

Clinical Results of Oblique Lateral Interbody Fusion (OLIF) Technique Compared with Conventional Lumbar Posterior Laminar Decompression for Lumbar Spinal Stenosis

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Abbreviations: OLIF: Oblique Lateral Interbody Fusion; DLCS: Decompression for Lumbar Spinal Stenosis; VAS: Visual Analog Scale Scores; ODI: Oswestry Dysfunction Index

ABSTRACT

Objective: To compare and analyze the safety and effectiveness of oblique lateral interbody fusion (OLIF) technique and conventional lumbar posterior laminar decompression for lumbar spinal stenosis (DLCS).

Methods: From October 2019 to November 2021 68 patients with lumbar spinal stenosis over 60 years of age were divided into OLIF group and traditional decompression group according to their treatment methods. There were 32 patients (14 males and 18 females) in the OLIF group, with an age distribution of 60 years or older and a mean of (69.56 ± 4.18) years, and 36 patients (15 males and 21 females) in the traditional decompression group, with an age distribution of 60 years or older and a mean of (70.32 ± 4.82) years, treated with traditional posterior decompression internal fixation of the vertebral plate. The general data, operation time, intraoperative bleeding, hospital stay, surgical complications, clinical efficacy evaluated by modified MacNab criteria, and patients' preoperative and final postoperative pain visual analog scale scores (VAS) and Oswestry dysfunction index (ODI) were statistically analyzed in both groups.

Results: There was no statistically significant difference in age, gender, BMI, disease duration, lesion segment, VAS score, and ODI index between the two groups before treatment ($P > 0.05$). After treatment, the operation time, intraoperative bleeding, hospital stay, and surgical complications were more advantageous in the OLIF group compared with the conventional decompression group, with statistical significance between groups ($P < 0.05$). Compared with the pre-treatment comparison, the VAS score and ODI score of patients in both groups showed significant improvement ($P < 0.05$), and the comparison between the two groups could be found that the improvement in VSA and ODI scores at the end of postoperative period in the OLIF group was more significant than that in the traditional decompression group, with statistical difference ($P < 0.05$). The clinical efficacy of the two groups evaluated by modified MacNab criteria at the end follow-up was 90.625% for the OLIF group and 80.55% for the conventional decompression group, respectively, with statistical differences ($P < 0.05$).

Conclusion: Compared with traditional decompression fusion, the use of OLIF technique can safely and effectively decompress DLCS, and also has many advantages such as less trauma, less bleeding, shorter operative time and hospital stay, and lower postoperative complications, which is worthy of clinical preference.

Introduction

Lumbar spinal stenosis is a common degenerative disease of the elderly, characterised by pathological spinal stenosis and compression of the spinal capsule together with nerve roots [1]. Clinical symptoms are usually low back pain, neurogenic claudication, lower limb pain and reduced walking ability. DLCS currently relies initially on conservative measures such as physiotherapy, steroid injections and oral medication [2-3]. However, in patients with painful weakness, progressive reduction in walking distance, progression of neurological deficits and failure of conservative treatment, surgery is often recommended [3]. Numerous studies have shown that the clinical outcome of surgical treatment is superior to that of conservative treatment [3-4]. Oblique Lateral Interbody Fusion (OLIF) reduces the risk of injury to the psoas major and lumbar plexus nerve roots when the natural gap between the retroperitoneal psoas major muscle and the abdominal aorta is used as a reference to create a surgical approach. Unlike paravertebral muscle and posterior lumbar spine surgery, OLIF does not damage the small joints [5].

Materials and Methods

General Information

Sixty-eight patients with DLCS aged 60 years or older from October 2019 to November 2021 were included and divided into OLIF and conventional decompression groups according to their treatment. There were 32 patients (14 males and 18 females) in the OLIF group with a mean age of (69.56±4.18) years, and 36 patients (15 males and 21 females) in the conventional decompression group, with an age distribution of 60 years or more and a mean of (70.32±4.82) years. The general data, operation time, intraoperative bleeding, hospital stay, surgical complications, clinical efficacy evaluated by modified MacNab criteria, patients' preoperative and final postoperative pain visual analogue scale scores (VAS) and Oswestry Dysfunction Index (ODI) were statistically analysed in both groups.

Inclusion Criteria

1. Age ≥ 60 years
2. Clinical signs of neurogenic intermittent claudication with or without radiculopathy and imaging of lumbar spinal stenosis
3. Unsatisfactory relief of clinical symptoms after conservative treatment for ≥ 3 months
4. All patients voluntarily underwent surgical treatment and regular postoperative review.

Exclusion Criteria: Lateral radiographs of lumbar hyperextension and hyperflexion showing lumbar instability,

Cobb angle difference >15° in hyperextension and hyperflexion or displacement of more than 3 mm, requiring fusion surgery; clear-cut cases of intermittent vascular claudication, obvious lumbar disc herniation, vertebral slippage of II° or more, lumbar infection or stenosis combined with malignant tumour.

Surgical Options

OLIF Group: The patient is placed prone on the operating table after satisfactory general anaesthesia, in the right lateral position, and the operative segment is fluoroscopically positioned and marked before surgery. The skin and deep fascia are incised sequentially with the aid of fluoroscopy, and the retroperitoneal space is reached by bluntly separating the external and internal oblique abdominal muscles and the transversus abdominis fibres, and the abdominal organs are moderately pushed forward. The target disc is exposed through the natural space between the retroperitoneal psoas major muscle and the abdominal aorta, and fluoroscopic fixation of the intervertebral space, canal dilation and removal of excess tissue is completed. The intervertebral space and intervertebral foramen are propped open to the desired height under the appropriate components, and the fusion device places the bone particles into the intervertebral space; after satisfactory results, the incision is closed layer by layer. See Figure 1 ventricular drain is inserted via the operating channel to the appropriate depth. The incision is closed with sutures. One preoperative and one postoperative dose of antibiotics was applied and bed rest was followed by bed exercise under the protection of a lumbar girth after 3 d.

Traditional Decompression Group: Patients in the traditional decompression group were treated with traditional laminectomy for decompression and internal fixation. The procedure was as follows: after satisfactory general anaesthesia, a posterior median incision was made with the patient's diseased segment as the centre, the skin, subcutaneous tissue and fascia at the edge of the supraspinous ligament were incised in turn, and the sacrospinous muscles on both sides of the spinous process were separated to fully expose the decompression and fixation segment; pedicle screws were placed, the inferior edge of the superior lamina and the entire superior edge of the inferior lamina were excised, and the nerve roots were exposed and released. The nerve roots were exposed and released by subtle enlargement of the lateral saphenous fossa, after which the nerve roots and dura were pulled medially, the intervertebral disc and cartilage endplates were completely removed, an appropriate intervertebral fusion device was selected for intervertebral implant fusion, and the nail rods were linked and fixed with pressure; the incision was closed layer by layer, a wound drainage tube was placed, and the wound was dressed after surgery. The open group in this study all underwent interbody fusion to avoid postoperative instability.

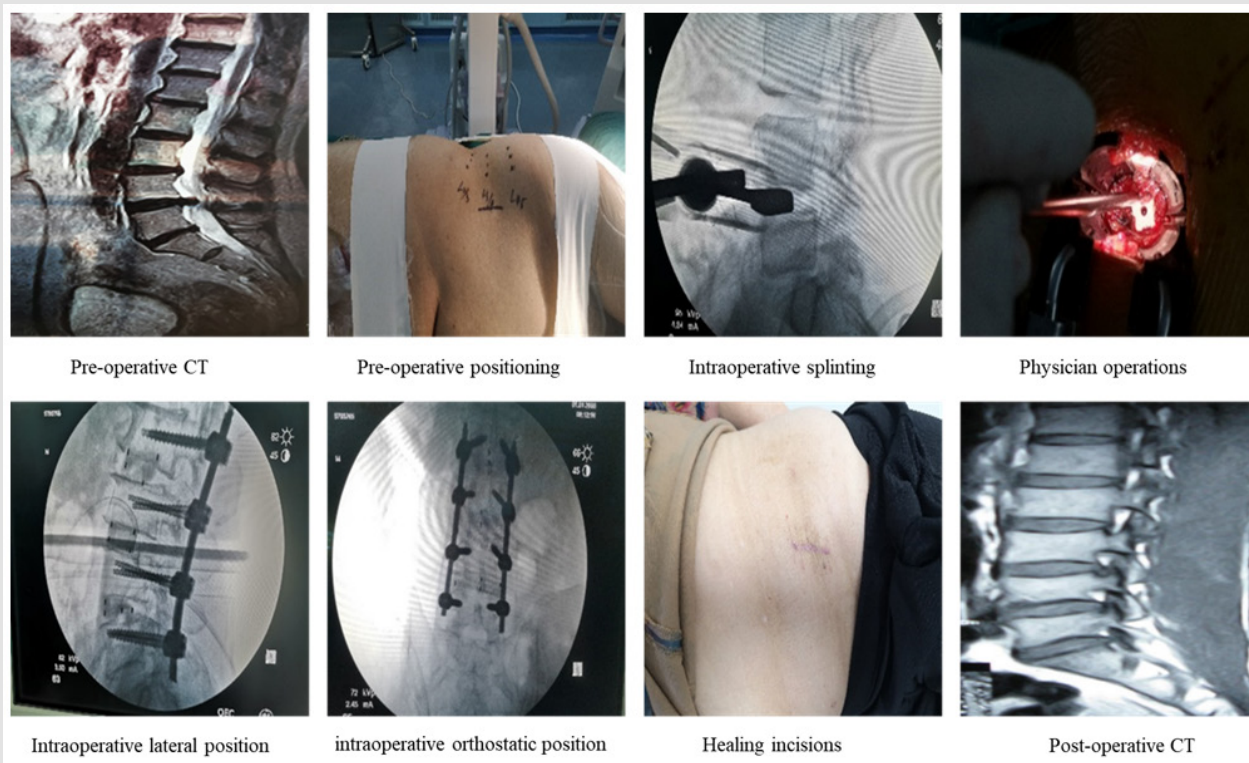


Figure 1: OLIF group surgical procedure.

Postoperative Management

A drainage tube was routinely placed in the incision. Two patients with cerebrospinal fluid leakage were placed intraoperatively and connected to a drainage bag, and the drainage tube was removed 24 hours after surgery as appropriate. Post-operative antibiotics were routinely administered to prevent infection. Patients were instructed to move their lower limbs as soon as possible to prevent deep vein thrombosis in the lower limbs and to reduce bed-ridden complications. Monitor the patient’s inflammatory and biochemical indexes postoperatively. Actively control blood pressure, blood glucose and other coexisting conditions.

Statistical Indicators

Patients’ age, gender, BMI, duration of disease, lesion segment, duration of surgery, intraoperative bleeding, length of hospital stay, surgical complications, modified MacNab criteria to evaluate

clinical efficacy, patients’ preoperative and final postoperative pain visual analogue scale scores (VAS), and Oswestry dysfunction index (ODI) were counted.

Statistical Methods

SPSS 26.0 software was used for statistical analysis. X2 test was used for counting data (gender, modified MacNab evaluation results) and independent t-test was used to compare the measurement data (operation time, intraoperative bleeding, hospital stay, operation complications, VAS score, ODI score), with $P < 0.05$ being considered a statistically significant difference.

Results

Analysis of Baseline Information for Both Groups

There was no statistical difference between the two groups in terms of gender, age, BMI and lesion segment ($P > 0.05$), and they were comparable. See Table 1.

Table 1: Statistical analysis of baseline information for both groups ($\bar{X} \pm S$; cases).

Group	Gender (m/f)	Age (years)	BMI (kg/m ²)	Lesion segments
				(L3-4/L4-5/L5-S1)
OLIF Group	14/18	69.56±4.18	23.13±1.91	6/15/2014
Traditional decompression group	15/21	70.32±4.82	23.64±2.71	6/16/2016
F	0.003	0.314	0.169	1.648
P	0.955	0.577	0.621	0.203

Analysis of Perioperative Data and Postoperative Complications in Both Groups

In the OLIF group, 32 patients had only one postoperative

wound infection and no other complications; in the traditional decompression group, 36 patients had three postoperative wound infections, one cerebrospinal fluid leak and one nerve strain. Injury (Table 2).

Table 2: Analysis of perioperative data in both groups ($\bar{X}\pm S$).

Group	n	Surgery time (min)	Intraoperative bleeding (ml)	Length of stay in hospital (day)
OLIF Group	32	120.78±11.25	282.50±64.21	12.97±1.29
Traditional decompression group	36	152.17±10.51	451.11±38.34	21.34±1.90
F		5.342	18.298	7.066
P		0.045	0	0.01

Analysis of Preoperative and Postoperative Final ODI and VSA in the Two Groups

There was no statistical difference in the preoperative VSA and ODI scores between the two groups ($P > 0.05$); the VSA and ODI scores at the last postoperative follow-up in both groups were significantly improved compared with the preoperative scores, and

there was a statistical difference in the intra-group comparison ($P < 0.05$); the comparison between the two groups revealed that the improvement in VSA and ODI scores at the end of the postoperative period was more obvious in the OLIF group than in the conventional decompression group, and there was a statistical difference ($P < 0.05$). See Table 3 and Figure 2.

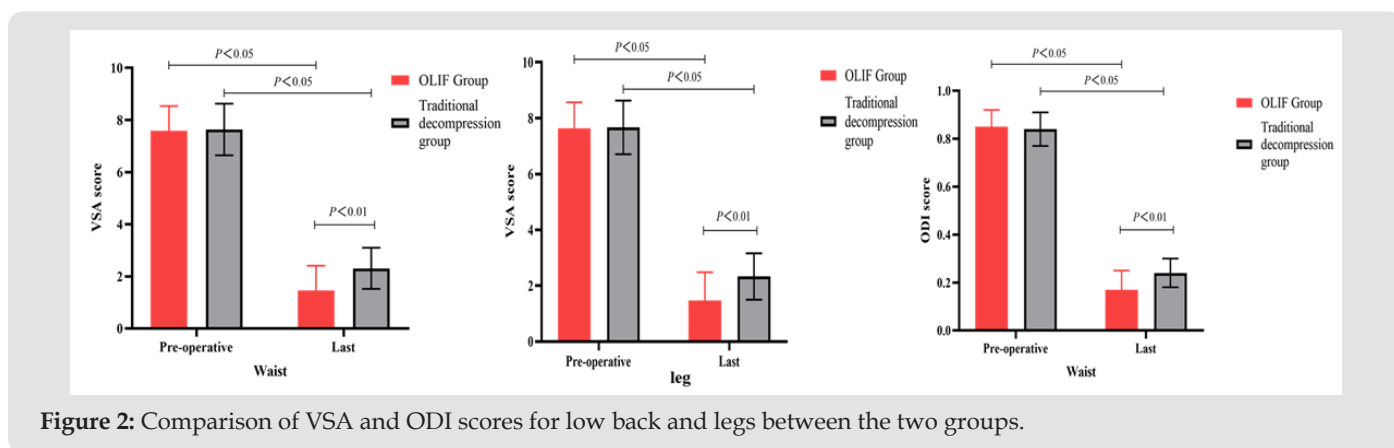


Figure 2: Comparison of VSA and ODI scores for low back and legs between the two groups.

Table 3: Comparative analysis of preoperative and final postoperative VSA and DOI scores between the two groups ($\bar{X}\pm S$).

Group	n	Waist VSA		Leg VSA		ODI	
OLIF Group	32	7.59±0.95	1.47±0.94	7.63±0.94	1.47±1.01	0.85±0.07	0.17±0.08
Traditional decompression group	36	7.64±0.99	2.31±0.79	7.67±0.96	2.33±0.83	0.84±0.07	0.24±0.06
F		0.037	15.783	0.033	14.933	0.117	19.701
P		0.849	0	0.857	0	0.734	0

Analysis of the Results of the Evaluation of the Modified MacNab Criteria in the Two Groups

The excellent rate of the two groups was 82.85% in the UBE group and 78.94% in the conventional decompression group when

the modified MacNab criteria were evaluated at the 12-month postoperative follow-up, and the UBE group was significantly better than the conventional decompression group, with statistical differences ($P < 0.05$) (Table 4).

Table 4: MacNab scores at the final postoperative follow-up in both groups (cases, %).

Group	n	Excellent	良	可	poor	Excellent rate
OLIF Group	32	19 (59.375)	10 (31.25)	3 (9.375)	0 (0.00)	29 (90.625)
Traditional decompression group	36	16 (44.44)	13 (36.11)	5 (13.89)	2 (5.56)	29 (80.55)
χ^2						17.21
<i>P</i>						0.009

Discussion

Degenerative lumbar spinal stenosis (DLCS) is the most common indication for spinal surgery in the elderly [6]. Wide laminectomy with or without concomitant fusion procedures has been considered the standard surgical procedure for decades [7,8]. This classic approach usually involves extensive soft tissue dissection, but can lead to fatty degeneration, atrophy and paravertebral muscle weakness and result in a failed low back surgery syndrome [9,10]. Randomised controlled trials have shown that fusion is not effective in decompression of degenerative DLCS [11,12]. Considering the complications of spinal fusion and internal fixation, simple but adequate decompression is a more reasonable approach for patients without an absolute indication for additional stabilisation surgery [13]. For the surgical treatment of degenerative DLCS, adequate decompression is the most critical determinant. The main aim of surgical treatment is to decompress the nerve structures, thereby relieving symptoms and improving function [14]. However, traditional open surgery requires extensive dissection and traction on the paravertebral muscles, which can lead to muscle ischaemia and damage to the nerves, resulting in atrophy, postoperative low back pain and low postoperative patient satisfaction [15].

Minimally invasive techniques have been developed to overcome these limitations. For over 20 years, minimally invasive (MI) spine surgery has been successfully treating patients with a variety of lumbar spine conditions [16-19]. With advances in surgical instrumentation and endoscopic techniques, MI spine surgery has gradually and rapidly evolved from a miniature open to a tubular or percutaneous endoscopic approach. In addition to the potential benefits of the MI spinal surgical approach (smaller wounds, reduced local pain, less blood loss, less postoperative wound pain and shorter hospital stays), numerous biomechanical studies have demonstrated the importance of the posterior column, including the interspinous ligaments and small joints, in maintaining spinal stability [20,21]. Minimising disruption to the paravertebral muscles and posterior stabilising structures is therefore the most critical issue in the long-term developmental progress of MI spine surgery [22]. In the last decade, due to advances in minimally invasive spinal fusion techniques, OLIF surgery has emerged and is increasingly being used by spine surgeons. The benefits of the OLIF technique include preservation of the posterior lumbar structures,

reduced blood loss and shorter hospital stays [23].

OLIF can reduce the posterior ligamentous complex by increasing the height of the vertebral space and promoting indirect decompression of the spinal canal. At the same time, OLIF allows reconfiguration of the vertebral sequence to enhance stability. The procedure is minimally invasive while achieving the same efficacy as conventional posterior surgery [24]. OLIF neither invades the spinal canal nor requires crossing the psoas major muscle. In contrast to posterior lumbar interbody fusion, the surgical approach to OLIF is to expose and distract the psoas major muscle by bluntly separating the internal oblique, transversus abdominis and transverse fascia through the natural gap between the psoas major muscle and the retroperitoneal vessels, i.e. revealing the guide needle for insertion into the target vertebral space and then gradually expanding to allow access to the target area [25]. Based on CT imaging data, the OLIF surgical window is divided into a vascular window, a bare window, a lumbaris major window, an ideal surgical window and an actual surgical window. The vascular window should be avoided when establishing the surgical procedure, noting the location of the abdominal aorta and inferior vena cava, and the presence of the lumbar segmental artery on the posterior lateral aspect of the vertebral body [26].

Preoperative preparation includes adequate knowledge of the width of the gap between the psoas major muscle and the large abdominal vessels to estimate the actual size of the surgical window [27]. The psoas major muscle should not be overstretched, as this may damage the lumbar plexus nerve roots. OLIF should be performed with caution in patients with large-vessel malformations or particularly narrow gaps between the psoas major muscle and the large abdominal vessels. If the assessment indicates that the surgical window is not suitable for OLIF, other treatment options such as posterolateral interbody fusion or conventional posterior decompressive fixation may be considered. In the current study, there was a significant improvement in the clinical symptoms of degenerative DLCS treated by the OLIF technique in the postoperative period. The most significant item was the VAS score for leg pain, which improved from 7.63 to only 1.47. Patients also showed significant improvements in neurological symptoms and disability status, which was reflected in the improvement in ODI. In addition, over 90% of patients had good or excellent outcomes when assessed using the modified MacNab criteria.

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