Comparison between oblique lumbar interbody fusion and posterior lumbar interbody fusion in the treatment of degenerative lumbar scoliosis: a retrospective clinical study

chaojun Xu
Zhengzhou University First Affiliated Hospital https://orcid.org/0000-0002-6900-4689
Yingjie HAO (haojack77@126.com)
Lei YU
Zhengzhou University First Affiliated Hospital
Guangduo ZHU
Zhengzhou University First Affiliated Hospital
Zhinan REN
Zhengzhou University First Affiliated Hospital
Yingchun CAI
Zhengzhou University First Affiliated Hospital
Cheng PENG
Zhengzhou University First Affiliated Hospital
Panke ZHANG
Zhengzhou University First Affiliated Hospital
Jian ZHU
Zhengzhou University First Affiliated Hospital
Shuyan CAO
Zhengzhou University First Affiliated Hospital

Research article

Keywords: Minimally invasive, Oblique lumbar interbody fusion, Degenerative adult lumbar scoliosis, Posterior lumbar interbody fusion

Posted Date: January 21st, 2020

DOI: https://doi.org/10.21203/rs.2.21443/v1

Abstract

Backgroud

Few studies compared radiographic and clinical outcomes between oblique lumbar interbody fusion and posterior lumbar interbody fusion in degenerative lumbar scoliosis.

Methods

This study retrospectively analyzed the case data of 40 patients with degenerative lumbar scoliosis in our hospital from July 2016 to October 2018. Among which,19 cases underwent oblique lumbar Interbody fusion(OLIF group) and 21 cases underwent posterior lumbar interbody fusion(PLIF group). The duration of the operation, volume of intraoperative hemorrhage, incision length, bed rest time, length of hospital stay, and complications were recorded for all patients. The clinical effects of 40 patients were evaluated by VAS for back pain and Oswestry Disability Index (ODI) and The radiographic parameters were evaluated using the lumbar scoliosis Cobb angle, sagittal vertical axis(SVA), coronal vertical axis(CVA), lumbar lordosis(LL), pelvic tilt(PT), sacral slope(SS), and Disc height(DH).

Results

The duration of the operation, the volume of intraoperative hemorrhage, incision length, bed rest time, length of hospital stay of the OLIF group were shorter than the PLIF group(P □ 0.05). The VAS scores for back pain, the ODI of the two groups were significantly decreased, which compared with the preoperative(P □ 0.05)□which in OLIF group was significantly more decreased than in PLIF(P □ 0.05) at 7 days and 3 months postoperatively, but at the last follow-up there were no significant difference between the two groups(P □ 0.05); The lumbar scoliosis Cobb angle, SVA, CVA, PT, LL, SS were significantly improved postoperatively(P □ 0.05). The OLIF group showed higher DH, smaller Cobb angle, and greater LL than the PLIF group at any time point(P □ 0.05). but there were no significant difference in SVA, CVA, PT and SS between the two groups at any follow-up points(P □ 0.05). The overall complication rate was slightly higher in the PLIF group□47.62%□than in the OLIF group□26.32%□without significant difference(x 2 =1.931, P =0.165). But the incidence of major complications in the PLIF group was significantly higher than that in the OLIF group (Fisher, P =0.026).

Conclusion

OLIF provides an alternative minimally invasive treatment for DLS, which compared with PLIF. It has the characteristics of a small incision, rapid recovery, fewer complications related to the surgical approach, and satisfactory orthopedics.

Keywords : Minimally invasive, Oblique lumbar interbody fusion, Degenerative adult lumbar scoliosis , Posterior lumbar interbody fusion

Backgroud

In recent years, the incidence of degenerative lumbar scoliosis(DLS) has increased. Lumbar interbody fusion (LIF), an effective treatment for DLS, has been tremendously advanced in recent decades. Such as traditional ALIF as well as P/TLIF[1, 2] have been widely applied and achieved good outcomes. Minimally invasive techniques have also been extensively explored to reduce surgical trauma and infection, shorten the hospital stay, and improve the prognosis. Oblique lumbar interbody fusion (OLIF), which was reported by Silvestre in 2012[3], has gained popularity in recent years. OLIF reaches the intervertebral space via a relatively small incision and induces less tissue destruction, It has the characteristics of interbody fusion with reduced blood loss, less severe postoperative pain, and a shortened incision length, bed rest time and hospital stay. Champagne P et al[4] had described the changes in spinal and pelvic sagittal parameters among patients who have undergone OLIF. Ohtori et al[5] found that OLIF significantly improved lumbar lordosis, pelvic tilt, and sacral slope; and Jin et al[6] reported a significant increase in segmental lordosis and disk height with OLIF. However, there is insufficient literature to show that OLIF helps patients who underwent degenerative lumbar scoliosis (DLS) to correct the lumbar scoliosis and improves treatment outcomes. Therefore, in the present study, we retrospectively analyzed and compared OLIF and PLIF for the treatment of degenerative lumbar scoliosis in terms of perioperative parameters, clinical outcomes, and radiographic results.

Materials And Methods

Inclusion criteria

The inclusion criteria were as follows: the degenerative lumbar scoliosis was mainly located in the L1-5 segments; the lumbar scoliosis Cobb angle was < 40°; with or without mild lumbar spinal stenosis and mild lumbar spondylolisthesis; pain accompanying or not accompanied by lower limb pain numbness after more than half a year of conservative treatment, affecting the quality of life; preoperative lumbar MRI or CT confirmed the presence of OLIF technology operation space between the abdominal aorta and the psoas muscle in the lumbar spine surgery segement.

Exclusion Criteria

The exclusion criteria were: combined with severe osteoporosis; lumbar spondylolisthesis more than 2 degrees; lumbar infection, severe spinal stenosis, calcification, rigidity, lumbar scoliosis caused by trauma, adults with idiopathic scoliosis, history of lumbar and abdominal surgery, the body mass index > $32Kg/m^2$. According to the above inclusion and exclusion criteria,we selected patients with lumbar vertebrae disease treated by OLIF

and PLIF surgery in our hospital from July 2016 to October 2018. In total, 40 patients were included in this study. Among them, 19 patients underwent OLIF (OLIF group) and 21 patients underwent PLIF (PLIFgroup). All surgeries were conducted by the same senior surgeon.

Olif Surgery

All patients were positioned right lateral decubitus after general anesthesia. The wide tape is used around the chest and at the level of the greater trochanter to secure the patient. A C-arm X-ray machine was used to determine the surgical position. A line is then drawn over the disc space of interest from the anterior to the posterior aspects of the disc space. Incisions of 4 to 8 cm in length were made to gradually expose the retroperitoneal adipose tissue layers. then blunt finger dissection is used to sequentially split the fibers of the external oblique, the internal oblique, and the transversalis. The surgeon's index finger was moved along the medial abdominal wall and backward to the psoas major muscle, and then the psoas was retracted posteriorly and the abdominal vessels were retracted anteriorly to fully expose the surgical intervertebral space. A guide needle was inserted to the target intervertebral space with confirmation of the needle position by the C-arm X-ray machine. Sequential dilators were placed over the guidewire then a lighted retractor was placed over the dilators and fixed to the vertebralbody with a pin, and the operation field was exposed. The annulus fibrosus was cut open and cartilage endplate removed so that a wide and lordotic intervertebral fusion cage packed with allograft bone was inserted into the target disc with the guidance of a C-arm. The tractor was removed, and the surgical field was repeatedly washed. When bleeding had fully stopped, the incision site was closed sequentially after a drainage tube was placed. (Operative procedures were show in Fig. 1; Typical case was shown in Fig. 6)

Plif Surgery

Taking L1-S1 levels for an example: The patient was placed in the prone position after general anesthesia. The preop planned level is determined by C-arm fluoroscopy. After proper sterilization, the patient is prepared for surgery. A routine posterior approach through a midline 14-cm incision is made. After subperiosteal blunt dissection, the paravertebral muscles were skimmed, and twelve pedicle screws were inserted through the vertebral pedicle. A total laminectomy and a medial facetectomy were performed on each patient, the nucleus pulposus was removed with the nucleus pulposus clamp, and rongeurs were used to perform a thorough discectomy down to the exposed endplate. Autologous bone was subsequently implanted into the disc space, and the cages packed with bone autograft were inserted. Bilateral pedicle screws were connected by new elongated screw rods and fixed with nuts. A drainage tube was placed, and the incision was closed layer by layer. (Typical case was shown in Fig. 7)

Follow-up And Evaluation Indicators

The duration of the operation, volume of intraoperative hemorrhage, incision length, bed rest time, length of hospital stay, and complications were recorded for all patients. Clinical and radiographic outcomes were evaluated preoperatively and at 1 week, 3 months, and 12 months postoperatively. Clinical evaluation included visual analog scale (VAS) for back pain and the Oswestry Disability Index (ODI). The radiographic examination included X-ray, computed tomography (CT), and magnetic resonance imaging. Radiologic parameters included lumbar scoliosis Cobb angle, sagittal vertical axis(SVA), coronal vertical axis(CVA), lumbar lordosis(LL), pelvic tilt(PT), sacral slope(SS) and disc height (DH) at the operated level. DH was calculated as the mean value of the anterior and posterior margin heights of the affected disc.

Fusion was identified by the formation of continuous bone trabeculae at the interface between the bone grafts and endplates.

Statistical Processing

SPSS 20.0 software (SPSS Inc, Chicago, IL) was used to conduct all statistical analyses. All quantitative variables are presented as means ± standard deviations. The Fisher exact test or chi-squared test was used to compare qualitative variables between groups, and the independent t-test was used to compare quantitative variables between groups. $P < 0.05$ was considered statistically significant.

Results

The age, gender, body mass index, the mean follow-uptime, fusion segments were shown between the 2 groups in Table 1.

Table 1 Baseline characteristics of 40 patients with degenerative lumbar scoliosis

	OLIF group	PLIF group	P value
Age,y	65.18 ± 8.20	62.07 ± 9.40	0.625
Gender			0.748
Male	6	8	
Famale	13	13	
Body mass index,Kg/m^2	20.09 ± 1.13	20.50 ± 1.50	0.424
Follow-up time, mon	21.68 ± 5.7	26.52 ± 5.85	0.208
Fusion			0.155
Single segment	1	3	
Two segments	11	10	
Three segments	7	6	
Four segments		2	

Surgical Characteristics

As shown in Table 2, the operative duration and incision length were shorter in OLIF group than that in PLIF group (105.11 ± 21.64 vs. 204.52 ± 47.22 minutes; 6.84 ± 1.71 vs. 14.05 ± 2.09 cm; respectively, $P < 0.001$). The intraoperative hemorrhage was less in the OLIF group, which compared with the PLIF group (106.84 ± 25.56 vs. 804.76 ± 423.65 ml; respectively, both $P < 0.001$). The OLIF group had a shorter bed rest time and shorter hospital stay than did the PLIF group ($P < 0.001$).

Table 2 Comparison of perioperative parameters between OLIF group and PLIF group.			
	OLIF group	PLIF group	P value
Operative duration, min	105.11 ± 21.64	204.52 ± 47.22	<0.001
Intraoperative hemorrhage, ml	106.84 ± 25.56	804.76 ± 423.65	<0.001
Bed rest time, d	2.89 ± 0.81	5.10 ± 1.18	<0.001
Hospital stay, d	6.94 ± 1.31	13.90 ± 1.51	<0.001
Incision length, cm	6.84 ± 1.71	14.05 ± 2.09	<0.001

Clinical Outcomes

Preoperative VAS scores for back pain and ODI were no significant differences in the OLIF and PLIF groups (6.57 ± 1.12 vs. 6.95 ± 0.86; 51.35 ± 3.34 vs. 49.67 ± 3.27%; respectively, both P>0.05). The VAS scores for back pain and the ODI of the two groups were significantly decreased postoperatively (P<0.05) (Table 3, Fig. 2). The OLIF group had lower VAS scores for back pain and the ODI than the PLIF group at 1 week and 3 months postoperatively (P < 0.05), No significant differences in VAS scores and the ODI were found at the 12 months postoperatively between the 2 groups.

Table 3 Comparison of clinical outcomes between OLIF group and PLIF group			
	OLIF group	PLIF group	P value
VAS for back pain			
Pre	6.57 ± 1.12	6.95 ± 0.86	0.243
7 d Post	2.63 ± 0.90	3.33 ± 1.02	0.027
3 mo Post	1.58 ± 0.61	2.38 ± 0.74	0.001
12 mo Post	1.21 ± 0.42	1.48 ± 0.60	0.117
ODI,%			
Pre	51.35 ± 3.34	49.67 ± 3.27	0.116
7 d Post	22.27 ± 3.57	32.34 ± 3.32	<0.001
3 mo Post	16.31 ± 1.59	20.77 ± 4.13	<0.001
12 mo Post	14.45 ± 1.78	14.02 ± 1.66	0.294

Radiological Outcomes

Concerning radiographic parameters (Table 4, Fig. 3, Fig. 4,Fig. 5), no significant differences in PT, SS, SVA, CVA, LL, Cobb angle and DH between the two groups were seen preoperatively (P > 0.05). The DH, LL, and SS were significantly increased after surgery for both groups ($P < 0.05$). The OLIF showed higher DH and greater LL than the PLIF group at all time points after surgery ($P < 0.05$), While no significant differences in SS were found between the two groups at any follow-up time point. Postoperative SVA, CVA, PT and Cobb angle between the two groups were decreased, which compared with the preoperative ($P < 0.05$). No significant differences in SVA, CVA, PT were found between the two groups at any follow-up time point($P < 0.05$). While the OLIF group showed smaller Cobb angle than the PLIF group at all time points preoperatively ($P < 0.05$).

Table 4 Comparison of radiologic parameters between OLIF group and PLIF group.			
	OLIF group	PLIF group	P value
PT,°			
Preoperative	27.44 ± 5.18	27.99 ± 6.28	0.766
Postoperative	20.80 ± 2.94	19.75 ± 3.11	0.285
Final follow up	20.93 ± 3.59	19.94 ± 3.63	0.396
SS,°			
Preoperative	25.27 ± 4.95	25.17 ± 4.66	0.947
Postoperative	37.54 ± 6.70	38.94 ± 6.24	0.496
Final follow up	36.98 ± 7.92	38.76 ± 6.29	0.434
SVA,mm			
Preoperative	53.86 ± 18.27	54.70 ± 12.27	0.864
Postoperative	26.36 ± 4.16	24.97 ± 3.80	0.277
Final follow up	26.69 ± 4.53	25.48 ± 3.28	0.335
CVA,mm			
Preoperative	30.58 ± 4.14	28.70 ± 5.12	0.212
Postoperative	13.56 ± 2.65	13.01 ± 1.82	0.440
Final follow up	12.56 ± 2.10	12.20 ± 1.97	0.577
LL,°			
Preoperative	33.83 ± 4.73	34.66 ± 5.03	0.597
Postoperative	43.59 ± 4.50	40.58 ± 4.28	0.036
Final follow up	43.36 ± 3.79	40.67 ± 3.91	0.034
Cobb,°			
Preoperative	28.28 ± 3.34	27.16 ± 3.89	0.78
Postoperative	6.48 ± 0.70	7.14 ± 1.15	0.036
Final follow up	6.38 ± 1.02	7.04 ± 0.95	0.041
DH,mm			
Preoperative	7.91 ± 0.87	8.11 ± 0.88	0.260
Postoperative	13.26 ± 1.24	12.23 ± 0.67	0.001

Table 4 Comparison of radiologic parameters between OLIF group and PLIF group.			
Final follow up	12.92 ± 0.95	11.71 ± 0.75	<0.001

Overall Complication Rates

In the OLIF group, there were one patient presented with ipsilateral transient weakness in hip flexion. two patient had incision pain and relieved after a week, 1 patient underwent a 6-month postoperative X-ray examination and found that one cage at L1-2 was transversely shifted to the left by 6.89 mm, and 1 patient was found that one cage was sinked. But there was no clinical symptoms. The cage was no further displacement/subsidence at last follow-up. In the PLIF group, the volume of intraoperative hemorrhage was beyond 2000 ml in two patients, two patients suffered from cerebrospinal fluid leakage and relieved after one week. One patient occurred hematoma of the wound after removing the drainage tube and the hematoma was gradually absorbed after symptomatic treatment. Two patients suffered from incision infection and improved after anti-infection treatment. Transient muscle strength decreased in 2 cases. One patient had heart failure. The overall complication rate was higher in the PLIF group(47.62%)than in the OLIF group(26.32%)without significant difference(x^2 = 1.931, P = 0.165). But the incidence of major complications in the PLIF group was significantly higher than that in the OLIF group (Fisher, P = 0.026).

Discussion

Adult degenerative lumbar scoliosis is a 3-dimensional deformity defined as a coronal Cobb angle of greater than 10 °. The reported incidence of scoliosis in adulthood has varied from 1.5–29.4%[7–10]. At present, the pathogenesis of degenerative lumbar scoliosis is not clear. Decreased bone density was previously associated with the etiopathogenesis of degenerative scoliosis[11]. The pathophysiology of degenerative scoliosis involves the asymmetric degeneration of the intervertebral disks and the facet joints at different levels, leading to unequal loading of the spinal column[12, 13]. At a biological level, osteophytes are formed at the facet joint and vertebral endplates, further narrowing the spinal canal[14], and instability of the spinal column ensues secondary to the destruction of the facet joints and intervertebral disks[15]. The spinal curvature seen in degenerative scoliosis tends to progress at a rate of 1° to 6° per year, with an average increase of 3° per year[16]. Clinical manifestations of DLS include low back pain, neurogenic claudication and radiological pain of lower limbs. Radioleptic pain and neurogenic claudication of the lower limbs may result from the nerve root tension on the convex side or nerve root compression on the concave side. At present, the surgical methods for the treatment of DLS[17] include decompression alone; decompression and posterior spinal fusion with instrumentation; decompression, anterior spinal fusion, and posterior spinal fusion with instrumentation; fusion and instrumentation to the sacrum and pelvis. The methods of minimally invasive surgery include Mis-T/PLIF, X/DLIF, and OLIF. At present, there is a great controversy over whether to choose traditional open surgery or minimally invasive surgery. For different patients, especially elderly patients with internal medical diseases, the risk of surgery is high, which makes it difficult for clinicians to choose between the minimum trauma and the best clinical effect, so the operation method should vary with each individual[18]. The selection of fixed segments is also controversial. However, the general principle of treatment is to achieve a balance of the sagittal and coronal positions of the spine, maintain the vertebral sequence, and reconstruct the lumbar lordosis.

In this study, OLIF technique and PILF technique were used to treat DLS. We find that the OLIF group had less intraoperative blood loss and shorter operative time, bed rest duration, and hospital stay than the PLIF group. The OLIF group had shorter incision length (6.84 ± 1.71 cm) than the PLIF group(14.05 ± 2.09 cm). The average bed rest duration in the OLIF group (2.89 ± 0.81 d) was shorter in PLIF group (5.10 ± 1.18 d). The VAS score for back pain and ODI in the OLIF group were significantly improved than that in the PLIF group at 7 days and 3 months after surgery. All this was reasonable because that in OLIF, the paravertebral muscles were not dissected, and the facet joints, interspinous and superior spinous ligments were not removed.

In terms of radiographic outcomes, the Lumbar scoliosis Cobb Angle, SVA, CVA, LL, PT, SS, and DH for both groups shows significant improvement from preoperative($P<0.05$). The OLIF group achieved the balance of bilateral paravertebral muscle strength and reconstructed the intervertebral stable system by implanting larger and wider fusion devices, while the PLIF group was improved by pedicle fixation system. The OLIF group showed higher DH and greater LL than the PLIF group postoperatively. This is reasonable because we inserted a relatively larger and wider cage into the target disc in OLIF. The larger and wider cage has a 4°-8° lumbar lordosis itself, which makes higher DH and greater LL than the PLIF group. The Cobb angle was more decreased than the PLIF group at any time points after surgy. This is reasonable because the large implanted fusion device can reach the cortical area of the contralateral annulus fibrosus, which makes the upper and lower margins of the adjacent vertebral segments of scoliosis restore to be parallel.

We found that one cage was transverse shifting to the left in 1 patient who underwent a 6-month postoperative examination. Another patient was found one cage subsidence, we considered that it was due to suffer from osteoporosis postoperatively or injury the endplate during the surgery. But there was no clinical symptoms in the two patients, we recommend wearing a waist support and regular follow-up. The cage was no further displacement/subsidence at last follow-up. All the surgical segments were merged at the last follow-up. To avoid the subsidence and displacement of the fusion cage after OLIF, it is recommended preoperatively to evaluate for osteoporosis, which may cause subsidence and displacement of the cage and supply postoperative calcium for patients with osteoporosis. It is also recommended to avoid to excessively deal with the endplate during the operation, and strictly wear a waist support for 3 months after the operation to prohibit lumbar rotation and strenuous exercise. At the last follow-up, the OLIF group had normal lumbar mobility, while the PLIF group had 8 cases of lumbar stiffness, which may be related to the formation of pseudarthrosis and fixation of the lower end to S1. In this study, the follow-up time was short, and no adjacent segment degenerative disease was found. Shinya Okuda[19] studied 1000 cases with PLIF and found that the overall ASD rate was 9.0%, and the average ASD period was 4.7 years after primary surgery, as for ASD by fusion length, age, and preoperative pathologies, ASD incidence was increased by fusion length, while the time period to ASD was significantly shorter in elderly patients and those with degenerative lumbar scoliosis. Kyu-Jung Cho[20] reported that the fusion level at L1 or L2 showed the highest incidence of the proximal adjacent segment, whereas fusion to T10 or above showed the least incidence of it. Suk et al.[21, 20] advocated that fusion to T10 or more cephalad might be beneficial for preventing adjacent segment disease. But fusion to T11 or T12 was found to be acceptable as upper vertebra for adult degenerative scoliosis since there was no significant difference in the rate of the proximal adjacent segment between fusion to T10 and fusion to T11 or T12. Bridwell KH[22] reported that decompensation in the coronal and sagittal planes, in large curves, often requires a fusion to the sacrum. Islam[23] found that a marked decrease in pseudoarthrosis rate on extensions of fusions to the sacrum when a combination of anterior fusion at L5–S1, S1 screws and iliac fixation was used. With an average follow-up of 41 months, the pseudoarthrosis rate with S1 screws only was reported to be 53%, whereas the rate for iliac fixation only and S1 screws plus iliac fixation were 42% and 21%, respectively.

Limitations

Of course, there are several limitations in this study. Firstly, this is a retrospective, small-sized study. Secondly, the follow-up period of cases is slightly short. It needs to make further follow-up to compare and analyse the long-term efficacy of both surgical methods.

Conclusions

OLIF is effective, safe and alternative for the treatment of DLS and is superior to PLIF in terms of perioperative parameters, short-term clinical outcomes, and DH, Cobb angle, LL restoration. It has a similar improvement rate of radiologic parameters in SVA, CVA, PT, and SS as compared to PLIF. The early efficacy is worthy of recognition, and the long-term efficacy needs further follow-up.

Abbreviations

OLIF = Oblique lumbar interbody fusion, DLS = degenerative lumbar scoliosis, VAS = visual Analog Scale, ODI = oswestry Disability Index,SVA = sagittal vertical axis, CVA = coronal vertical axis, Cobb = Lumbar coronal Cobb angle, LL = lumbar lordosis, PT = pelvic tilt, SS = sacral slope, DH = Disc height.

Declarations

Author contributions

All author contributed to the study conception and desin. Conception and desin: CX, YH. Acquisitim of date: LY, GZ, ZR, YC, CP, PZ, JZ, SC. Methodology: LY, GZ, ZR. Analysis and interpretation of date: CX, YH. Original draft: CX. Review and editing: YH. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Competing interests：The authors declare that they have no competing interests.

Funding：There was no funding in this study.

Acknowledgements: Not applicable.

Conflicts of Interest : None of the authors has any potential conflicts of interest.

Availability of data and materials ：Data requests are available from the corresponding author.

Compliance with ethical standards: Informed consent was obtained from all patients.

Ethics approval and consent to participate: The study was approved by the Ethics Committee of the First Affiliated Hospital of Zhengzhou University, and informed consent was obtained from all individual participants that were included in this study.

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Figures

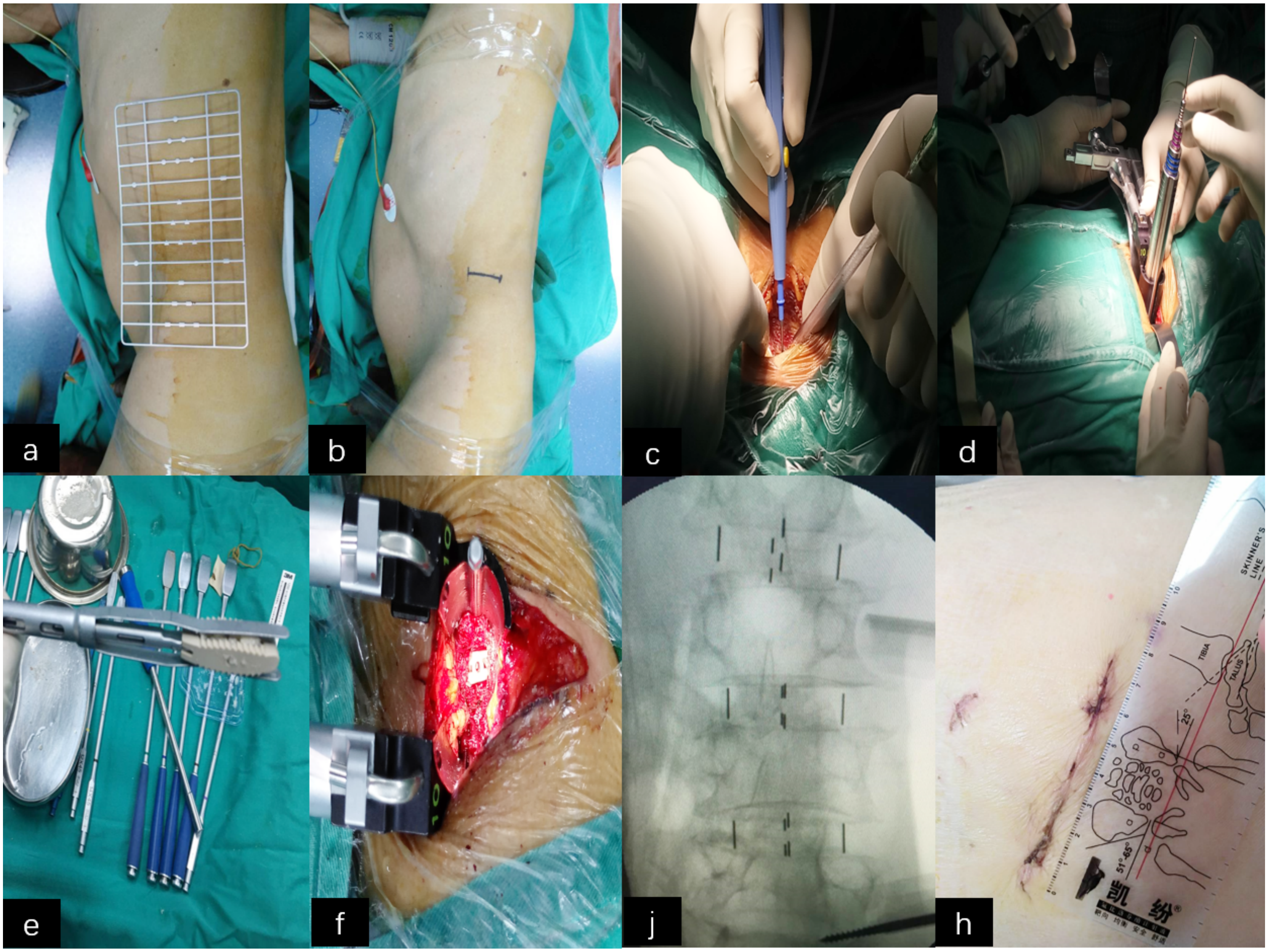

Figure 2

a,b Preoperative positioning. c Excision of the external oblique abdominal muscle, oblique internus abdominis, and transverse abdominis muscle to reveal the extraperitoneal tissue. d Place a step-by-step expansion work channel. e,f Implanting the cage after the test model. j Intraoperative C-arm irradiation and the cage position and orthopedic satisfaction. h Postoperative measurement of the incision length was about 8cm.

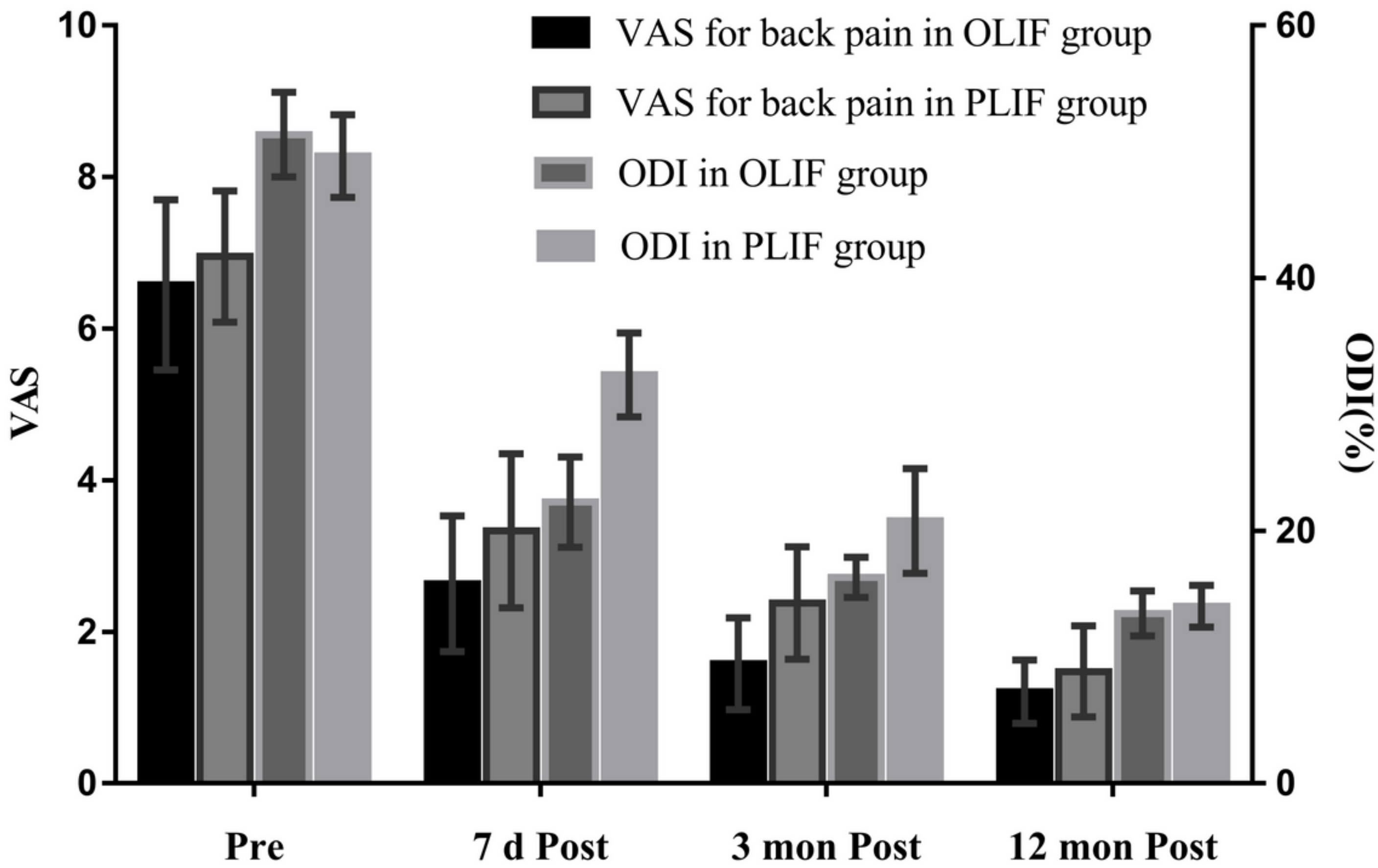

Figure 4

Clinical outcome parameters in the two groups

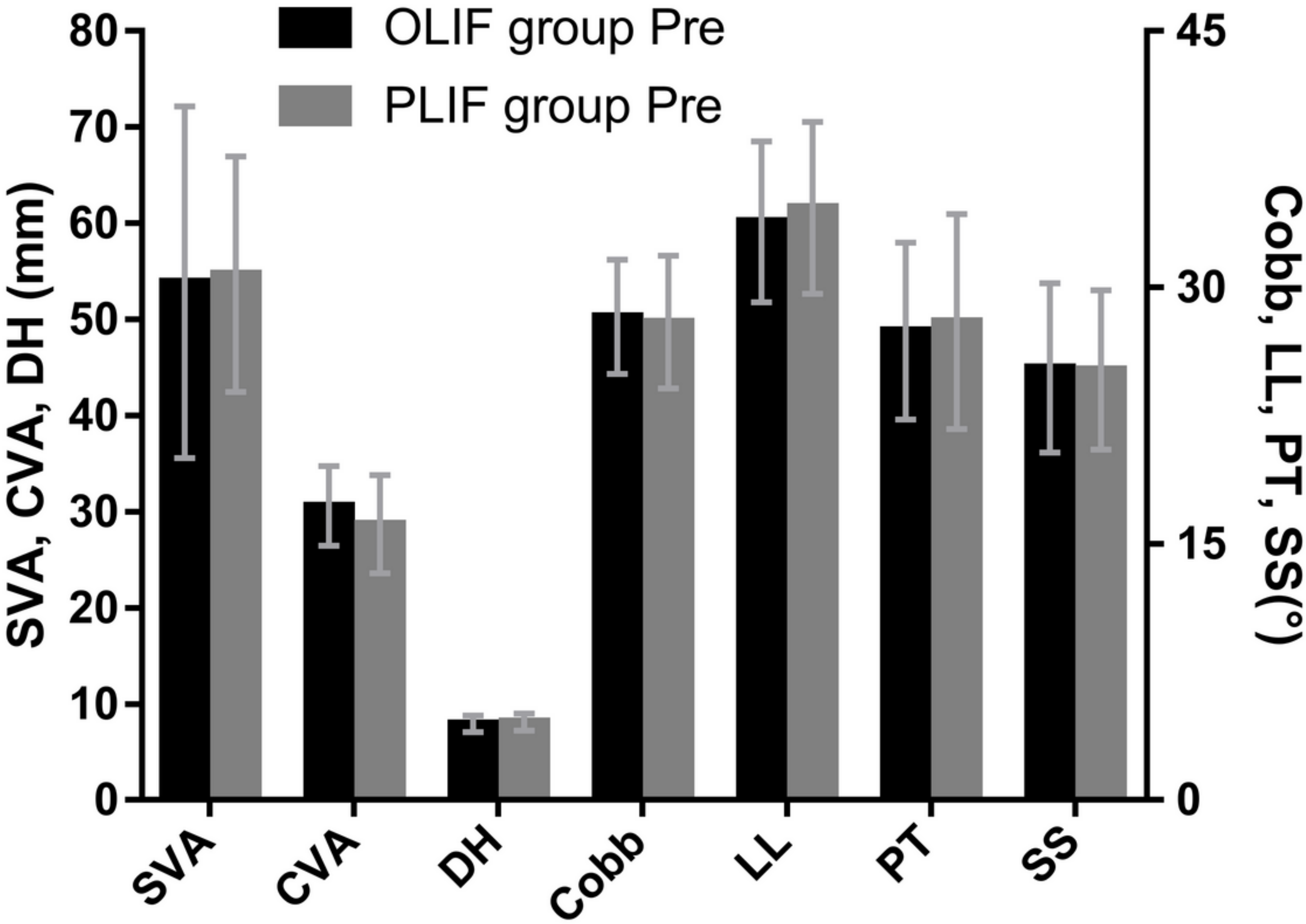

Figure 6

The preoperative radiologic parameters between OLIF group and PLIF group

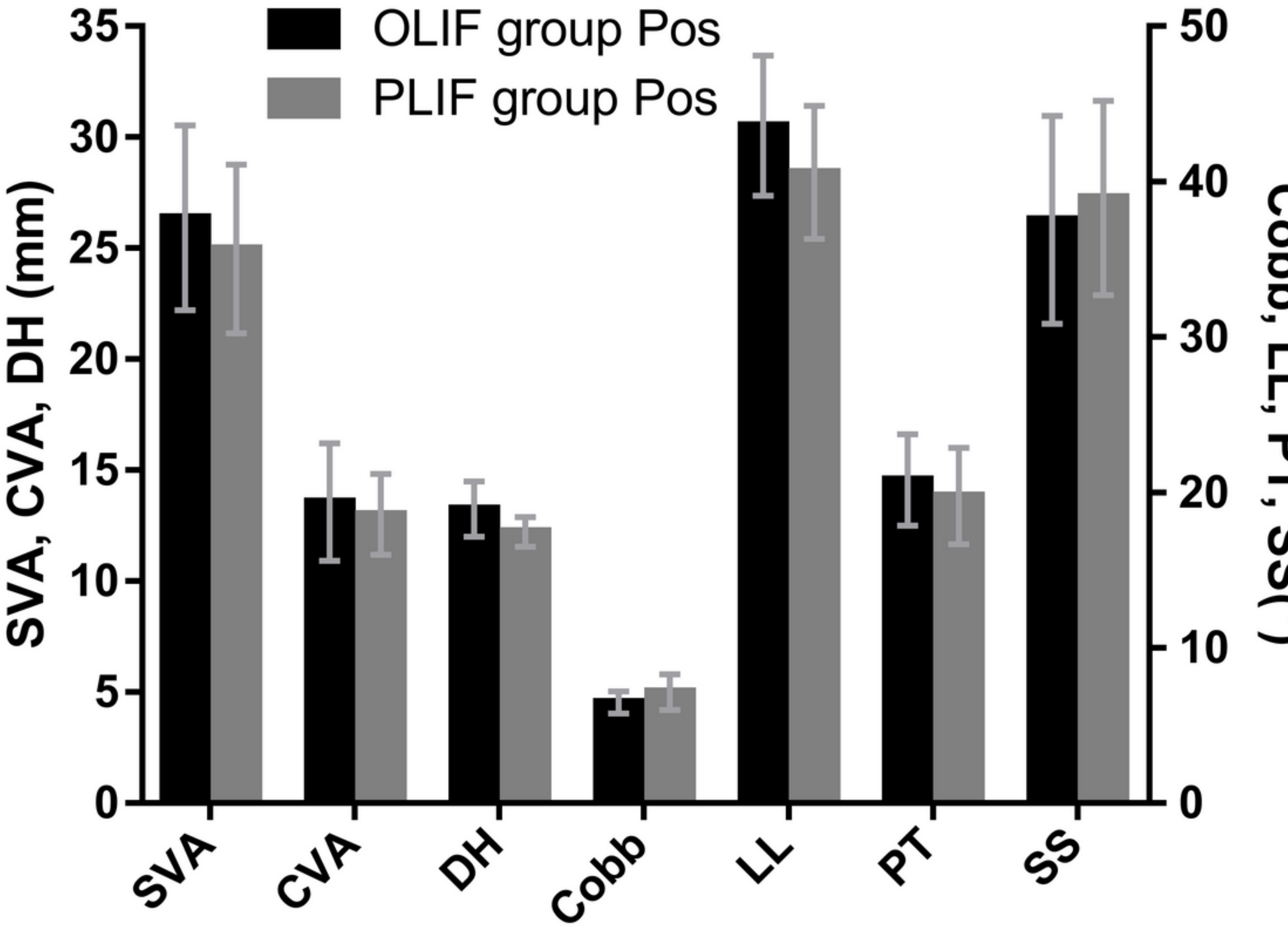

Figure 8

The postoperative radiologic parameters between OLIF group and PLIF group

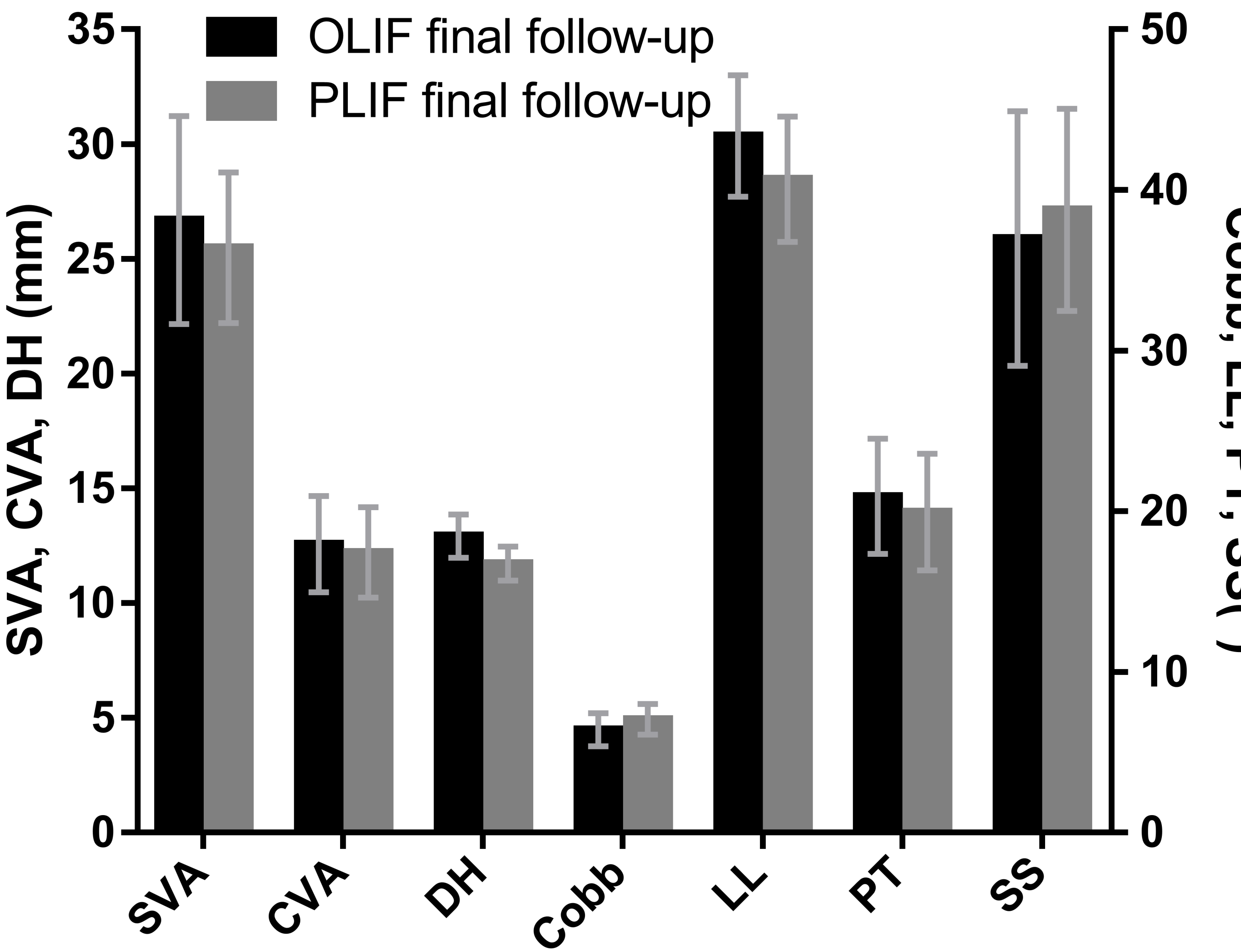

Figure 10

The final follow-up radiologic parameters between OLIF group and PLIF group

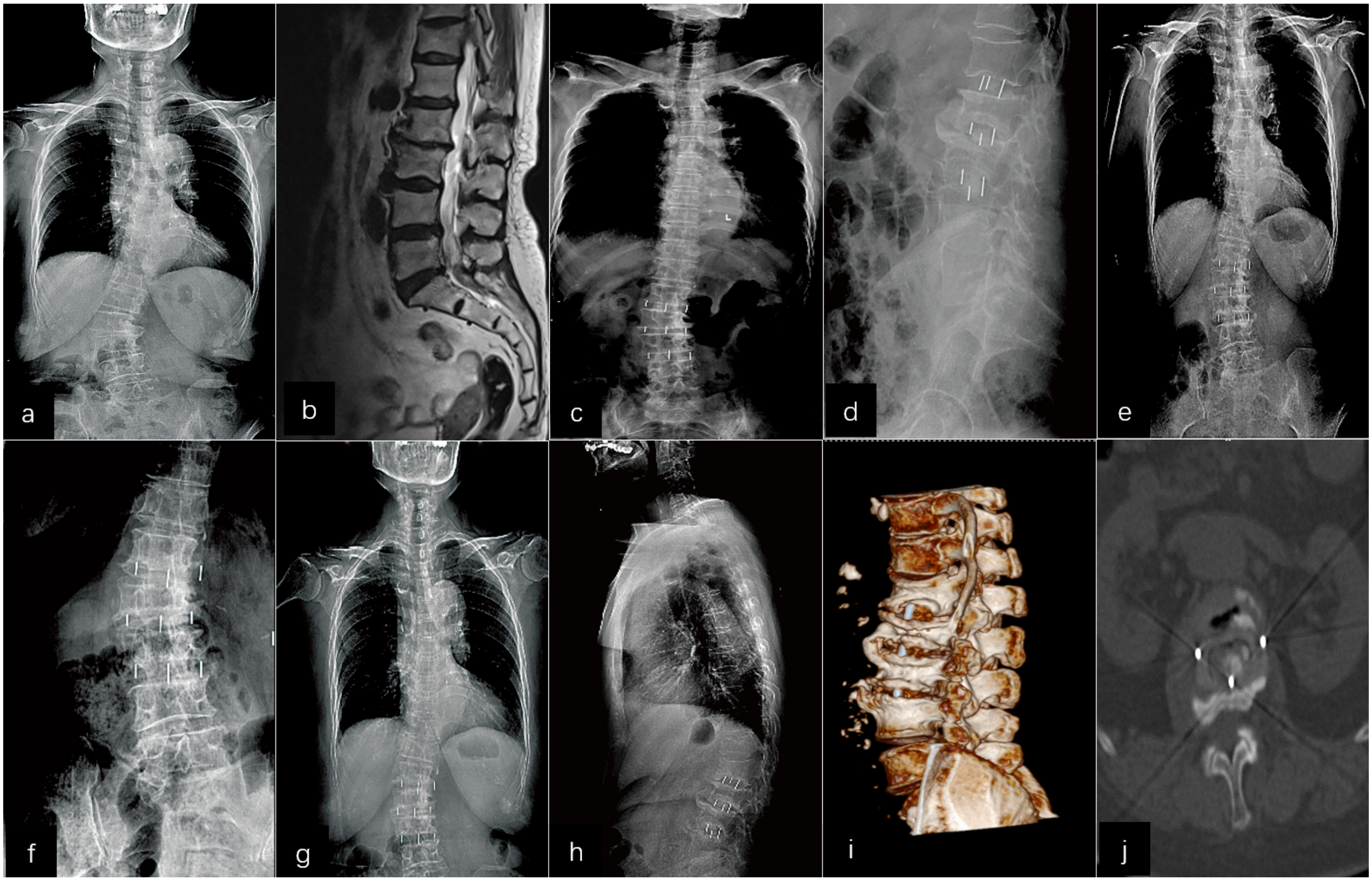

Figure 11

A 67-year-old female patient with low back pain for 5 years with radiational pain in the right lower extremity, increased for half a year. a The preoperative spinal full-length positive radiograph The Cobb angle was 35.36°; b. The preoperative lumbar MRI; c,d The Full-length positive position of the spine and lumbar lateral radiographs 3 months after the operation; e,f At 6 months after the operation, the L1/2 interbody cage was displaced to the left by 6.89 mm, but no clinical symptoms. It was recommended to wear the lumbar support and review it after 3 months. Last follow-up g,h. The cage was not further shifting, the Cobb angle was 7.70°. X-ray correlation indicators of the lumbar spine at the last follow-up after surgery were improved compared with the preoperative; i,j The intervertebral fusion can be seen in the surgical segments.

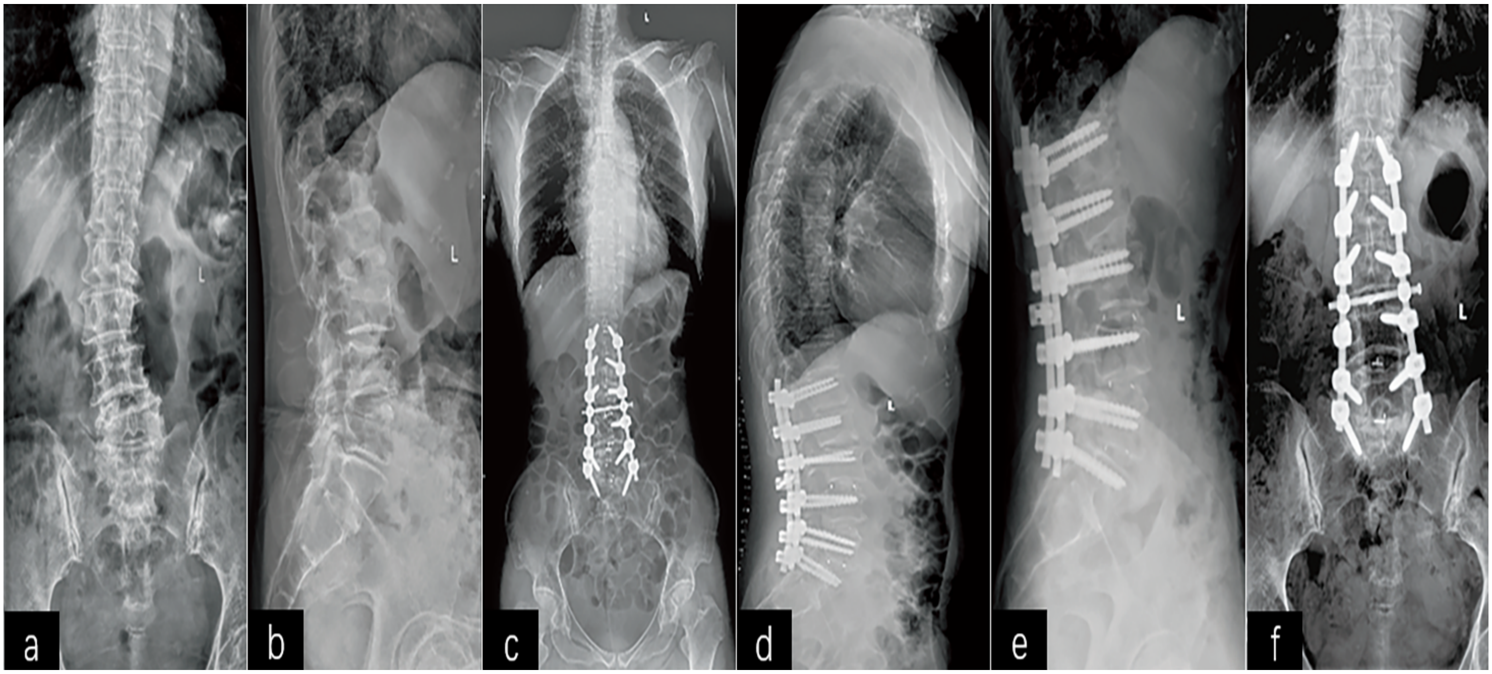

Figure 14

Preoperative images of a 72-year-old female patient who suffered from degenerative lumbar scoliosis. Anteroposterior and lateral radiographs(a,b)showed the Cobb angle was 21.64° c,d The anteroposterior and lateral radiographs of 1week postoperative. e,f The last follow-up anteroposterior and lateral radiographs.