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ORIGINAL RESEARCH

Study of *insitu* posterolateral lumbar instrumentation and fusion with pedicle screws and rods in grade 3 and grade 4 spondylolisthesis: A case series

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ABSTRACT
Introduction: Spondylolisthesis is defined as the forward slippage of a cephalad vertebra on a caudal vertebra. The term spondylolysis is also derived from the Greek word "lysis" (loosening). Spondylolisthesis is now specifically used to describe a bony defect in the pars interarticularis, the portion of the neural arch joining caudal to the confluence of the pedicle and the superior articular process and at the most cephalad part of the lamina and the inferior articular process. Spondylolisthesis can be present with or without lysis. Numerous studies prove that reduction of severe high-grade spondylolisthesis is essential, whereas low grade spondylolisthesis depending on the etiology, can be managed by several methods like direct repair of the pars defect in lysis patients or instrumented posterolateral fusion in situ with or without decompression.**Material and Methods:** A series of 10(7 Females and 3 males) patients with gr3 &gr4 Spondylolisthesis were selected forthis studywith mean age group of 50.All patients were treated by in situ posterolateral fusion with pedicle screws and rods with local bonegraft and functional outcome was assessed using oswestry scoring index.**Results:** Patients showed good clinical outcome and significant pain reduction in 90%. Restoration for a pain limited comfortable daily life was achieved early.**Conclusion:** The pedicle screw and rod system is easy to use and allow for anatomic restoration of the isthmus in isthmic spondylolisthesis or restoring the stability after laminectomy/discectomy in degenerative spondylolisthesis.
Key words: Spondylolisthesis, posterolateral fusion, oswestry scoring index

INTRODUCTION

The term spondylolisthesis is derived from Greek word (spondylos-vertebra, olisthesis-to slip or slide down a slippery path)[2]. It is defined as anterior or posterior slipping of one vertebra on another. Spondylolisthesis has a reported incidence of 4% to 6% in childhood, with most being isthmic and occurring at L5 to S1[3,4]. Herbinaux[1], a Belgian Obstetrician is credited with the first description of this condition.In 1782, he reported a complete dislocation of the L5 vertebral body in front of the sacrum, with narrowing of the birth canal and resultant problem in delivery.The degenerative and isthmic types of spondylolisthesis account for 90% of all vertebral body slips[12]. The parts of a typical vertebra are an anterior body and a posterior arch which enclose the vertebral canal. The neural arch is constituted of two pedicles on lateral aspect and two laminae on the posterior aspect which unite to form the spinous process. This fundamental change in bony anatomy exposes the disc to increased shear load, even though the axial load remains unchanged. The increased shear load on the disc causes premature disc degeneration[2].

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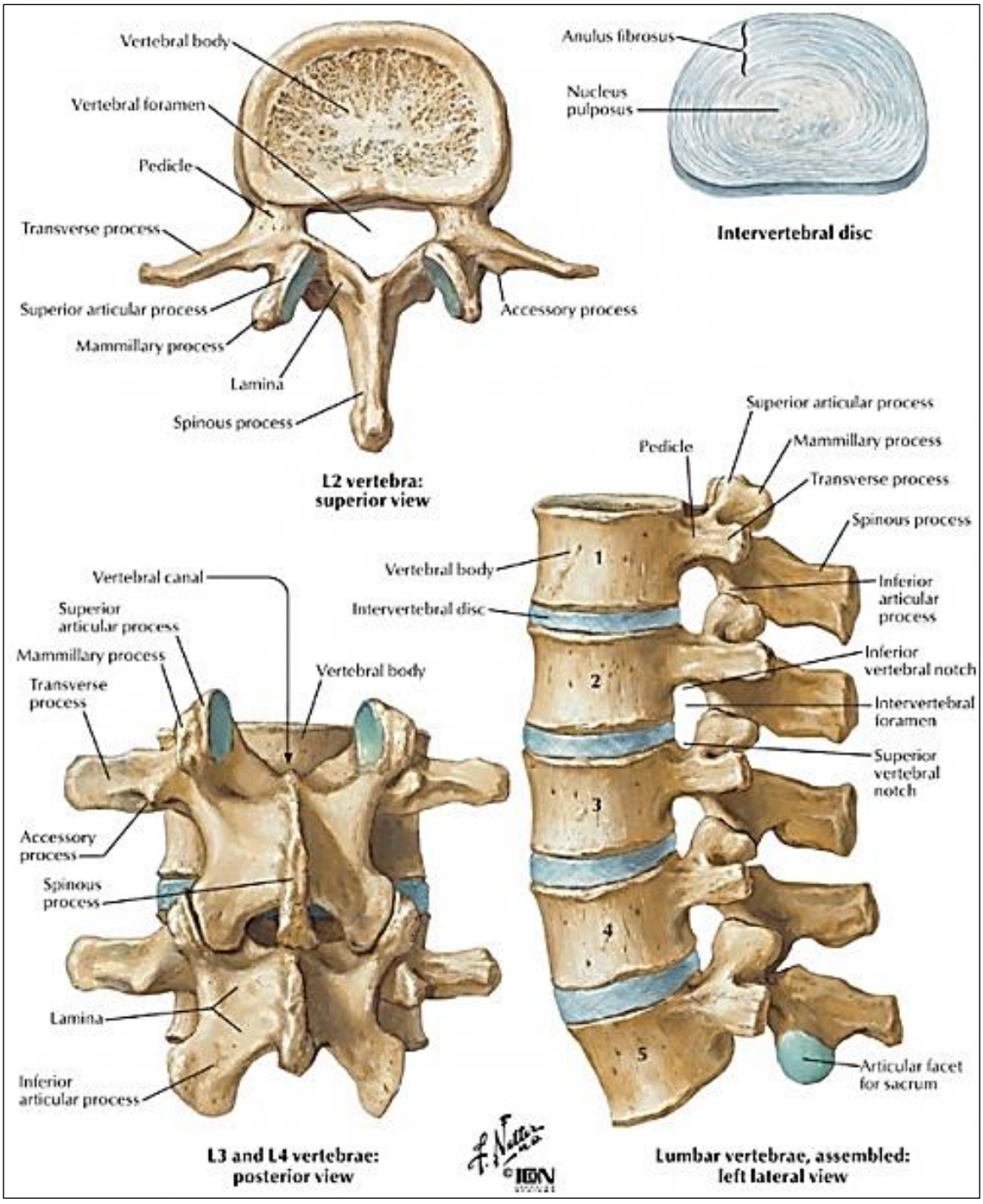

CLASSIFICATION OF SPONDYLOLISTHESIS

Wiltse *et al.* [8] categorized spondylolisthesis into five types based on etiology.

1. Dysplastic spondylolisthesis.
2. Isthmic Spondylolisthesis.
3. Degenerative spondylolisthes.
4. Traumatic spondylolisthesis.
5. Pathologic spondylolisthesis.

MEYERDING CLASSIFICATION

The Meyerding[11] classification grade is determined by measuring the degree of slip using standing, neutral lateral radiographs of the lumbar spine[9] Grade I-≤ 25% Grade II-25%-50% Grade III-50%-75% Grade IV-> 75%.

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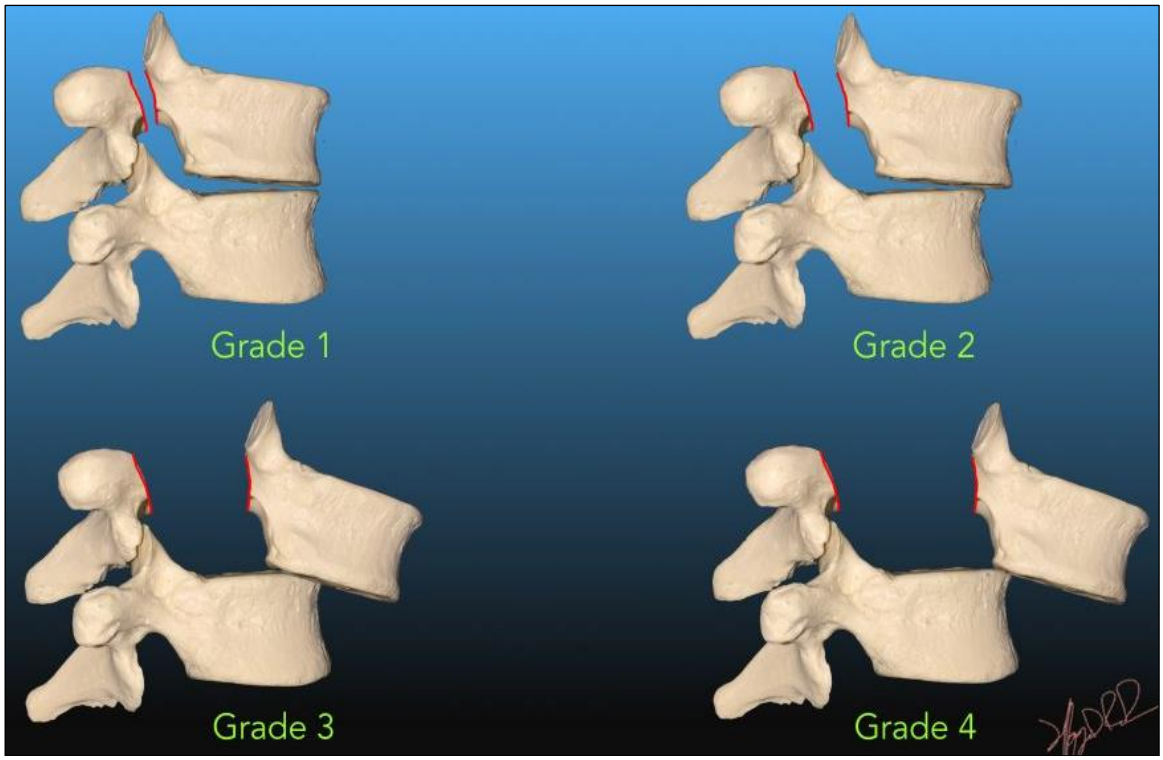

FIXATION CAN BE DONE BY VARIOUS METHODS

TECHNIQUES INCLUDE

1. Anterior Lumbar Interbody Fusion (ALIF).
2. Posterior Lumbar Interbody Fusion (PLIF).
3. Trans Foraminal Lumbar Interbody Fusion (TLIF).
4. Posterior fusion.
5. Posterolateral Fusion (PLF).
6. Anterior fusion and release with posterior fusion (360° fusion).

POSTEROLATERAL FUSION (PLF) plays an essential role in not only stabilizing the lumbar spine but also preventing the progression of the listhesis [13,14].

AIM: The Purpose of our study wasreduction ofsevereback pain, prevention of further slip, and stabilization of unstable segment.

ETIOPATHOGENESIS

The etiology of spondylolisthesis may present with specific physical exam findings, for example, in degenerative spondylolisthesis one may feel a step-off at the level above the slip, whereas in isthmic the step-off may be palpated below[5,6,7]. A prominent sacrum and hamstring tightness is also apparent[5,6,7,8].There is a congenital or dysplastic abnormality of the L5-S1 facet joint that prevents proper articulation. This allows the superior vertebra to slide forward over the inferior vertebra. Displacement is early but limited due to intact neural arch. The pars interarticularis is intact but poorly developed, elongated or lysed.

IMAGING

Plain radiography AP and Lateral Views, Oblique view ("Scotty dog" profile) radiography-flexion-extension lateral views.

MRI: Non-invasive screening tool for detection of compression on neural elements early identification of disc desiccation evaluation of spinal stenosis facet over growth hypertrophy of ligamentum flavum synovial cysts of facet joints sagittal Images Disc Spinal canal.

MATERIALS AND METHODS

This is a prospective study of 10 patients carried out in the Department of Orthopaedics,Navodaya Medical College Hospital and Research Centre,Raichurfrom April 2022 to June 2024. Out of the 10 patients, 7(70%) were females and 3(30%) were males. The mean age of the patients were 50 years. Out of 10 patients, 4(40%) patients had listhesis at L4-L5 level and another 6 (60%) at L5-S1 level. 7(70%) were Isthmic variant and 3 (30%) were Degenerative spondylolisthesis.

1. Detailed history and clinical examination and investigations was done.
2. A Pre anaesthetic evaluation was done.

Follow ups at 1,6 and 12 and 24 months were made.

INCLUSION CRITERIA

Grade 3 and 4 spondylolisthesis.
Degenerative and isthmic spondylolisthesis.
18 to 60 years failure of conservative management.

EXCLUSION CRITERIA

Age <18 years.

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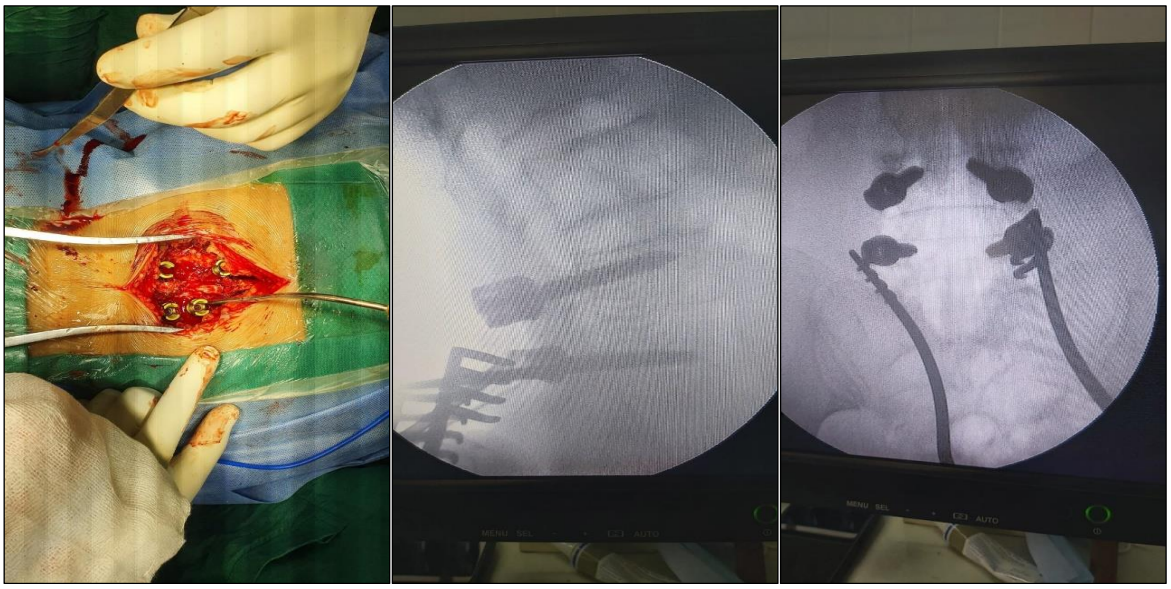
Age>60 years.
Grade 1 and 2.

Congenital and traumatic listhesis generalised bone disorders.

OPERATIVE PROCEDURE: The patients were operated under general anaesthesia. After induction, patients were positioned prone with bolsters underneath. The level of listhesis is confirmed by C-Arm. Through midline posterior incision, paraspinal muscles were retracted laterally. Blunt dissection is made through longismus and multifidus plane.Spinous process, lamina and the facet joints were exposed.The entry point for pedicle screws are atthe junction of the lateral facet and the transverse processes or intersection of the vertical line through the facet joints as a horizontal line through the transverse process. Since pedicle screws traverse all the three columns of the vertebrae, they can rigidly stabilize both the ventral and dorsal aspects of the spine[3].
Laminectomy/Discectomy of the appropriate level is done when symptoms of spinal stenosis/Disc prolapse or root compression are present. Local bone graft chips are placed,thorough saline wash was given and drain was fixed and suturing and dressing was done.Patients were shifted to post-operative ward and monitored.

INTRA OP PICTURES



POST OP CARE: Patients were made to roll over after 24 hours and dressing was performed on second post operative day with removal of drain and patients were advisedto walk with lumbo-sacral brace. Patients were discharged after 5th post operative day and were advised to wear.Sutures were removed on 10th post operative day.

FOLLOW UP: Patients were followed up in regular intervals at 1,6, 12and 24 months.

Patients were assessed mainly for pain, spasm and neurological deficit,and also radiological assessment of spinal fusion, percentage of slip, slip angle was assessed using serial X-rays and oblique views if necessary to look for the progression of listhesis.

CLINICAL PICTURES
Pre operative Radiograph and MRIPostOperative Radiograph.

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RESULTS

The quality of life is assessed by a scoring system called oswestry scoring index.Out of the 10 patients, 7 patients(70%) had improvement in the oswestry scoring index significantly with score below 10%. 2 patients(20%) had improvement in the range below 40% and the remaining 1 patient (10%) had a deterioration in the oswestry scoring index. Radiologically, the percentage of slip is maintained in 8 patients(80%). Though 1 patients(10%) had an increase in the percentage of slip,1 patient(10%) had a superficial wound infection in the immediate post-op period which subsided with antibiotics. None of the patients in our study were reported with screw backout nor post op weakness,no cases had implant breakage.

ANALYSIS OF FUNCTIONAL OUTCOME BY OSWESTRY SCORING INDEX

No of cases	Score (Average%)	Disability Level
7	6	No Disability
2	12	Mild Disability
1	38	Moderate disability

DISCUSSION

Spondylolisthesis is a fascinating condition reported over two centuries ago, with so many different types and degrees of slip. Community prevalence rates for the condition are not known but probably around 4-6% in the adult population[3,4]. It is clear however, that only a small minority of affected individuals ever have symptoms but this proportion increases with severity of slip. In our study of 10 cases, the mean age of the patients were found to be 50 years. This could possibly be because 70% of the patients had isthmic spondylolisthesis (5 patients at the level of L5-S1 and 2 patients at L4-L5 level) Patients,30% of the patients had degenerative spondylolisthesis(at L4-L5) level. The degenerative and isthmic types of spondylolisthesisaccount for 90% of all vertebral body slips[12]. While dysplastic type is less common. The aim of the surgical management in spondylolisthesis are to relieve pain and the neurological deficit, to provide stability and to prevent progression by fusion. The following are some of the pertinent points of debate.

- Whether surgery is indicated or not.
- Whether spinal decompression is required.
- Spinal fusion-whether posterior or anterior or combined.
- Whether instrumentation required for improving fusion.
- Whether reduction should be attempted or not in general the younger the patient with painful spondylolisthesis, the more definite is the indication for surgery and the more likely is surgery to be successful.

Risk of progression of slip if not surgically treated is an often-used surgical indication. Wiltse and Hutchinson have described a reasonable policy for the surgical treatment of spondylolisthesis and is widely accepted[15].With the available literature, instrumented in situ posterolateral spinal fusion withlocal bone graft is the current method of choice with or without decompression.Lee *et al.* also presented a case series of 182 patients who had undergone single-level PLF with local bone alone, which resulted in a 93% fusion rate at the end of the follow-up period of at least 18 months[16].Decompressive procedures in spondylolisthesishave their proponents and there are two basic methods-removal of the loose posterior element (Gill's operation)[16] or decompressive laminectomy. In our study of 7 cases of isthmic lytic spondylolisthesis, our management involved postero-lateral instrumented in situ pedicle screw fixation with decompression with localbone graft.6patients during

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their follow up showed an improvement in their clinical,functional and radiological outcome. 1 case presented with increased degree of slip and failure of fusion. In our series of 3 cases of degenerative type, we did laminectomy and instrumented fusion with excellent results during the follow up. Thus, decompression has a definite role in most of the cases of spondylolisthesiswith regard to spinal fusion, fixation of the unstable spine by posterolateral is the treatment most surgeons prefer. In addition it is relatively safe. A high rate of successful fusion by the posterolateral technique has been reported by Watkins, Wiltse and others[15]. In our study the overall fusion rate achieved was 90% and it is comparable with most literature.The failure of fusion which occurred in 1 case could be attributed to inadequate immobilization. Deguchi[17] in their study of 83 cases, concluded that for multilevel spinal fusion in isthmic spondylolisthesis a rigid pedicle screw fixation resulted in a high fusion rate and single level fusion was equally effective with either rigid or semi-rigid pedicle screw instrumentation. In our series most of the patients not only showed solid spinal fusion after *insitu* posterolateral fusion, but had significant improvement in appearance. "Spondylolysis and Spondylolisthesis are diagnosis that, for most paitents have a benign prognosis and can be managed non operatively. For most symptomatic patients for whom this management fails, fusion *in situ* yields satisfactory and long-lasting results and remains the gold standard against which other surgical treatment must be compared "(Smith JA 1999)[18].

CONCLUSION

Although this study is limited by few number of patients, the outcomes suggest that the management of high grade listhesis can be accomplished successfully with Posterolateral technique. In conclusion, we would suggest PLF technique supplemented with Local bone graft is an ideal technique in high grade listhesis for the achievement of

1. Reduction.
2. Direct decompression of nerve roots.
3. Fusion of vertebra.
4. Good biomechanical support by pedicular instrumentation.

This technique is also advisable in view of low complication rate.

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