year. This significant difference in the reported incidence of this complication may be due to multiple factors like differences in the duration of follow-up in the available studies, difficulty in identifying subsidence of polyetheretherketone cages compared with titanium cages, and differences in the criteria for assessing subsidence. Subsidence depends on multiple factors related to bone quality, implant material, and technique. We recommend against aggressive endplate preparation and using an appropriate size cage to prevent such complications.

Neurological deficit was noted in 6 patients. It includes anterior thigh or groin numbness; ipsilateral psoas weakness and bilateral foot drop due to cage displacement. All but two recovered in 3 months. Groin numbness in one patient and foot drop in one patient due to cage displacement persisted beyond 1 year.

We have encountered one case of ureteric injury which was diagnosed in the postoperative period. The patient had a clear watery collection in the drain in the postoperative period. However, we had a differential diagnosis of cerebrospinal fluid leak due to dural injury or urine leak due to ureteric injury. To differentiate this, pyridium tablet, an analgesic with azo dye, was given which caused the urine to stain orange and this confirmed our diagnosis of ureteric injury (►**Fig. 4**). Computed tomography urography further highlighted our diagnosis. Urinary diversion was done initially followed by ureteric repair with graft after 1 month. After this instance, we place ureteric catheters in patients undergoing revision surgeries where massive adhesions are expected, to easily identify ureter intraoperatively and also in multilevel procedures. Some surgical strategies to avoid a ureter injury could be the complete retraction of the retroperitoneal fatty tissue before starting the discectomy, the anterior mobilization of the ureter, and the thorough inspection of the intervertebral space through the tubular retractor. Lastly, the possibility of a ureter lesion should be considered when faced with perioperative hematuria or nonspecific signs and symptoms in the postoperative scenario, such as abdominal pain, fever, vomiting, ileus, leukocytosis, or abdominal distention distension, and clear discharge from the surgical wound.

ASD is a well-known complication of any spinal fusion procedure and OLIF is no exception to this. Though the incidence of radiographic adjacent segment pathology is reported to be as high as 44% in lumbar fusion surgeries, clinical adjacent segment pathology (ASP) is much lower and only 6% needed reoperation.[14] Incidence of both clinical and radiographic adjacent segment pathology is theoretically lesser in OLIF as compared with TLIF, since the posterior elements are not exposed or damaged. In our series, the incidence of ASD following OLIF is 3.5% and none required surgical intervention. If ASD is symptomatic and warrants surgery, reoperation with an extension of instrumentation and fusion to include the newly degenerated symptomatic level may be required.[15]

Other complications described in the literature include sympathetic chain injury, vascular injury, iliac or iliolumbar vein laceration, postoperative lower limb ischemia, lateral femoral cutaneous nerve injury, transient intercostal neuralgia, symptomatic pseudoarthrosis, pleural laceration, anterolateral ligament rupture, wound complication, psoas abscess, retrograde ejaculation, and ventral dural injury.[16]

The main limitation of our study is the low sample size with midterm follow-up. Thus, we recommend further research with longer clinical and radiographic follow-up with increased sample size which can help delineate the complication rates and the more delayed complications of the procedure.

Conclusion

OLIF is a promising surgical technique with the potential to treat variety of degenerative conditions of the lumbar spine, with considerable advantages over the posterior surgical approaches in properly selected patients. But despite its various benefits, OLIF can lead to serious complications in rare instances. A good understanding of the complications of this procedure is essential not only to help the surgeon exercise adequate preventive measures but also to counsel the patient regarding the outcomes and complications.

Authors' Contributions

All four authors made substantial contributions to the conception or design of the work, the acquisition, analysis, or interpretation of data, drafted the work or revised it critically for important intellectual content, approved the version to be published, and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. G.K. was responsible for conceptualization, writing the original draft, and visualization. B.M. contributed through supervision, methodology, and investigation. A.T.J. handled formal analysis, data curation, resources, and validation. G.K. also participated in writing the review, editing, and software development, while A.T.J. assisted with visualization and writing the original draft. R.M. took charge of project administration and conceptualization.

Ethical Approval

Ethics approval was obtained by our institution's Institutional Review Board. We conducted this study in compliance with the principles of the Declaration of Helsinki. The study's protocol was reviewed and approved by the Institutional Review Board

Patients' Consent

Written informed consents were obtained from all study participants.

Funding

None.

Conflict of Interest

None declared.

References

1 Hibbs RA. An operation for progressive spinal deformities: a preliminary report of three cases from the service of the orthopaedic hospital. 1911. Clin Orthop Relat Res 2007;460(460): 17–20

2 Miller DJ, Vitale MG. Dr. Russell A. Hibbs: pioneer of spinal fusion. Spine 2015;40(16):1311–1313

3 Fred H, Association TAO. Albee 1876–1945. J Bone Joint Surg Am 1945;27(02):345–346

4 Reisener MJ, Pumberger M, Shue J, Girardi FP, Hughes AP. Trends in lumbar spinal fusion-a literature review. J Spine Surg 2020;6(04): 752–761

5 Briggs H, Milligan PR. Chip fusion of the low back following exploration of the spinal canal. J Bone Joint Surg Am 1944; 26:125–130

6 Choy WJ, Abi-Hanna D, Cassar LP, Hardcastle P, Phan K, Mobbs RJ. History of integral fixation for anterior lumbar interbody fusion (ALIF): the Hartshill Horseshoe. World Neurosurg 2019; 129:394–400

7 Harms J, Rolinger H. A one-stager procedure in operative treatment of spondylolistheses: dorsal traction-reposition and anterior fusion (author's transl) [in German]. Z Orthop Ihre Grenzgeb 1982;120(03):343–347

8 Lestini: Lumbar spinal fusion: advantages of posterior... - Google Scholar. Accessed March 10, 2024 at: https://scholar.google.com/scholar_lookup?title=Lumbar%20spinal%20fusion%3A%20advantages%20of%20posterior%20lumbar%20interbody%20fusion&author=W.F.%20Lestini&publication_year=1994&pages=577-590

9 Cole CD, McCall TD, Schmidt MH, Dailey AT. Comparison of low back fusion techniques: transforaminal lumbar interbody fusion (TLIF) or posterior lumbar interbody fusion (PLIF) approaches. Curr Rev Musculoskelet Med 2009;2(02):118–126

10 Ozgur BM, Aryan HE, Pimenta L, Taylor WR. Extreme lateral interbody fusion (XLIF): a novel surgical technique for anterior lumbar interbody fusion. Spine J 2006;6(04):435–443

11 Arnold PM, Anderson KK, McGuire RA Jr. The lateral transpsoas approach to the lumbar and thoracic spine: a review. Surg Neurol Int 2012;3(Suppl 3):S198–S215

12 Silvestre C, Mac-Thiong JM, Hilmi R, Roussouly P. Complications and morbidities of mini-open anterior retroperitoneal lumbar interbody fusion: oblique lumbar interbody fusion in 179 patients. Asian Spine J 2012;6(02):89–97

13 Jones C, Okano I, Salzmann SN, et al. Endplate volumetric bone mineral density is a predictor for cage subsidence following lateral lumbar interbody fusion: a risk factor analysis. Spine J 2021;21(10):1729–1737

14 Lee JC, Choi SW. Adjacent segment pathology after lumbar spinal fusion. Asian Spine J 2015;9(05):807–817

15 Burch MB, Wiegers NW, Patil S, Nourbakhsh A. Incidence and risk factors of reoperation in patients with adjacent segment disease: a meta-analysis. J Craniovertebr Junction Spine 2020;11(01): 9–16

16 Quillo-Olvera J, Lin GX, Jo HJ, Kim JS. Complications on minimally invasive oblique lumbar interbody fusion at L2–L5 levels: a review of the literature and surgical strategies. Ann Transl Med 2018;6 (01):101

