

Original Article

THE OUTCOME OF SPARING S1 ARTHRODESIS IN THE MANAGEMENT OF  
LUMBOSACRAL DEGENERATIVE DISEASES

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Received 10/5/2024

Accepted 13/8/2024

Abstract

**Background:** In patients with a completely healthy disc at L5-S1 disc or minimal degenerated disc and planned for short segment fixation with one or two levels above the sacrum, sparing S1 arthrodesis will not carry a high risk of adjacent segment or the need for another surgery with an extension of the fixation to the S1. In comparison to long segment fixation especially in elderly patients the fusion should extend to involve the sacrum from the start due to the high possibility of adjacent segments disease. Through the last three decades, the decision to take S1 in the fixation segment versus stopping at L5 in the management of lumbar degenerative spine diseases has still been debated. **Aim of the study:** The purpose of this study was to evaluate the clinical outcome of the S1 sparing arthrodesis in the management of lumbar spine degenerative disease with above-level short- segment fusion procedures. **Patients and methods:** Under a complete ethical committee (family education and consent) twenty-six patients with degenerative lumbosacral spine diseases were introduced to our Neurospine unit in Sohag University Hospital Department of Neurosurgery from January 2020 to January 2024. All patients underwent preoperative evaluation with complete neurological examination, lumbosacral dynamic X-ray, lumbosacral MRI spine, and CT lumbosacral spine if needed. Oswestry disability index (also known as Oswestry Low Back Pain Disability Questionnaire) and Visual analogue pain scale (VAS) were used in this study for all patients to evaluate the post-operative outcome. **Results:** Twenty-six patients were operated with degenerative lumbosacral spine diseases with a predominance of male ratio. Our patient's ages ranged from 33–67 years with a mean of  $58.36 \pm 5.96$  years. In our study, the L4-5 grade II spondylolisthesis was more predominant accounting for 8 cases. Mild degenerative L5-S1 disc was found in 12 cases however, the remaining 14 cases were normal L5-S1 disc. Back pain was the main complaint for all our patients and we use the Oswestry Back Pain Disability Scale and VAS for pre- and postoperative assessment. Sciatic pain presented in 20 cases, and only 3 cases presented with partial foot drop. **Conclusion:** Sparing the extension of the fixation to the sacrum in the management of lumbosacral degenerative diseases especially in those with mild or near normal L5-S1 disc will preserve the biomechanics of the lumbosacral junction with low incidence of pseudoarthrosis and sacroiliac joint degenerative changes.

**Keywords:** Arthrodesis, Lumbosacral, S1.

1. Introduction

Through the last three decades, the decision to take S1 in the fixation segment versus stopping at L5 in the management of lumbar degenerative spine diseases has still been debated. Extension of the fixation segment as prophylactic in near-normal anatomy of the lumbosacral junction to

avoid the need for re-surgery with distal segment extension has been controversial [1-3]. Taking the L5 as an end of the fusion procedures provides L5-S1 motion segment preservation with the advantages of low-risk pseudoarthrosis, decreased time of surgery and low tissue damage. In con-

trast, taking the S1 in the fusion procedures makes the surgery more extensive with a high risk of pseudoarthrosis. S1 fixation should be considered in cases with preoperative marked L5-S1 disc prolapse with canal stenosis or having preoperative L5-S1 spondylolisthesis [1,4]. In patients with a completely healthy disc at L5-S1 disc or minimal degenerated disc and planned for short segment fixation with one or two levels above the sacrum, sparing S1 arthrodesis will not carry a high risk of adjacent segment or the need for another surgery with the extension of the fixation to the S1. In comparison to long segment fixation especially in elderly patients the fusion should extend to involve the sacrum from the start due to the high possibility of adjacent segments disease [5]. The purpose of this study was to evaluate the clinical outcome of the S1 sparing arthrodesis in the management of lumbar spine degenerative disease with above-level short-segment fusion procedures.

## 2. Patients and Methods

Under the complete ethical committee (family education and consent) twenty-six patients with degenerative lumbosacral spine diseases were introduced to our Neurospine unit in Sohag University Hospital Department of Neurosurgery from Jan. 2020 to Jan. 2024 with inclusion criteria:

- 1) Age less than 70 y.
- 2) Average body build not overweight not more than 100 kg.
- 3) Vital stable patients with no serious cardiothoracic or abdominal injuries.

We excluded patients with instability in the lumbosacral segment, severe degenerative L5-S1, severe osteoporosis (osteopenia) and those with degenerative deformity (scoliosis) All patients underwent preoperative evaluation with complete neurological examination, lumbosacral dynamic X-ray, lumbosacral MRI spine, and CT lumbosacral spine if needed. Oswestry disability index (also known as Oswestry Low Back Pain Disability Questionnaire) and Visual

analogue pain scale (VAS) were used in this study for all patients to evaluate the post-operative outcome. All patients were assessed postoperative, 6 months, and 12 months later clinically and radiologically.

### 2.1. Surgical technique

Under general anesthesia with a prone position, we use either the pillows or the frame to have a prone position with a lax abdomen to save the paravertebral congestion intraoperative. Then preoperative mark using the intraoperative C-arm to ensure the level before sterilization. Midline incision with dissection of the muscle using the Cobb and monopolar coagulation when needed. We tried to do dissection by using the Gauze and Cobb more than the diathermy to protect the muscle from its damage and hence residual back disability. Exposure to the facets laterally and the transverse process with saving the facet capsule. In our series, we used transpedicular polyaxial screws with 6.5 diameter and 45 mm length in all cases. Insertion of the screws done under the C-arm guide with Lateral views. Only in one case which was recurrent, we did laminectomy first before screw insertion due to anatomical alternation of the landmarks. After laminectomy and exposure to the nerve roots facetectomy was done for the affected level unilateral or bilateral (if the was associated bilateral fracture pars), discectomy with shivering the disc space until ensuring removal of the endplate to enhance later on fusion. Putting the rod in onside with slight distraction, using small bone chips intradiscal before choosing the ideal cage size, we used a straight cage unilateral, In 8 cases we used a titanium cage and in the remaining, we used a peak cage. Ensuring by C-arm to put the anterior end of the cage in parallel to the anterior edge of the vertebral body to preserve the lordotic curve of the lumbosacral spine, this step is followed by slight compression and then putting the rod on the contralateral side. In cases with mild degenerative L5-S1 foraminotomy is done with the removal of the interspinous ligament (horseshoe

decompression) AP view with C-arm to ensure the medial inclination of the screws should be taken, figs. (1 & 2). Using the local vancomycin powder as a local instillation antibiotic, the closure of the paravertebral sheath, subcutaneous layer and finally the skin with putting drain for 3 days.

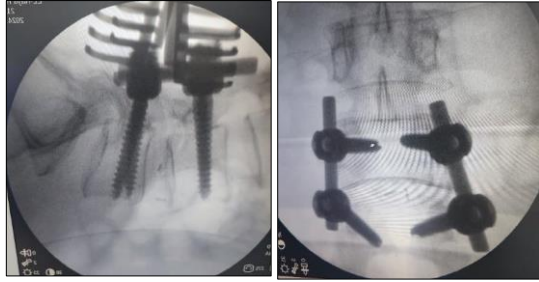


Figure (1) Intraoperative C-arm images AP and Lateral to ensure the position screws and the cage of the recurrent case

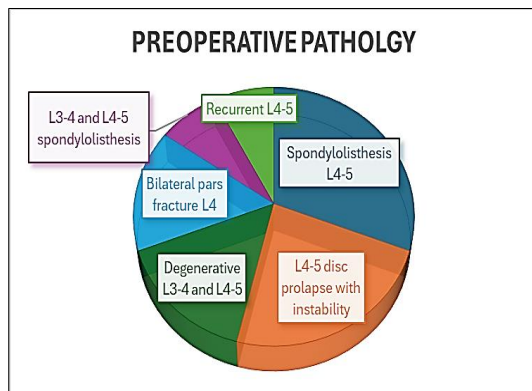


Figure (2) Preoperative distribution of the pathology among the current study cases

## 2.2. Statistical analysis

Data was analyzed using Microsoft Excel 2016 (Microsoft Corporation, USA) and SPSS version 24 (May 2016, IBM Corporation, USA). Qualitative data is presented as numbers and percentages, while quantitative data is presented as mean and standard deviation. Comparison between pre- and postoperative data regarding the

Oswestry scale and visual pain analogue scale was done using the McNemar Chi-square test and paired t-test. A p- value of less than 0.05 is considered significant.

## 3. Results

Twenty-six patients were operated with degenerative lumbosacral spine diseases with a predominance of male ratio. Our patient's ages ranged from 33-67 years with a mean of  $58.36 \pm 5.96$  years. In our study, the L4-5 grade II spondylolisthesis was more predominant accounting for 8 cases. Mild degenerative L5-S1 discs were found in 12 cases however, the remaining 14 cases were normal L5-S1 discs, tab. (1) & fig. (3). Back pain was the main complaint for all our patients and we use the Oswestry Back Pain Disability Scale and VAS for pre- and postoperative assessment. Sciatic pain was presented in 20 cases, and only 3 cases were presented with partial foot drop, tabs. (2 & 3) & and figs. (4 & 5). The postoperative evaluation showed improvement in the clinical outcome of the back pain, sciatic pain, and partial foot drop, tab. (4) & fig. (6). In three cases, an iatrogenic dural tear happened and repair was done simply. Two patients presented with postoperative CSF leak and stopped within 4 weeks after limitation of movement and medication. Superficial wound infection was noted in one case which resolved with broad-spectrum antibiotics and daily dressings. No postoperative neurological deficit has been reported in our study. Through our follow-up period, no cases of discitis or hardware failure were reported.

Table (1) Preoperative distribution of the pathology among the current study cases

Preoperative pathology	Patients (n)
<b>Spondylolisthesis L4-5</b>	8
<b>L4-5 disc prolapse with instability</b>	6
<b>Degenerative L3-4 and L4-5</b>	4
<b>Bilateral pars fracture L4</b>	4
<b>L3-4 and L4-5 spondylolisthesis</b>	2
<b>Recurrent L4-5</b>	2

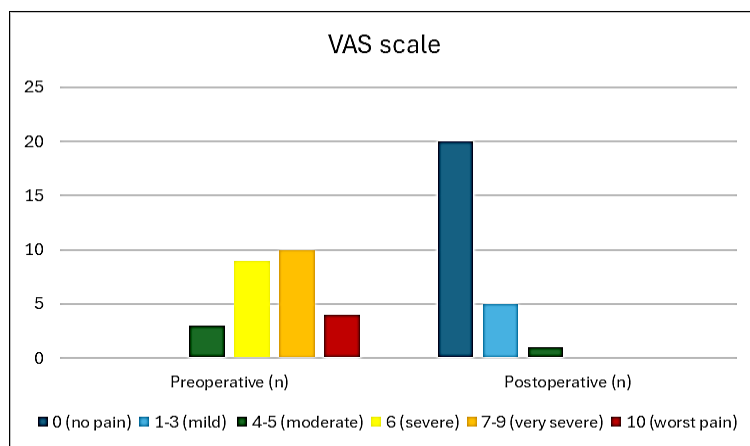


Figure (3) The preoperative and postoperative VAS scale

Table (2) The preoperative and postoperative VAS scale

VAS SCALE (visual analogue pain)	Preoperative (n)	Postoperative (n)
0 (no pain)	0	20
1-3 (mild)	0	5
4-5 (moderate)	3	1
6 (severe)	9	0
7-9 (very severe)	10	0
10 (worst pain)	4	0
Mean±SD	7.15±1.78	0.5±0.67
Significance:	Test	P value
Paired t-test	19.222	<0.001
McNemar Chi-square test	7.006	0.032

Table (3) The preoperative and postoperative ODI index

Oswestry disability index (ODI)	Preoperative (n)	Postoperative (n)
0-20 points (minimal disability)	0	26
21-40 points (moderate disability)	8	0
41-60 points (severe disability)	14	0
61-80 points (cripple, pain impinges on all aspects of patient's life))	4	0
81-100 points (patients are bed-bound exaggerating their symptoms)	4	0
Mean±SD	52.15±20.99	8.46±4.57
Significance:	Test	P value
Paired t-test	12.491	<0.001
McNemar Chi-square test	18.872	<0.001

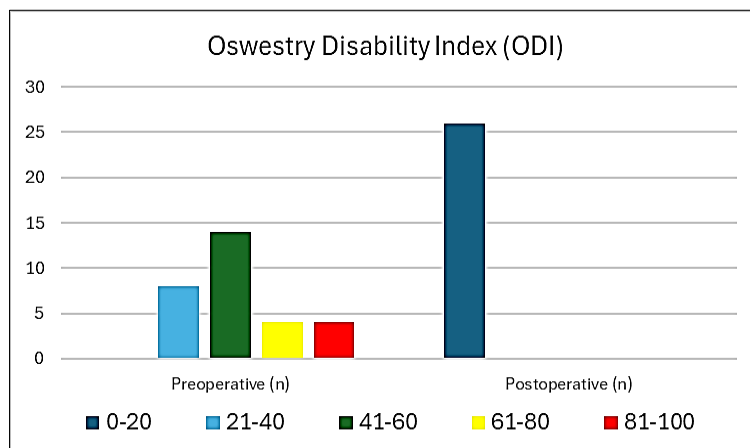


Figure (4) The preoperative and postoperative ODI index

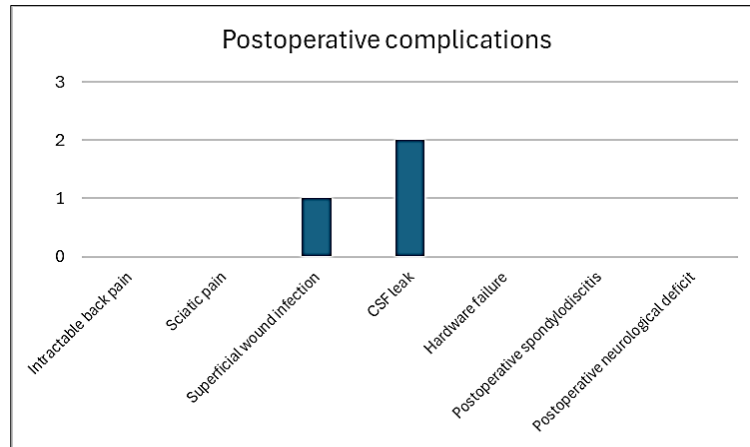


Figure (5) The postoperative complications

Table (4) The postoperative complications

Postoperative complications	Patients (n)
Intractable back pain	0
Sciatic pain	0
Superficial wound infection	1
CSF leak	2
Hardware failure	0
Postoperative spondylodiscitis	0
Postoperative neurological deficit	0



Figure (6) Lumbar X-ray (AP, Lat, and dynamic films) showing bilateral fracture of L4 with instability

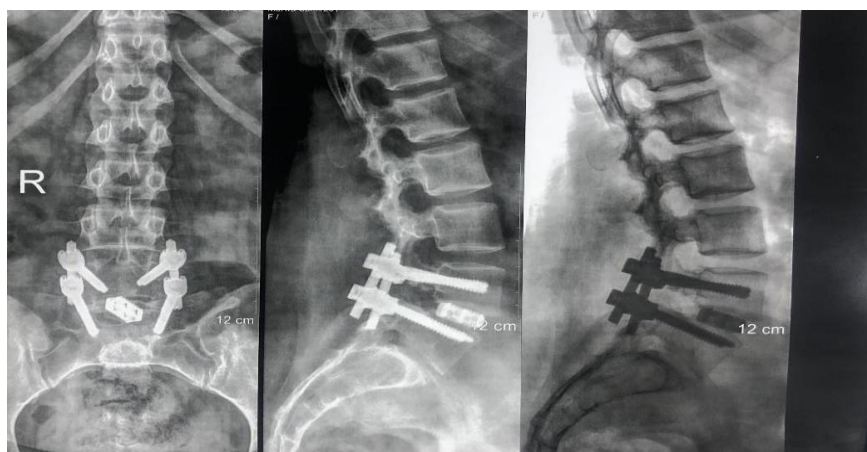


Figure (7) Follow-up X-ray showing L4-5 fixation with titanium interbody cage





Figure (8) MRI preoperative and CT postoperative of a case with L3-4 spondylolisthesis grade I and L4-5 spondylolisthesis grade II



Figure (9) Preoperative MRI and CT showing L4-5 spondylolisthesis and postoperative X-ray showing L4-5 fixation with S1 sparing

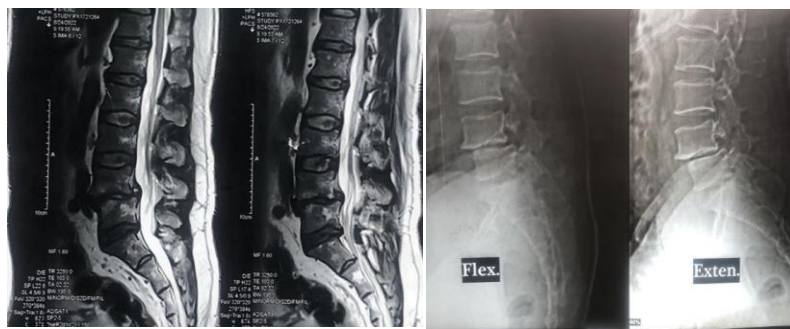


Figure (10) Preoperative MRI spine and dynamic X-ray showing L4-5 spondylolisthesis

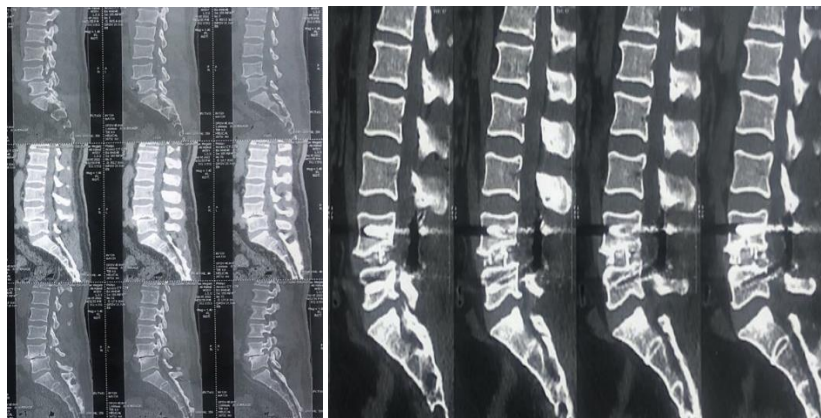


Figure (11) CT lumbosacral spine of the same patient follow-up

#### 4. Discussion

Most Elderly patients with degenerative spine disease have a high incidence of L5-S1 degenerative changes varying from minimal to advanced degenerative changes, the operative decision in these patients whether to extend the distal end of the fixation segment to the sacrum or not is still controversial, especially in patients with minimal degenerative changes in L5-S1 [4,6-8]. Extending the posterior fusion surgery to the sacrum increases the operative time with more blood loss in addition to postoperative complications like; a high incidence of pseudoarthrosis, altering the mechanics of gait, and raising the subsequent sacroiliac joint degeneration. For these complications, authors advised limiting the indication of the S1 arthrodesis to selected indicated cases: (1) instability of lumbosacral segment due to spondylolisthesis or previous surgery (2) severe L5-S1 degenerative segment (3) deformity involving down the sacrum [1,4,9]. Despite being the posterior lumbar fusion surgery is the gold surgical treatment for lumbar instability. The post-operative alternation in the spine biomechanics with the affection of the adjacent segments of the facet joints and the disc becomes a serious issue raising the possibility of ASD and hence further surgery. Furthermore, previous studies reported that with the interbody lumbar fusion the stress in the adjacent cranial segment is more than the caudal segment. Therefore, in our study, we demonstrate the value of shortening the fusion segment to avoid the progress of ASD and the adjacent segment disease [10-13]. The caudal affection after spinal fixation caused by loss of lumbar lordotic curve due to destruction of the interspinous ligament with iatrogenic injury of the superior facet is more than in comparison to the caudal segment degeneration affected by isolation of L4-5 fusion with sparing of S1 arthrodesis [14-17]. Still a matter of controversy with problematic decision-making in cases with L4-5 spondylolisthe-

sis with degenerative lumbosacral segment (L5-S1) whether to do short segment fixation or to extend the fixation to the sacrum. The concern of the negative affection of leaving degenerative L5-S1 in the clinical outcome facing on the other side that the S1 fusion does not provide better clinical outcome than S1 sparing arthrodesis. With the S1 fixation, the sacroiliac joint bilaterally should be affected with joint degeneration in addition to increasing the incidence of buttock stiffness. The sacroiliac pain in our patients was found in four cases and improved with medical treatment without the need for local injection. No cases of postoperative buttock stiffness were reported in our series [18-21]. Long-term studies conducted with the authors for more than 7 years follow-up with CT and MRI lumbosacral spine to evaluate the incidence of the adjacent segment disease in L4-5 fixation while sparing the sacrum. They found that there was no significant incidence for the adjacent segment disease in S1 sparing arthrodesis and the nature of L5-S1 preoperative whether it is normal or degenerated level not affect the incidence of adjacent segment disease (12.1% vs. 18.2% and 5.2% vs. 4.5%, respectively). In our series, we did not report adjacent segment diseases however there was pre-existing L5-S1 degeneration or not [21].



Figure (12) Pre and postoperative MRI lumbosacral showed no effect on L5-S1 disc after sparing of S1 arthrodesis with solid fusion of L4-5

In addition, Ghiselli et al. studied the effect of isolated L4-5 interbody fusion with several studies with follow-up periods between 3.9 years and 7.3 years. They found

that the percentage of radiological findings of adjacent segment disease did not exceed 10% however there is no affection for the clinical outcome and the finding only was with the radiological follow [17]. However, to ensure the incidence of the adjacent segment and its clinical presentation we should go for a long-term follow-up as the short-period follow- manifestation of the adjacent segment, especially in normal preexisting L5-S1 [12]. On the other hand, extending the surgery to the sacrum with its exposure will increase muscle destruction, timing of the surgery, and blood loss. Our studies showed average intraoperative blood loss (250-350cc) authors reported blood loss when u extend to S1 reached (600-850) with an increase in the operative time and possibility of malposition of sacral screws [9]. According to Oswestry and VAS, our study showed significant improvement in the preoperative complaints without postoperative disability from sacroiliac pain or pseudoarthrosis. The incidence of postoperative CSF leak in this study was (2 cases) 0.7%. This incidence should increase in the cases of extending fixation to the S1 due to the very thin dura with more exposure and delayed healing (reaching 9.5%). There were no cases reported of superficial wound infection with the instillation of local antibiotics and good hygiene of the wound (22).up wouldn't detect the

## 5. Conclusion

*Sparing the extension of the fixation to the sacrum in the management of lumbosacral degenerative diseases especially in those with mild or near normal L5-S1 disc will preserve the biomechanics of the lumbosacral junction with low incidence of pseudoarthrosis and sacroiliac joint degenerative changes*

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