

Pre-Existing Adjacent Level Degeneration Effect On Decision Making In Single Level Lumbar Spondylolisthesis

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ABSTRACT

Background: Spondylolisthesis is common in white people rather than black and in male rather than females due to fatigue and activities in extensions while degenerative type is more common in females due to small posterior segment that become more liable for shear force. The aim of this work is to examine the operative treatment outcome and then the need for second surgery between single level fusion (the displaced level only) and multiple level fusions for (the displaced level and the adjacent diseased level). **Patients and methods:** This cohort study is conducted at neurosurgery department, Kasr Al-aini, Cairo University on 40 patients complaining from single level spondylolisthesis to compare operative outcome between fusions of single level versus multiple level fusion. Patients are random divided into two groups; group (A): who underwent concomitant fixation of the adjacent degenerated level (6 screws). Group (B): who underwent fixation of single displaced level only (4 screws). All patients were treated operatively by posterior pedicle screw fixation either of single level or multi level. All data was analyzed to evaluate whether concomitant fusion of the adjacent level improve outcome and reduce the need for second surgery. **Results:** in group (A) 2 levels fixation the age was 6 patients (30 %) from 40 – 50 years, 12 patients (60 %) from 51 – 60 years and 2 patients (10 %) above 60 years. In group (B) single level fixation the age was 8 patients (40 %) from 40 – 50 years, 10 patients (50 %) from 51 – 60 years and 2 patients (10 %) above 60 years. In group (A) there are 5 (25 %) males and 15 (75 %) females and in group (B) there are 6 (30 %) males and 14 (70 %) females. In group (A) there are 7 patients (35 %) with isthmic type spondylolisthesis and 13 patients (65 %) degenerative type. Group (B) there are 6 patients (30 %) with isthmic type spondylolisthesis and 14 patients (70 %) degenerative type. The degeneration in adjacent segments according to pfirmann's grading system in MRI was as following: in group (A) with 2 levels fixation: there was 12 patients (60%) grade II, 6 patients (30%) grade III and 2 patients (10%) grade IV. In group (B) with single level fixation: there was 6 patients (30%) grade II, 7 patients (35%) grade III and 6 patients (30 %) grade IV while one patient (5%) was grade V. **Conclusion:** Lumbar spine fusion should be done in the best sagittal alignments, pfirmann's grading of disc degeneration is better to be evaluated for the adjacent segments pre operative in case with lumbar spondylolisthesis with adjacent segment disease which favour to include the adjacent segment in fusion if stage 3 or more was found.

Keywords: Spondylolisthesis, Pfirmann's Grading System, MRI, Lumbar Lordosis

INTRODUCTION:

Spondylolisthesis is defined as slippage of a vertebra with respect to the underlying vertebra that cause instability and nerve compression. The term spondylolisthesis is derived from the Greek language spondylo means vertebra and listhesis means to slide (1). Spondylolisthesis may be isthmic that include fracture of the pars interarticularis or degenerative without rupture of the posterior arc. Degenerative spondylolisthesis is more common in females than males and rare before 40 years. Incidence of spondylolisthesis in general population is 6 % and in children below 6 years is 2.6% while in adult is 5.4% (2).

The etiology of spondylolisthesis is multifactorial and there are many risk factors, the biomechanical studies have demonstrated an increase in stress in the pars interarticularis when a force is exerted on the vertebral column area when in extension, so activities that increase lordosis and maintain the column in extension such as weight lifting and kyphotic deformities increase the incidence of fracture of the pars and spondylolisthesis (3). Also, in spondylolisthesis there is abnormal sacro pelvic orientation with disturbed global sagittal balance as the column that slide also move the entire trunk, and it is unclear whether this imbalance is the primary causative risk factor for spondylolisthesis or secondary adaptive changes but is responsible for progression of the disease because the mechanical stress over lumbo-sacral region increase (4-5).

Patients with spondylolisthesis usually present with mechanical low back pain (LBP) which may or may not correlates with the severity of the slippage which increase by extension and improved by rest and should be differentiated from discogenic pain which increase by flexion and setting. With

progression of slippage the neural canal become stenotic and presents by neurogenic claudication which should be differentiated from vascular claudication (6).

Spondylolisthesis can be diagnosed by plain radiographs of the lumbar spine in erect position to evaluate type of slippage, sacroiliac balances and overall sagittal balance. Computed tomography (CT) can add a value in the diagnosis and may be helpful on detection of facet, sclerosis and pars defect. Magnetic resonance image (MRI) is of choice in evaluation of the disc on presence of radiculopathy (7).

Although the spondylolisthesis is a common presentation in clinical practice, however there is a strong therapeutic controversy about treatment, when surgical treatment is decided there are many controversy either we will do decompression alone or with Stabilization, and if with stabilization either dynamic or with fusion, to reduce the slippage or to fuse in situ and for how many segment the fusion will be done (8-9).

A common sequel of fusion is adjacent segment disease (ASD), so we have to know site and extend of fusion in order to predict and prevent the occurrence of adjacent segment disease (10-11).

The aim of this work is to examine the operative treatment outcome and then the need for second surgery between single level fusion (the displaced level only) and multiple level fusions for (the displaced level and the adjacent diseased level).

PATIENTS and METHODS:

This cohort is conducted at neurosurgery department, Kasr Al-aini, cairo university on 40 patient complaining from single level spondylolisthesis to compare operative outcome between fusion of single level versus multiple level fusion.

Inclusion criteria:

Patients with single level lumbar spondylolisthesis (Degenerative or isthmic) with concomitant adjacent level degeneration.

Full characteristics data were taken. Adjacent segment degeneration can be evaluated by clinical and radiological finding: (i) Radiological by the presence of disc degeneration by pfirmann's grading systems, modic changes, facet degeneration and canal stenosis. (ii) Clinically by the presence of symptoms and signs as back pain or neural deficits referable to that level.

Exclusion criteria:

Patient with previous lumbar surgery, neoplastic or pathologic spondylolisthesis, spinal deformities not due to spondylolisthesis, bone diseases affect healing and Sever co-morbidities that prevent surgery.

Patients are random divided into two groups; group (A): who underwent concomitant fixation of the adjacent degenerated level (6 screws). Group (B): who underwent fixation of single displaced level only (4 screws).

All patients were treated operatively by posterior pedicle screw fixation either of single level or multi level. Operative details was registered. All data was analyzed to evaluate whether concomitant fusion of the adjacent level improve outcome and reduce the need for second surgery.

Postoperative Outcomes:

A- Primary outcome: back pain, sensory and motor manifestations and sphincteric manifestations measured by Oswestry low back pain disability questionnaire, that measure physical pain and over whole health related quality of life.

B- Secondary outcome: need for second surgery within 1 year and complications of the surgery as motor or sensory deficits and urine retention.

Statistical analysis:

Recorded data were analyzed using the statistical package for social sciences, version 21 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Differences between mean values of experimental groups were tested with analysis of variance (ANOVA). Tukey's multiple comparison test was carried out as post hoc test of ANOVA. The results were considered statistically significant when the P value <0.05. Different stages of significance were considered P-value <0.05 was considered significant. P-value <0.001 was considered as highly significant. P-value > 0.05 was considered insignificant.

RESULTS:

The present study showed age distribution among the studied patients; in group (A) 2 levels fixation the age was 6 patients (30 %) from 40 – 50 years, 12 patients (60 %) from 51 – 60 years and 2 patients (10 %) above 60 years. In group (B) single level fixation the age was 8 patients (40 %) from 40 – 50 years, 10 patients (50 %) from 51 – 60 years and 2 patients (10 %) above 60 years (**Figure 1**). The age was distributed as following: in group (A) there are 5 (25 %) males and 15 (75 %) females and in group (B) there are 6 (30 %) males and 14 (70 %) females (**Figure 2**).

Regards type of spondylolisthesis; group (A) there are 7 patients (35 %) with isthmus type spondylolisthesis and 13 patients (65 %) degenerative type. Group (B) there are 6 patients (30 %) with isthmus type spondylolisthesis and 14 patients (70 %) degenerative type (**Figure 3**). Grade of spondylolisthesis showed 13 patients (65 %) with grade I spondylolisthesis and 7 patients (35 %) with grade II in group (A), while in group (B) showed 14 patients (70 %) with grade I spondylolisthesis and 6 patients (30 %) with grade II (**Figure 4**). Concerning Level of spondylolisthesis, in group (A) there are 9 patients (45 %) with L4-5 spondylolisthesis and 11 patients (55 %) with L5-S1. In group (B) there are 13 patients (65 %) with L4-5 spondylolisthesis and 7 patients (35 %) with L5-S1 (**Figure 5**).

In our study the degeneration in adjacent segments according to Pfirrmann's grading system in MRI was as following: in group (A) with 2 levels fixation: there was 12 patients (60%) grade II, 6 patients (30%) grade III and 2 patients (10%) grade IV. In group (B) with single level fixation: there was 6 patients (30%) grade II, 7 patients (35%) grade III and 6 patients (30 %) grade IV while one patient (5%) was grade V (**Figure 6**).

A case of 49 years old female complaining from low back pain and inability to walking for long distance. Condition started more than 6 months with low back pain of chronic onset, progressive course, dull aching in nature, increases by movement especially extension and after prolonged sleeping and partially improved by rest. The condition was associated with intermittent bilateral lower limb claudication for less than 50m not improved until setting. The patient received many medical treatments without improvement then asked to do X-ray then MRI that showed L5-S1 spondylolisthesis. On examination patient was full motor power, straight leg rising was less than 60 indicating lower roots compression with low back tenderness, patient was continent and sluggish deep tendon reflex. Surgery was done: L4-5 S1 posterio-lateral fixation by 6 trans-pedicular screws and 2 rods with decompression. Patient improved post operative as regard low back pain and right lower limb pain, surgical drain was removed at day 2 and patient was discharged at day 3 (**Figure 7**).

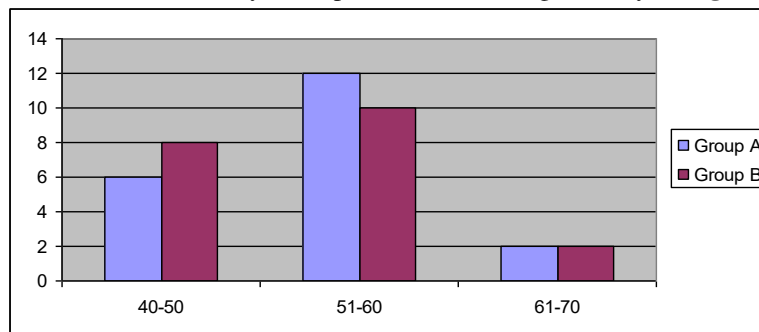


Figure (1): Age distribution between the studied patients

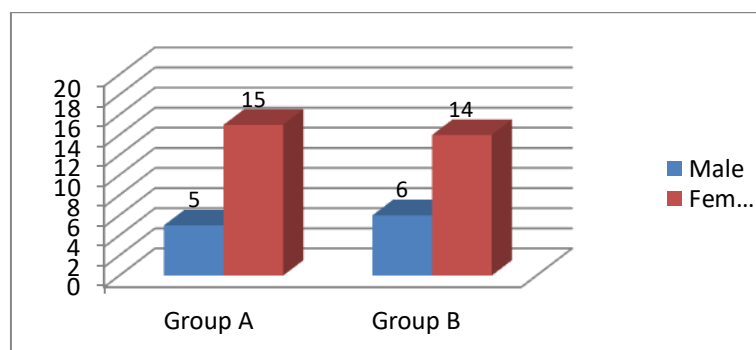


Figure (2): Sex distribution between the studied patients

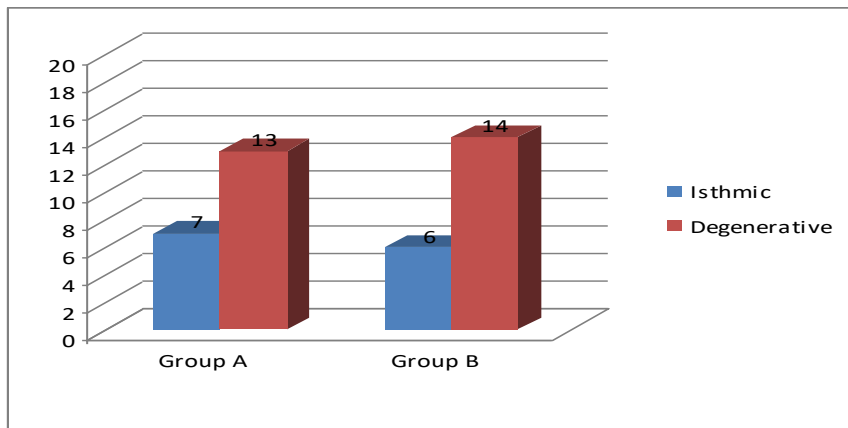


Figure (3): Types of Spondylolisthesis between the studied patients

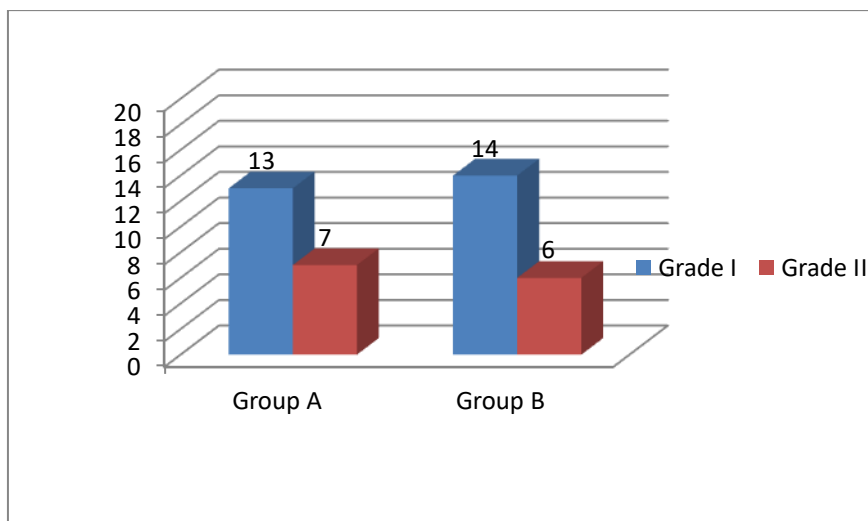


Figure (4): Grade of Spondylolisthesis between the studied patients

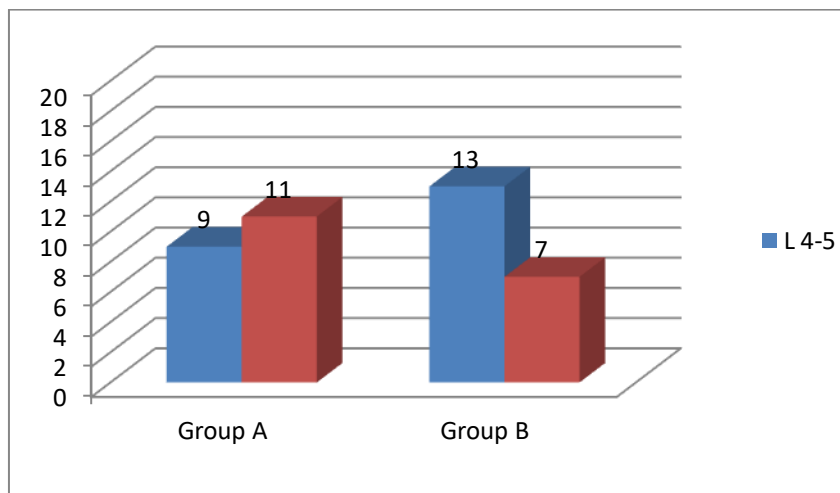


Figure (5): Level of Spondylolisthesis between the studied patients

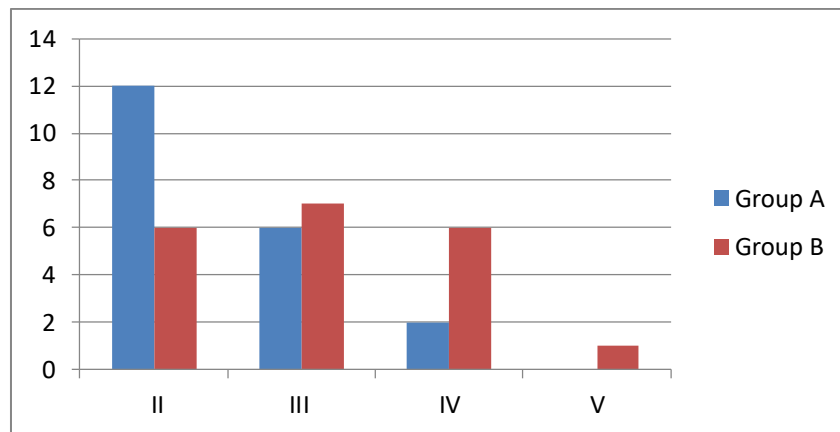


Figure (6): Pfirrmann's grading of degeneration between groups

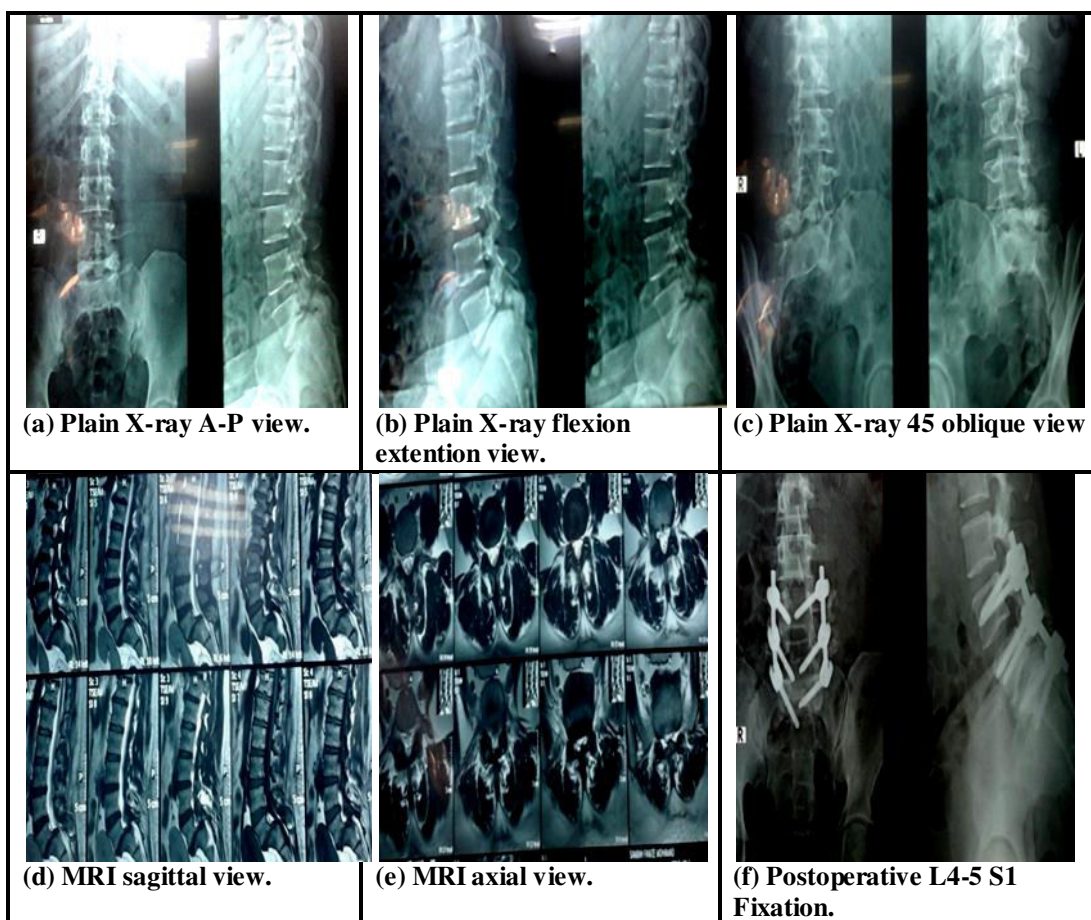


Figure (7): A case 49 years old female complaining from low back pain and inability to walking for long distance with low back pain of chronic onset, progressive course, dull aching in nature, increases by movement especially extension. **(a,b,c):-** Xray show A-P, lateral, 45 oblique, flexion and extension views shows grade I spondylolisthesis with bilateral pars interarticularis fracture of L5 (Isthmic) and decreased Lumbar lordosis. **(d,e):** MRI show L5 slippage over S1 with pseudo disc. Adjacent level (L4-5) shows degeneration in the form of black disc, loss of annulus-nucleus differentiation and low disc space **(f):** Post operative L4-5 S1 Fixation by 6 trans-pedicular screws and 2 rods with decompression and patient improved all signs post operatively.

Discussion:

Fusion with instrumentation and decompression became a standard in operative management of spondylolisthesis especially in presence of deformity as instrumental fusion provides immediate stabilization, prevent mobility that enhance the fusion and correct the deformity to restore the normal parameters (12). The functional benefits from inter-body fusion with postero-lateral instrumentation

remain controversial, guideline in 2014 document certain indication for inter-body fusion as: the presence of modic type I discopathy, presence of hyper mobility and helping in restoration of local lordosis (13).

Fusion may be unilateral or bilateral. Luo et al in a meta-analysis found no significant statistical differences between bilateral and unilateral pedicle screw fixation with regard to clinical outcome, fusion rate and complications with less operative time, blood loss and risk of adjacent segment disease (14).

In our study all patient were operated upon by bilateral postero-lateral instrumentation, 20 patients were operated upon by fusion of the single displaced level and 20 patients were operated upon by fusion of the displaced level and the adjacent degenerated level. This study aimed is to examine the operative treatment outcome and then the need for second surgery between single and multiple level fusion.

In our study the majority of cases was with degenerative type spondylolisthesis 65% in group (A) and 70% in (B) the majority of cases were females 75% in group (A) and 70% in (B), that may be due to increased incidence of osteoporosis and obesity in females more than males that may increase the incidence of degenerative type spondylolisthesis in females.

Our study are in agreement with a several studies; **Jack et al. (15)** reported a retrospective review of patients undergoing lumbar spine fusion for traumatic instability compared to those undergoing lumbar spine fusions for degenerative disease, allowing for at least a five-year follow-up period found a higher rate of re-operative adjacent segment pathology in a spondylotic group of patients undergoing elective lumbar spine fusion compared to a traumatic group undergoing fusion for mechanical instability that prove that, adjacent segment disease is related more to patient tendency for developing degenerative change than altered biomechanical forces post-fusion.

Kim et al.,(16) studied a 10-years follow-up of posterolateral fusion for lumbar spinal stenosis and/or Grade 1 spondylolisthesis, found that unilateral pedicle screw instrumentation showed a lower rate of radiologic ASD, especially in second cephalad adjacent segment, and a better clinical outcome by ODI.

Also, **Masevnin et al.,(17)** evaluated 146patients who underwent one level fusion divided into 2 groups according to presence and degree of adjacent segment degeneration by modified pfirman's system. He found Symptomatic adjacent segment pathology was more frequent in group with pre-existing degeneration more than grade 3 by modified pfirman's system.

Smorgick et al.,(18) performed a sub analysis study on 207 patients to compare surgical outcomes and complications of multi level decompression and single level fusion to multi level decompression and multi level fusion for patients with multilevel lumbar stenosis and single level degenerative spondylolisthesis, patients were divided into two groups, 130 had multilevel decompression with one level fusion and 77 patients had multi level decompression and multi-level fusion with similar outcomes in both groups.

Moreover, **Kumar et al., (19)** performed a study including 83 patients analyzing the relationship between lumbar sagittal imbalance and the development of adjacent segment degeneration. 31 patients (38%) developed adjacent level degeneration above the fused level over 5.2 years of these patients 14 (45%) required a second surgical intervention. The lowest incidence of adjacent segment degeneration was in patients with corrected lumbar lordosis and global sagittal balance 8% compared with those of sagittal imbalance 50%.

Our study was matches with **Akamuru et al.,(20)** study that studied the effect on adjacent segment after lumbar spine fusion in different position (in situ, hypolordotic and hyperlordotic) concluded that fusion in hypolordosis had the worst effect on adjacent segment because of the compensatory hyper mobility and strain on posterior segment that when exceeded the normal maximum range causes adjacent segment disease.

So, we can extend the fixation to include the adjacent degenerated levels, and the extent of the fusion aims to elimination of the adjacent degenerated disc that cause painful disc disease, and to achieve the best sagittal alignment with restoration of lumbar lordosis and global balance that seems to be vital to a successful surgical outcome.

Conclusion:

Lumbar spine fusion should be done in the best sagittal alignments, pfirman's grading of disc degeneration is better to be evaluated for the adjacent segments pre operative in case with lumbar spondylolisthesis with adjacent segment disease which favour to include the adjacent segment in fusion if stage 3 or more was found.

No conflict of interest.

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