Oblique Lateral Interbody Fusion Combined with Lateral Plate VS. Combined with Posterior Pedicle Screw Fixation in Lumbar Degenerative Diseases

Hai-dong Li (hd_lee2008@163.com)
the first people's hospital of huzhou, department of spinal surgery https://orcid.org/0000-0002-7471-129X

Li Zhong
The first people's hospital of Huzhou

Xiang-Qian Fang
Zhejiang University School of Medicine

Lei-Sheng Jiang
Shanghai Jiaotong University School of Medicine Xinhua Hospital

Research article

Keywords: oblique lateral interbody fusion, lateral fixation, plate, lumbar degenerative diseases

Posted Date: November 2nd, 2021

DOI: https://doi.org/10.21203/rs.3.rs-1027290/v1

Abstract

Background The oblique lateral interbody fusion (OLIF) is a minimally invasive indirect decompression technique for the treatment of degenerative spinal disease. OLIF with posterior pedicle screws fixation frequently is performed, whereas it requires much more surgery time and blood loss. The purpose of this study was to compare the oblique lateral interbody fusion (OLIF) combined with lateral plate (LP) vs. OLIF combined with posterior pedicle screw (PS) fixation for the treatment of lumbar degenerative diseases.

Methods The clinical data of 53 patients with lumbar degenerative diseases who underwent OLIF from January 2020 to September 2020 were retrospectively analyzed，24 in OLIF combined with lateral plate (OLIF+LP) group and 29 in OLIF combined with pedicle screw (OLIF+PS) group. All patients completed a minimum 1-year follow-up. The duration of operation, blood loss, fusion rate and complications were recorded. The visual analog scale (VAS) score, Oswestry Disability Index (ODI), disc height (DH), foraminal height (FH) and cross-sectional area (CSA) were also evaluated.

Results The operation time was 75.41±11.53 min in the OLIF+LP group, which shorter than that in OLIF+PS group(127.05±5.62min, P<0.01). Also, the blood loss was significantly less in the OLIF+LP group (39.55±5.32 ml) than in the OLIF+PS group (89.81±9.62, P<0.01). The VAS and ODI scores both significantly reduced after operation in OLIF+LP group. There was no difference either in VAS or ODI scores by 1 year after surgery between two groups (P>0.01). The DH, FH, and CSA parameters were all improved significantly after operation in both groups, however, there was no significant difference at the any follow-up point between the two groups. The total complication rate was 13.21% (7/53) in this study, and there was no siginificant difference between the two groups. The fusion rate was 91.67% in the OLIF+LP group and 93.10% in the OLIF+PS group (P =0.69).

Conclusions OLIF+LP fixation seems to be a valuable surgical option for single-segmental lumbar degenerative disease, it can achieve much better clinical outcomes than OLIF+PS group.

Background

Lumbar degenerative disease is a common and debilitating ailment, causing pain and disability in elderly patients and burdening our healthcare system. The prevalence of low-back pain due to lumbar spondylosis is estimated at 3.6% worldwide [1]. Meantime, the rates of lumbar spine surgery have increased steadily over time [2]. Posterior lumbar interbody fusion (PLIF) and transforaminal lumbar interbody fusion (TLIF) have widely used as a gold treatment for lumbar degenerative disease. However, extensive dissection of the paraspinal muscles as well as multifidus atrophy was the common criticism for the posterior surgery [3]. Many complications such as peri-operative bleeding, dural tear, nerve root injury and postoperative low back pain were reported [4]. It has been suggested that the perioperative complications rate of minimally invasive transforaminal lumbar interbody fusion (MI-TLIF) was still 15.6%, and the most common complication was durotomy (5.1%) [5].

Oblique lateral lumbar interbody fusion (OLIF) was first reported in 2012 by Silvestre, which using the natural space between the left lateral border of the abdominal aorta and the anterior medial border of the left psoas muscle, to avoiding the morbidity of traditional posterior surgery [6]. Moreover, minimally invasive OLIF technique can also significantly improve the coronal and sagittal balance of adult degenerative scoliosis (ADS) [7]. Excellent clinical results of this minimal invasive surgery has been already confirmed for treatment of ADS [8].

OLIF has mostly combined with supplemental posterior pedicle screw fixation (OLIF+PS) for the treatment of lumbar spine disease [9]. Zeng et al suggested that the rate of complications was lower with the usage of combined pedicle screw fixation [10]. Ohtori et al used posterior pedicle screws in all their patients who underwent OLIF and reported good outcomes [11]. However, these procedures need two different incisions, adding more surgical risks and economic expense. To our knowledge, few studies have reported about OLIF combined with lateral plate instrumentation (OLIF+LP). The purpose of this study is to compare the clinical and radiographic efficacy of OLIF+LP and OLIF+PS for the treatment of lumbar degenerative disease.

Methods

This retrospective study was approved by the Ethics Committee of the authors' affiliated institutions, and all the patients signed an informed consent document. From January 2020 to September 2020, 53 patients who underwent single-segmental OLIF surgery were identified and included in this study. The inclusion criteria were the presence of single-segmental lumbar degenerative diseases as follows: (1) lumbar degenerative disc diseases; (2) degenerative spondylolisthesis with Meyerding grade I; (3) failure to >6 months of conservative treatment. The exclusion criteria were as follows: (1) severe osteoporosis (T score<2.5); (2) multi-segmental degenerative lumbar spine diseases; (3) follow-up < 6 months; (4) severe lumbar degenerative spondylolisthesis (more than Meyerding grade II); (5) severe lumbar spinal canal stenosis which required direct posterior decompression. They were randomly grouped according to the order of admission, there were 24 patients in OLIF+LP group, and 29 patients in OLIF+PS group. The surgical manipulations of all the patients were completed by the same surgical team. The characteristics of the patients are shown in Table 1. There was no difference in demographic characteristics between the two groups. All the patients were followed up at least 12 months.

Surgical procedure

The general technique of OLIF has been previously described [12]. After general anesthesia, the patient was positioned in a lateral decubitus manner with left hip on the top. A standard X-ray was made to identify the targeting vertebral levels. A skin incision of 3-4cm in length was made and retroperitoneal space was accessed by blunt dissection along the retroperitoneal fat tissue. The psoas muscle was dissected with the index finger and retracted posteriorly, and the peritoneal sac was mobilized anteriorly.

After discectomy, vertebral endplates were prepared, and then inserted the intervertebral cage filled with demineralized bone matrix (DBM).

In OLIF+LP group, after conventional OLIF procedure, lateral plate fixation system was placed at the lateral part of vertebrae. The screws were usually inserted upward and downward along the endplate so that segmental vessels would be spared (Fig 1). In the OLIF+PS group, after the general OLIF procedure, the patient was placed in the prone position to undergoing posterior bilateral pedicle screw fixation via Wiltse approach, and the posterolateral fusion was not performed. All the patients were allowed to ambulate by Boston brace on the second postoperative day. The Boston brace was recommended for 3 months.

Radiographic assessment

The routine X-ray, computed tomography (CT) and MRI were allowed for all the patients. As shown in the Fig 2, the radiological parameters, such as disk height (DH), foraminal height (FH), and cross-sectional area (CSA) were measured according to the methods reported by Sato [13]. All the imaging examinations were read independently by two experience physicians. The calculated intra-class correlation coefficients were all >0.85 for all variables. The Bridwell interbody fusion grading system was used for evaluation of fusion rate [14]. Grades I and II were considered as successful. Cage subsidence was defined as a cage sinking into an adjacent vertebral body by >2 mm according to the CT scans [15].

Clinical assessment

A standardized and validated questionnaires that included the VAS score for back pain intensity and the ODI score were allowed for all the patients. A 10-point VAS was used, which 1= least pain and 10=worst pain. Clinical data were obtained on preoperative, 7 days, 3 months, and 12 months after operation. Surgical characteristics and complications were also recorded.

Statistical analysis

Statistical analysis was performed using SPSS 18.0 for Windows (IBM, Armonk, NY, USA). Continuous data are presented as means ± standard deviation, and were analyzed using the Student t test. The level of significance was set at $P < 0.05$.

Results

Clinical evaluation

The mean operative time was 75.41±11.53 min (range 53-110 min) in OLIF+LP group, and 127.05±5.62 min (range 93-210 min) in the OLIF+PS group, the difference was statistically significant ($P<0.01$). The

mean intraoperative blood loss was 89.81±9.62 ml in the OLIF+PS group, much more than OLIF+LP group (39.55±5.32, P<0.01). There was no significant difference either in VAS or ODI scores pre-operative between two groups. As shown in the Fig3, the VAS and ODI scores were both improved significantly after the surgery in the two groups. However, the OLIF+LP group suffered less back pain both at 7 days (3.05±0.67 VS 4.55±0.39, P<0.01) and 3 months after surgery (2.35±0.67 VS 3.25±0.37, P<0.05) than OLIF+PS group; Interestingly, this difference was disappeared at one year after surgery. Similarly, the difference on ODI scores between the two groups had statistical significant only at 7 days after surgery (17.36±2.76 VS 22.80±6.02, P<0.01). The clinical outcomes are summarized in Table 2.

Radiographic evaluation

As shown in the Table 3, the DH, FH, and CSA were 8.96±1.23 mm, 16.18±3.49 mm and 88.95±14.79 mm^2 respectively before the surgery in the OLIF+LP group, and they were all increased significantly after the surgery (P<0.05). Similarly, these three radiographic parameters were all improved significantly after operation in the OLIF+PS group. There was no significant difference on these three parameters at any follow-up period between two groups. The rate of cage subsidence was 8.33% (2/24) in the OLIF+LP group, which is similar to the OLIF+PS group (2/29, 6.90%). There was no cage retropulsion in both of groups during the follow-up. The fusion rate was 91.67% (22/24) in the OLIF+LP group and 93.10% (27/29) in the OLIF+PS group at 12 months (P =0.69). Images of typical cases are shown in Fig 4 and Fig 5.

Complications

The total complication rate was 13.21% (7/53) in this retrospective study. In the OLIF+LP group, two cases of L4/5 end-plate injury were noticed intraoperatively. Two patients with lumbosacral injury were recorded in the OLIF+LP group. These patients had hip flexion weakness. Fortunately, they had both recovered within 2 months postoperative. In the OLIF+PS group, one patient with leg weakness and two patients with end-plate injury were recorded. No major vessel injuries or nerve root injuries occurred during the surgery. No intervertebral space infections, cerebrospinal fluid leakage, vertebral body fracture or instrument failure occurred during the follow-up.

Discussion

The lateral spinal fixation system was an internal fixation system tailored for lateral and anterior surgical approaches. It increased the immediate stability after OLIF, and theoretically increased the fusion rate after surgery. Moreover, single lateral incision can avoid the muscle injury of posterior structures, decrease the potential risk of nerve damage and shorten the operation time. In this retrospective study, the post-operative radiograpgic parameters such as DH□FH and CSH were all improved than before in both of the groups. Undoubtedly, the clinical symptoms alleviated in all of the patients. However, the patients in OLIF+LP group had lower VAS and ODI scores after surgery than the OLIF+PS group, the

destruction of posterior longitudinal complex during the pedicle screw fixation in the OLIF+PS group may be the main cause.

OLIF was reported as an relatively safe procedure through the transpsoas approach, allowing for psoas preservation, and avoids the vascular injury [6]. It has been found to result in about 30.0% average increase in the neural foramen area and a 30.2% median increase in the cross-sectional area of the dural sac [12-13]. However, the occurrence of complications is inevitable, and the complications rate fluctuates from 3.7% to 66.7% [16]. In a study directed by Abe, intraoperative complications were reported as 44.5%, while only 4.7% of postoperative complications occured. The most common complication was the endplate fracture followed by the transitory weakness of the psoas muscle and transient neurological symptoms. Zeng et al reported that the endplate damage, cage sedimentation and shifting were the three most common complications of OLIF [10]. In their study, the complication rate was 36.26% in the stand-alone group, much higher than that in OLIF combined pedicle screw group (29.86%). Up to date, the pedicle screw instrumentation was commonly applied for stabilization after OLIF because they were considered as the standard method of fixation to providing the best bio-mechanical stability of the spine [17]. However, the selection between unilateral pedicle screw (UPS) and bilateral pedicle screw (BPS) fixation still remain controversial in lumbar spine surgery. Wen et al compared the clinical and radiological outcomes of BPS and UPS fixation among the patients who underwent OLIF, they suggested that the OLIF combined with UPS fixation is an effective and reliable option for single-level lumbar diseases [18].

Obviously, posterior pedicle screw fixation decreases the incidence of sedimentation, but the increased cost, prolonged operation time, and greater damage to the posterior muscle tissue should be taken into consideration. Blizzard et al first reported the lateral position technique for percutaneous pedicle screw placement following LLIF or OLIF, however, the 2.8% rate of re-operation for malpositioned screws is slightly higher [19]. Lateral pedicle screw instrumentation after anterior lumbar interbody fusin (ALIF) or lateral lumbar interbody fusion (LLIF) has been previously reported to avoiding the disadvantages of posterior pedicle screw fixation [20-21]. In a retrospective study of 65 lumbar DDD patients, Xie et al reported that OLIF combined with lateral pedicle screw fixation is a safe and effective surgical method with less operation time and less blood loss [22]. Liu et al suggested the OLIF with supplemental anterolateral screw instrumentation can achieve good clinical result with about 95% fusion rate [23]. Moreover, the combination of OLIF and lateral screw instrumentation was also reported as an effective and safe option for the treatment of degenerative spine deformity [24]. However, there was few report about the usage of lateral plate instrumentation combined with OLIF. In the current study, the oblique lateral spinal system was used with OLIF procedure, it was a very convenient and safe method realizing one-stage intervertebral fusion and instrumentation through a single small incision.

A major concern is that the lateral instrumentation may not be strong enough to maintain the spinal stability, preventing the interbody cages from subsidence and promoting fusion. The biomechanical strength of lateral plate fixation system should be considered. Compared with the stand-alone OLIF condition, lateral plate instrumentation significantly decreased the lateral bending and axial rotation ROM

without changing on flexion-extension ROM [25]. The cage combined with a lateral plate was not statistically different from that with bilateral pedicle screws in lateral bending. In another biomenchanical study, the two-hole lateral plate and bilateral pedicle screw fixation both significantly limit ROM in all loading planes, and they are both recommended with laterally placed cages for the treatment of two-level lumbar spine disease [26]. In a three dimensional finite element study, Liu et al suggested the lateral plate and screws can not provide sufficient biomechanical stability for multilevel lateral interbody fusion [27]. On the other hand, in an cadaveric biomechanical study, Lai et al suggested that unilateral pedicle screw and lateral plate may both provide sufficient biomechanical stability for multilevel LLIF [28]. In present study, we apply the lateral plate instrumentation only to the one-segmental lumbar degenerative disease, the grade II or more serious lumbar spondylisthesis patients were excluded. No instrumentation failure case occurred in our study.

The complication of lateral plate fixation is another concern. The vertebral body fractures have been reported in the patients who underwent LLIF combined with lateral pedicle screw or lateral plate fixation [29-30]. The reason might be that a fracture propagated through the screw hole from the fixed-angle anterolateral plate, resulting the coronal plane fracture especially in osteoporotic cases. The coronal plane vertebral fracture also occurred in osteoporotic patients who underwent XLIF combined with XLP lateral instrumentation, the unilateral pedicle screw instrumentation does not prevent this complication [31]. Brier-Jones et al speculate that violation of the epiphyseal ring or subchondral bone by plate-anchoring screws may contribute to the coronal vertebral body fractures [32]. Kepler et al suggested that the unbalanced distribution of compressive stress is another important factor leading to vertebral fractures [29]. In present study, there was none complication related to the lateral plate fixation system. Several factors as follows may be able to explained it. Firstly, all patients admitted were single-segmental lumbar degenerative disease; Secondly, the cages used by OLIF were much larger, which located in the II-III area of the vertebral body, and the stress distribution of the whole vertebral body is even. Thirdly, the spine brace is advised for the first three months after surgery.

Limitations

The present study had some limitations. Firstly, We performed a retrospective study with a small sample size, and the duration of follow-up was short. Secondly, our study only included patients with single-segmental lumbar degenerative disease, whether it suitable for the multilevel lumbar degenerative disease is unknown. Further random control trials with large samples are needed to verify its pros and cons.

Conclusion

OLIF+LP fixation seems to be a valuable surgical option for single-segmental lumbar degenerative disease, it can achieve much better clinical outcomes than OLIF+PS group.

Declarations

Ethics approval and consent to participate

This study had been approved by Ethics Committee of the authors' affiliated institutions, and the informed consent to participate in the study should be obtained from all the patients.

Consent for publication

All patients provided written informed consent to use their clinical data for publication purposes.

Availability of data and material

The datasets used and/or analyzed during the current study are availabe from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no conflict of interest.

Funding

This study was sponsored by the Medical Health Science and Technology Project of Zhejiang Province (2021KY349) and Project of Huzhou Science and Technology Bureau(2020GY08).

Authors' contributions

HDL had full access to all of the data in the study and took responsibility for the integrity of the data and the accuracy of the data analysis. All authors meet all three of the requirements for authorship. XFF and LSJ were highly involved in the planning and execution of this study. Furthermore, LZ was highly involved in the acquisition of data and in the process of data interpretation. All authors read and approved the final manuscript.

Acknowledgements

We express deep thanks to Dr. Xiang-Qian Fang and Lei-Sheng Jiang for their technical support.

References

1. Ravindra VM, Senglaub SS, Rattani A, Dewan M, Hartl R, Bisson E, et al. Degenerative lumbar spine disease: estimating global incidence and worldwide volume. Global Spine J.2018; 8:784–794.
2. Makanji H, Schoenfeld AJ, Bhalla A, Bono CM. Critical analysis of trends in lumbar fusion for degenerative disorders revisited: influence of technique on fusion rate and clinical outcomes. Eur Spine J.2018; 27:1868–1876.
3. Fan SW, Hu ZJ, Fang XQ, Zhan FD, Huang Y, Yu HJ. Comparison of paraspinal muscle injury in one-level lumbar posterior inter-body fusion: modified minimally invasive and traditional open approaches. Orthop Surg. 2010;2:194–200.
4. Wang YP, An JL, Sun YP, Ding WY, Shen Y, Zhang W. Comparison of outcomes between minimally invasive transforaminal lumbar interbody fusion and traditional posterior lumbar intervertebral fusion in obese patients with lumbar disk prolapse. Ther Clin Risk Manag. 2017; 13:87–94.
5. Wong AP, Smith ZA, Nixon AT, et al. Intraoperative and perioperative complications in minimally invasive transforaminal lumbar interbody fusion: a review of 513 patients. J Neurosurg Spine. 2015;22:487–495.
6. Silvestre C, Mac-Thiong JM, Hilmi R, Roussouly P. Complications and morbidities of mini-open anterior retroperitoneal lumbar inter-body fusion: oblique lumbar interbody fusion in 179 patients. Asian Spine J.2012; 6:89–97.
7. Wu WJ, Liang Y, Cao P, et al. Minimally invasive lateral lumbar interbody fusion significantly improves the sagittal balance for adult degenerative scoliosis.Zhonghua Yi Xue Za Zhi. 2020; 100:192–196.
8. Abbasi A, Khaghany K, Orandi V et al. Clinical and Radiological Outcomes of Oblique Lateral Lumbar Interbody Fusion. Cureus. 2019;11:e4029.
9. Blizzard DJ, Thomas JA. MIS single-position lateral and oblique lateral lumbar interbody fusion and bilateral pedicle screw fixation: feasibility and perioperative results. Spine (Phila Pa1976).2017; 43:440–446.
10. Zeng ZY, Xu ZW, He DW, Zhao X, Ma WH, Ni WF, et al. Complications and prevention strategies of oblique lateral Interbody fusion technique. Orthop Surg.2018; 10:98–106.
11. Ohtori S, Orita S, Yamauchi K, Eguchi Y, Ochiai N, Kishida S,et al. Mini-open anterior retroperitoneal lumbar Interbody fusion: oblique lateral Interbody fusion for lumbar spinal degeneration disease. Yonsei Med J.2015; 56:1051–1059.
12. Fujibayashi S, Hynes RA, Otsuki B, Kimura H, Takemoto M, Matsuda S. Effect of indirect neural decompression through oblique lateral interbody fusion for degenerative lumbar disease. Spine (Phila Pa 1976).2015; 40:E175–182.
13. Sato J, Ohtori S, Orita S, Yamauchi K, Eguchi Y, Ochiai N, et al. Radiographic evaluation of indirect decompression of mini-open anterior retroperitoneal lumbar interbody fusion: oblique lateral interbody fusion for degenerated lumbar spondylolisthesis. Eur Spine J.2017; 26:671–678.
14. Bridwell KH, Lenke LG, McEnery KW, Baldus C, Blanke K. Anterior fresh frozen structural allografts in the thoracic and lumbar spine. Do they work if combined with posterior fusion and instrumentation

in adult patients with kyphosis or anterior column defects? Spine (Phila Pa 1976).1995; 20:1410–1418.

15. Lim TH, Kwon H, Jeon CH, Kim JG, Sokolowski M, Natarajan R, et al. Effect of endplate conditions and bone mineral density on the compressive strength of the graft-endplate interface in anterior cervical spine fusion. Spine (Phila Pa 1976).2001; 26:951-956.
16. Gragnaniello C, Seex K. Anterior to psoas (ATP) fusion of the lumbar spine: evolution of a technique facilitated by changes in equipment. J Spine Surg.2016; 2:256–265.
17. Fang G, Lin Y, Wu J, Cui W, Zhang S, Guo L, et al. Biomechanical Comparison of Stand-Alone and Bilateral Pedicle Screw Fixation for Oblique Lumbar Interbody Fusion Surgery-A Finite Element Analysis. World Neurosurg. 2020;141:e204-e212.
18. Wen JK, Shi CG, Yu L, Wang S, Xi YH, Ye XJ. Unilateral versus bilateral percutaneous pedicle screw fixation in oblique lumbar interbody fusion. World Neurosurg.2020; 134:e920-e927.
19. Blizzard DJ, Thomas JA. MIS Single-position Lateral and Oblique Lateral Lumbar Interbody Fusion and Bilateral Pedicle Screw Fixation: Feasibility and Perioperative Results. Spine (Phila Pa 1976). 2018;43:440–446.
20. Choi YH, Kwon SW, Moon JH, Kim CH, Chung CK, Park SB, Heo W. Lateral Lumbar Interbody Fusion and in Situ Screw Fixation for Rostral Adjacent Segment Stenosis of the Lumbar Spine. J Korean Neurosurg Soc.2017; 60:755–762.
21. Caputo AM, Michael KW, Chapman TM, Jennings JM, Hubbard EW, Isaacs RE, Brown CR. Extreme lateral interbody fusion for the treatment of adult degenerative scoliosis. J Clin Neurosci. 2013; 20: 1558–1563.
22. Xie TH, Wang CY, Yang ZQ, Xiu P, Yang X, Wang X,et al. Minimally invasive oblique lateral lumbar interbody fusion combined with anterolateral screw fixation for lumbar degenerative disc disease. World Neurosurg.2020; 135:e671-e678.
23. Liu JP, Feng HL. Oblique lateral interbody fusion (OLIF) with supplemental anterolateral screw and rod instrumentation: a preliminary clinical study. World Neurosurg.2020; 134:e944-e950.
24. Wang K, Zhang C, Cheng C, Jian FZ, Wu H. Radiographic and clinical outcomes following combined oblique lumbar interbody fusion and lateral instrumentation for the treatment of degenerative spine deformity: a preliminary retrospective study. Biomed Res Int. 2019;8:5672162.
25. Fogel GR, Parikh RD, Ryu SI, Turner AW. Biomechanics of lateral lumbar interbody fusion constructs with lateral and posterior plate fixation. J Neurosurg Spine.2014; 20:291–297.
26. Nayak AN, Gutierrez S, Billys JB, Santoni BG, Castellvi AE. Biomechanics of lateral plate and pedicle screw constructs in lumbar spines instrumented at two levels with laterally placed interbody cages. Spine J.2013; 13:1331–1338.
27. Liu XL, Ma J, Park P, Huang XD, Xie N, Ye XJ. Biomechanical comparison of multilevel lateral interbody fusion with and without supplementary instrumentation: a three dimensional finite element study. BMC Musculoskelet Disord. 2017;18:63.

28. Lai O, Chen YL, Chen QX, Hu Y, Ma WH. Cadaveric biomechanical analysis of multilevel lateral lumbar interbody fusion with and without supplemental instrumentation. BMC Musculoskelet Disord.2021; 22:1186.
29. Kepler CK, Sharma AK, Huang RC. Lateral transpsoas interbody fusion (LTIF) with plate fixation and unilateral pedicle screws. J Spinal Disod Tech.2011; 24:363–367.
30. Le TV, Smith DA, Greeberg MS, Dakwar E, Baaj AA, Uribe JS. Complications of lateral plating in the minimally invasive lateral transpsoas approach. J Neurosurg Spine.2012; 16:302–307.
31. Dua K, Kepler CK, Huang RC, Marchenko A. Vertebral body fracture after anterolateral instrumentation and interbody fusion in two osteoporotic patients.Spine J.2010;10:e11-15.
32. Brier-Jones JE, Palmer DK, Inceoglu S, Cheng WK. Vertebral body fractures after transpsoas interbody fusion procedures. Spine J.2011; 11:1068–1072.

Tables

Table 1

Demographics of the patients of two groups

	OLIF+LP (n=24)	OLIF+PS (n=29)	P
Gender			0.476
Male	11	13	
Female	13	16	
Age (years)	63.34±10.20	61.95±11.12	0.543
Level (n)			
L2-3/L3-4/L4-5	3/8/13	4/10/15	0.398
Operative time (min)	75.41±11.53	127.05±5.62	<0.001
Blood loss (ml)	39.55±5.32	89.81±9.62	<0.001
Hospitalization (day)	7.51±1.20	8.00±0.71	0.609

Table 2

Comparison of the VAS and ODI score between the groups.

Parameters	Pre-op	Post-op		
		7-days	3-months	12-months
VAS OLIF+LP	7.13±1.35	3.05±0.67*†	2.35±0.67*†	2.12±0.34*
OLIF+PS	7.03±1.66	4.55±0.39*	3.25±0.37*	2.15±0.16*
ODI OLIF+LP	59.67±6.92	17.36±2.76*†	14.75±1.48*	10.42±1.29*
OLIF+PS	60.27±4.91	22.80±6.02*	15.06±1.07*	10.50±1.90*

*P<0.05, Post-op vs. Pre-op in each group. † P<0.05, OLIF+LP group vs. OLIF+PS group at each time point. ODI, Oswestry Disability Index; VAS, Visual Analog Scale.

Table 3

The comparison of the radiological data of the two groups

Parameters	Pre-op	Post-op
DH OLIF+LP	8.96±1.23	13.02±8.83*
OLIF+PS	8.66±2.21	12.82±7.35*
FH OLIF+LP	16.18±3.49	21.54±2.12*
OLIF+PS	16.35±5.19	21.96±3.14*
CSA OLIF+LP	88.95±14.79	126.53±8.83*
OLIF+PS	89.23±12.18	127.12±10.14*

*p<0.05, Post-op vs. Pre-op in each group. DH, Disk Height; FH, Foraminal Height; CSA, Cross Sectional Area;

Figures

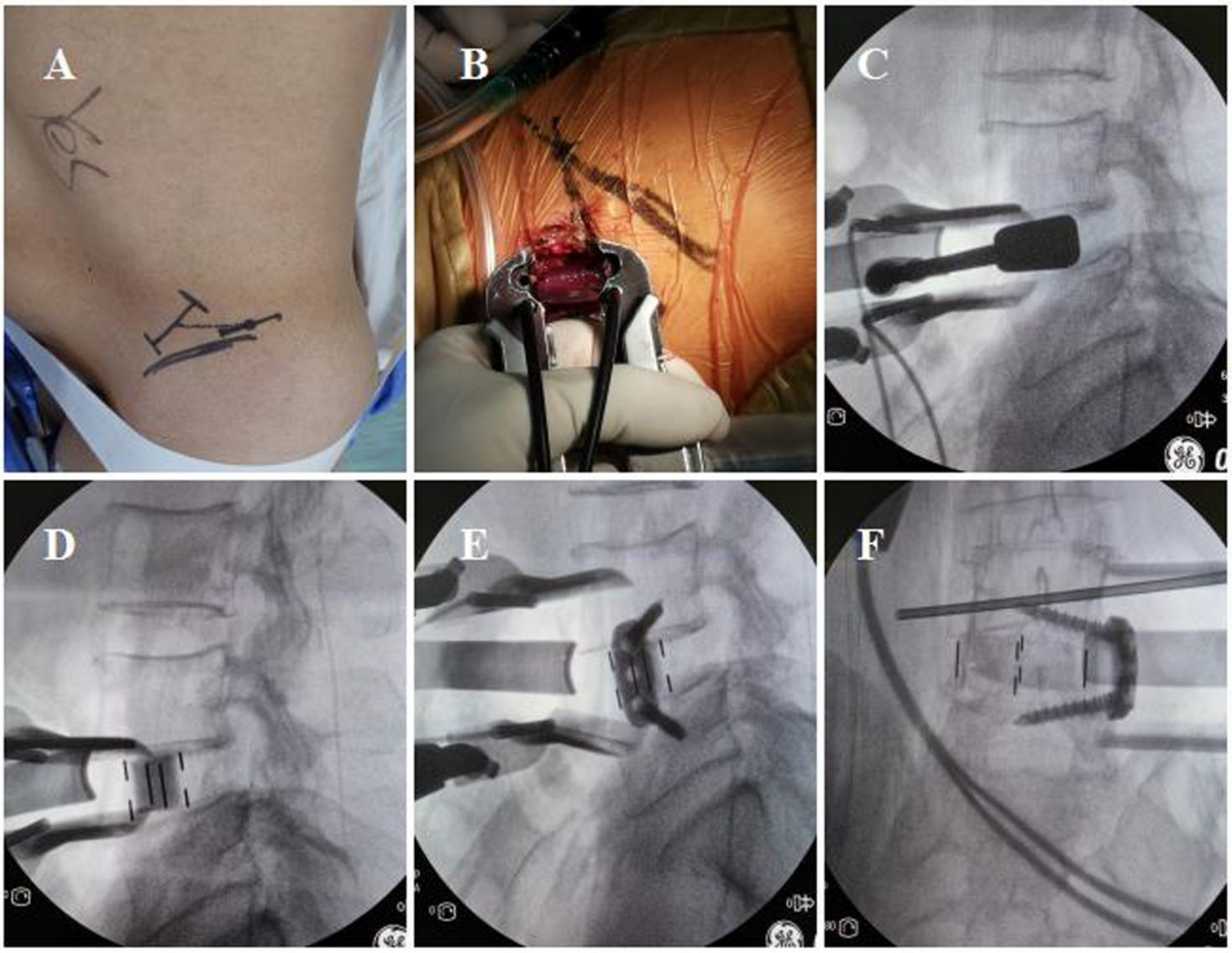

Figure 1

Radiographic images showed the surgical process of OLIF with lateral plate fixation. The skin incision was made 4-8cm anterior to the midportion of the disk (A). Retractor for OLIF used after dilatation (B). The trial position is located in the 1/3 of the vertebral body (C). Insert the interbody fusion cage (D). Fix the lateral plate instrumentation (E-F).

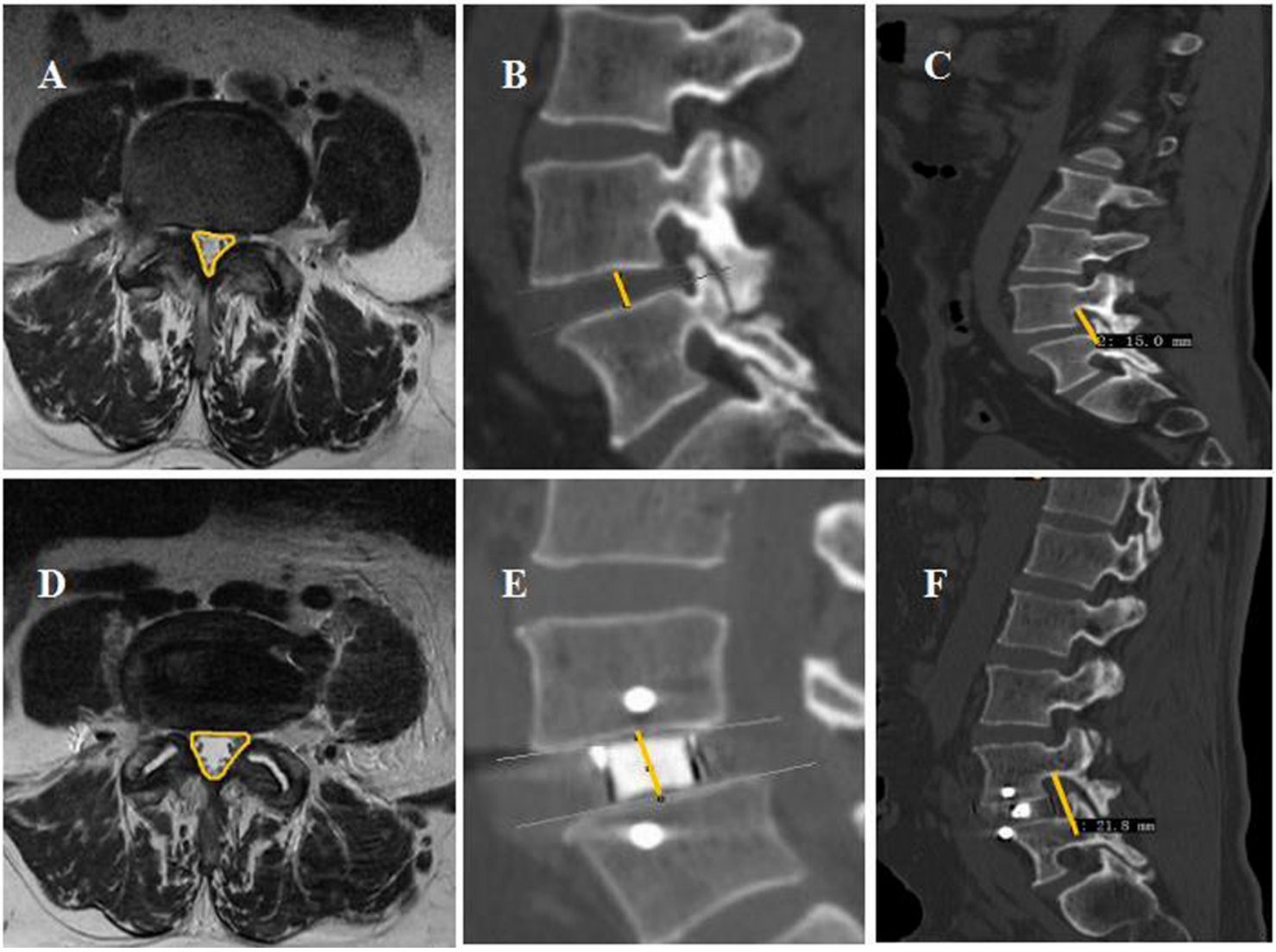

Figure 2

A 65-year-old woman with a diagnosis of degenerative spondylolisthesis of L4 (Meyerding grade I) was treated with oblique lateral lumbar interbody fusion combined with lateral plate fixation. The cross-sectional area (CSA) of the thecal sac was evaluated using magnetic resonance imaging (A) before and (D) 7 days after surgery. Three-dimensional computed tomography scans were used to evaluate the disk height (DH), foraminal height (FH) (B,C) before and (E,F) 7 days after surgery.

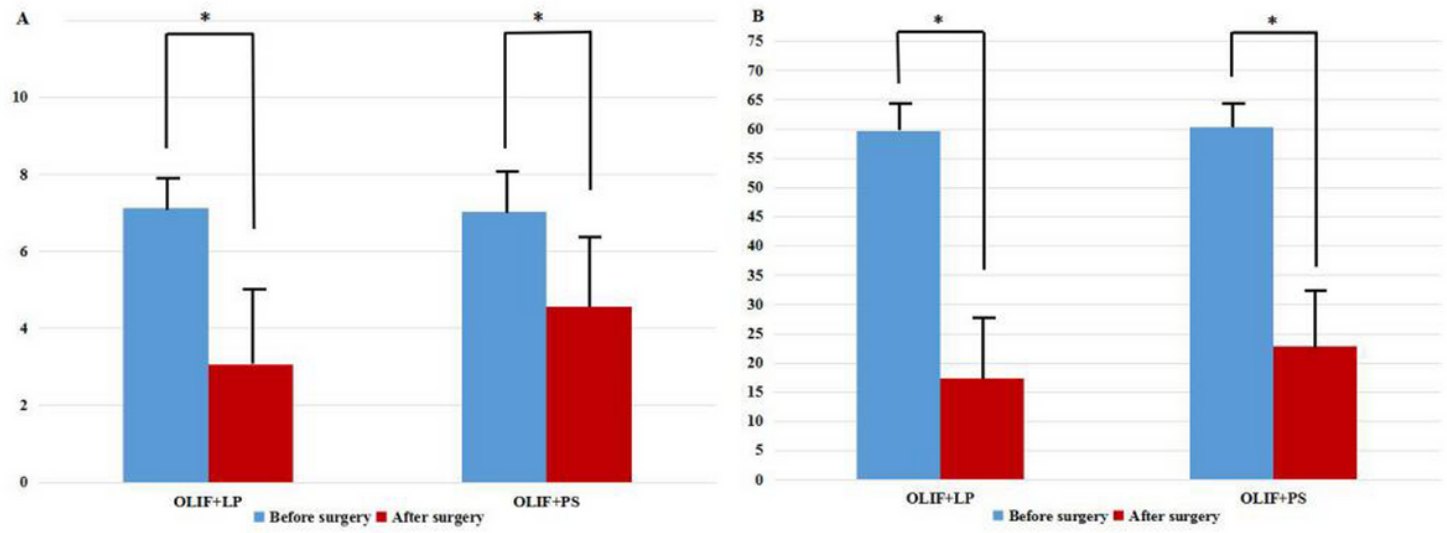

Figure 3

The preoperative and postoperative VAS (Visual Analog Scale) (A) and ODI (Oswestry Disability Index) scores (B) of two groups are shown. Significant improvement is seen both in VAS and ODI scores after surgery of each group.

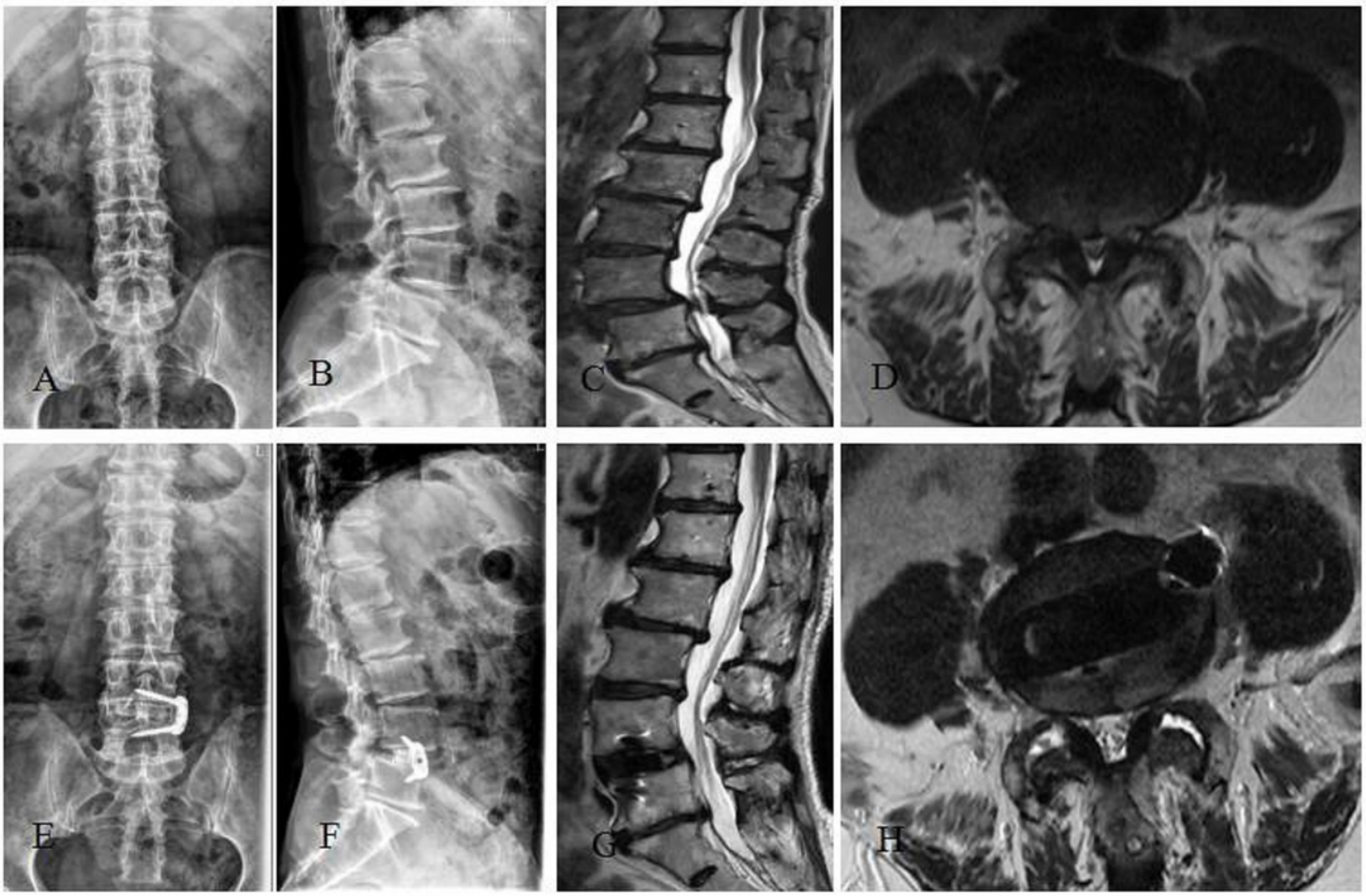

Figure 4

Imaging studies of a representative caes of OLIF+LP. A 73-year-old man with a diagnosis of lumbar spinal stenosis with degenerative spondylolisthesis of L4 (Meyerding grade I) had undergone oblique lateral lumbar interbody fusion combined with lateral plates fixation. Preoperative anteroposterior and lateral radiographs (A,B). Preoperative magnetic resonance imaging scans (C,D). Anteroposterior and lateral radiographs as 12 months postoperatively (E,F). Magnetic resonance imaging scans as 12 months postoperatively (G,H).

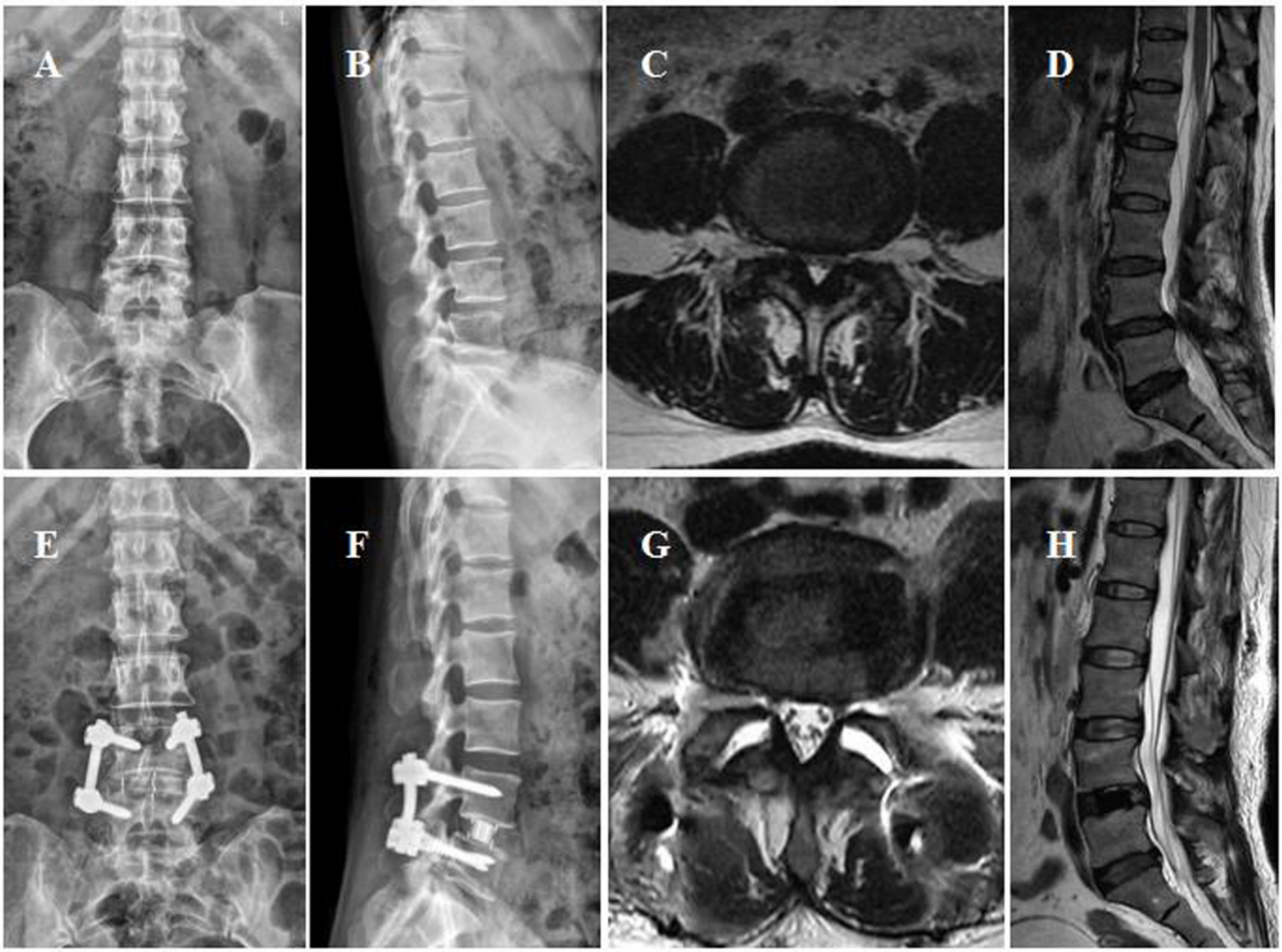

Figure 5

Imaging studies of a representative case of OLIF+PS. A 65-year-old woman with a diagnosis of lumbar spinal stenosis with degenerative spondylolisthesis of L4 had undergone oblique lateral lumbar interbody fusion combined with posterior pedicle screw fixation. Preoperative anteroposterior and lateral radiographs (A,B). Preoperative magnetic resonance imaging scans (C,D). Anteroposterior and lateral radiographs as 12 months postoperatively (E,F). Magnetic resonance imaging scans as 12 months postoperatively (G,H).