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Smiley Rod Technique for Direct Pars Repair in Patients with Symptomatic Lumbar Spondylolysis: A Prospective Case Series

Aditya Prasad Panda[1], Priyankar Nanda[2], Sudipta Kumar Patra[1], Anuraag Mohanty[3], Saptarshi Bajpai[4], Geeta Chand Acharya[5]

Learning Point of the Article:

The Smiley Rod technique can provide motion-preserving pars repair with meaningful pain relief and functional improvement in carefully selected adults with symptomatic L5 spondylolysis.

Abstract

Introduction: Lumbar spondylolysis is a common cause of chronic low back pain in adolescents and young adults. Although most patients improve with conservative treatment, persistent symptoms may require surgery. Fusion provides stability but sacrifices segmental motion. Direct pars repair aims to restore pars continuity while preserving mobility. This study evaluated clinical and radiological outcomes of the Smiley Rod technique for symptomatic L5 spondylolysis.

Materials and Methods: This prospective case series included ten patients aged 18–40 years with symptomatic L5 pars defects who failed at least 6 months of conservative management. Patients with Grade II or higher spondylolisthesis, significant disc degeneration, spinal canal stenosis, infection, or previous lumbar surgery were excluded. All patients underwent direct pars repair using the Smiley Rod technique. Visual Analog Scale (VAS) and Oswestry disability Index (ODI) scores were recorded preoperatively and at 3 months, 6 months, and 1 year. Computed tomography was used to assess pars fusion at 1 year.

Result: The mean pre-operative VAS score improved from 6.1 ± 0.7 to 1.3 ± 0.4 at 1 year. Mean ODI improved from 58.4% ± 6.2% preoperatively to 14.8% ± 3.6% at final follow-up. Complete pars fusion was seen in six patients and partial fusion in four. All patients returned to routine activities within 6 months. No implant-related complications, neurological deficits, surgical site infections, or adjacent segment degeneration were observed.

Conclusion: The smiley rod technique appears to be a safe and effective motion-preserving option for selected patients with symptomatic L5 spondylolysis, with favorable short-term clinical and radiological outcomes.

Keywords: Spondylolysis, pars repair, smiley rod, motion preservation, low back pain.

Introduction

Lumbar spondylolysis is a defect of the pars interarticularis and is a recognized cause of low back pain in adolescents and young adults. Population-based imaging studies have reported a prevalence of approximately 5–6% in the general population, with higher occurrence in males and physically active individuals [1,2]. The L5 vertebra is most frequently involved, and repetitive extension and rotational stresses are considered important

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Dr. Aditya Prasad Panda | Dr. Priyankar Nanda | Dr. Sudipta Kumar Patra | Dr. Anuraag Mohanty | Dr. Saptarshi Bajpai | Dr. Geeta Chand Acharya

[1]Department of Orthopedics, Kalinga Institute of Medical Sciences, Bhubaneswar, Odisha, India,
[2]Department of Orthopedics, Central Institute of Orthopedics, VMMC and Safdarjung Hospital, New Delhi, India,
[3]Department of Hand Surgery , Institute for Research and Rehabilitation of Hand and DPH, Government Stanley Medical College, Chennai, Tamil Nadu, India,
[4]Department of Orthopedics Ram Manohar Lohia Institute of Medical Sciences, Lucknow, Uttar Pradesh, India,
[5]Department of Community Medicine, Kalinga Institute of Medical Sciences, Bhubaneswar, Odisha, India.

Address of Correspondence:
Dr. Priyankar Nanda,
Department of Orthopedics, Central Institute of Orthopedics, VMMC and Safdarjung Hospital, New Delhi, India.
E-mail: priyankarnanda@gmail.com

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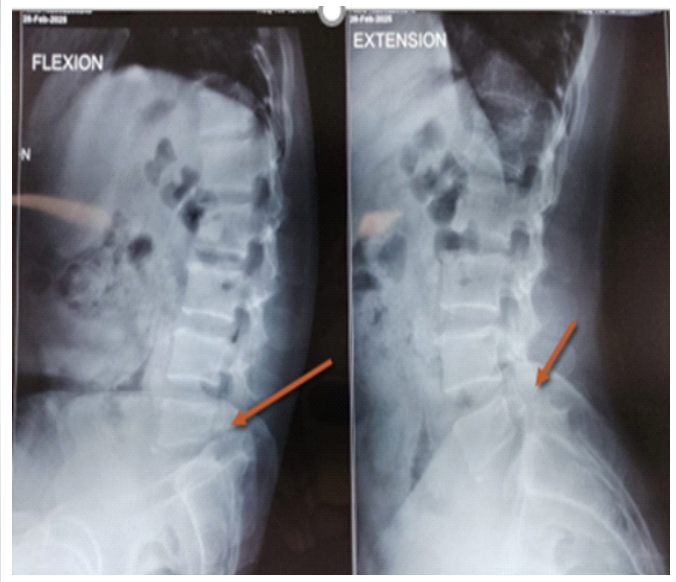


Figure 1: Pre-operative lateral view radiograph of the lumbosacral spine showing L5 spondylolysis.

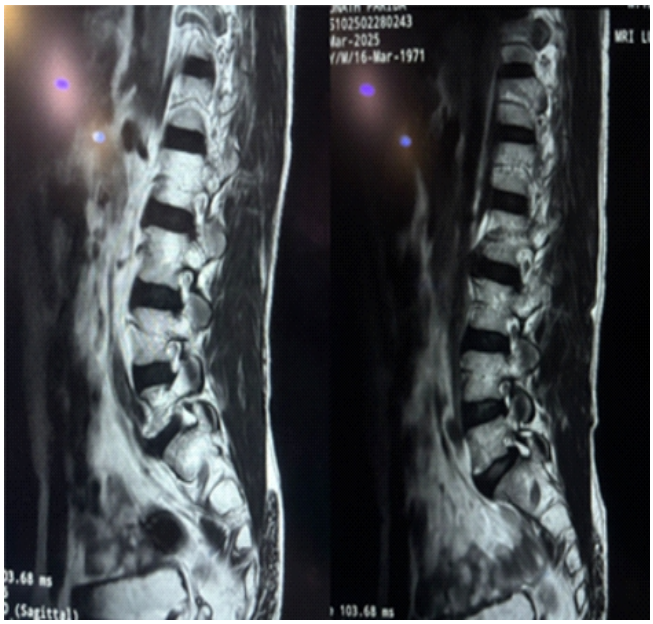


Figure 2: Pre-operative magnetic resonance image demonstrating the L5 pars interarticularis defect.

etiological factors, particularly in athletes [3,4].

Computed tomography (CT) and magnetic resonance imaging have improved detection, staging, and characterization of pars defects, allowing earlier diagnosis and better treatment planning [5,6]. Conservative management, including activity modification, physiotherapy, analgesics, and bracing, remains the first line of treatment and is effective in many early lesions [7,8]. However, a subset of patients develops persistent pain and functional limitation despite prolonged conservative treatment.

Intervertebral fusion has traditionally been used for refractory cases because it provides stability and pain relief [9]. However, fusion eliminates motion at the operated segment and may increase stress at adjacent levels, predisposing young patients to adjacent segment degeneration [10,11,12,13]. Direct pars repair techniques were developed to address this limitation by restoring anatomical continuity of the pars while preserving segmental motion [14,15,16,17].

The aim of this study was to evaluate the short-term clinical and radiological outcomes of direct pars repair using the Smiley Rod technique in selected patients with symptomatic L5 spondylolysis.

Materials and Methods

This prospective case series was conducted at a tertiary care center between April 2024 and April 2025. The study was approved by the Institutional Ethics Committee of Kalinga Institute of Medical Science, Bhubaneswar, Odisha [IEC Ref No. KIIT/KIMS/IEC/1246/2024 on February 27, 2024]. Written informed consent was obtained from all participants before enrolment. The study was conducted in accordance with the World Medical Association Declaration of Helsinki.

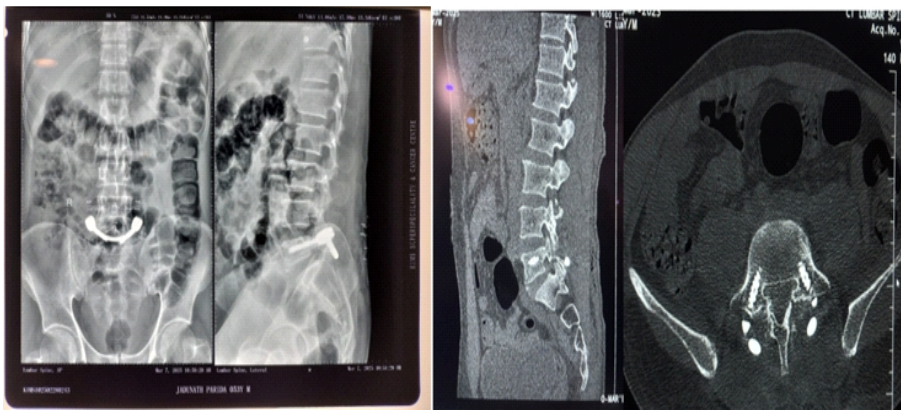


Figure3: One-year follow-up radiological assessment.

Ten patients aged 18–40 years with symptomatic lumbar spondylolysis were enrolled. Inclusion criteria were radiologically confirmed L5 pars interarticularis defect (Fig. 1 and 2), Grade I or lower spondylolisthesis, and persistent low back pain despite a minimum of 6 months of structured conservative management. Conservative treatment included activity modification, physiotherapy, and analgesics. Exclusion criteria were Grade II or higher spondylolisthesis, significant disc degeneration (Pfirrmann grade ≥III),

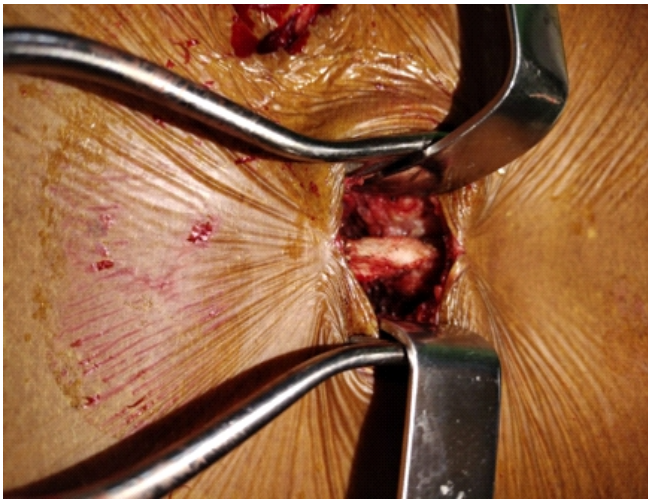


Figure 4: Intraoperative exposure of L5 spinous process.

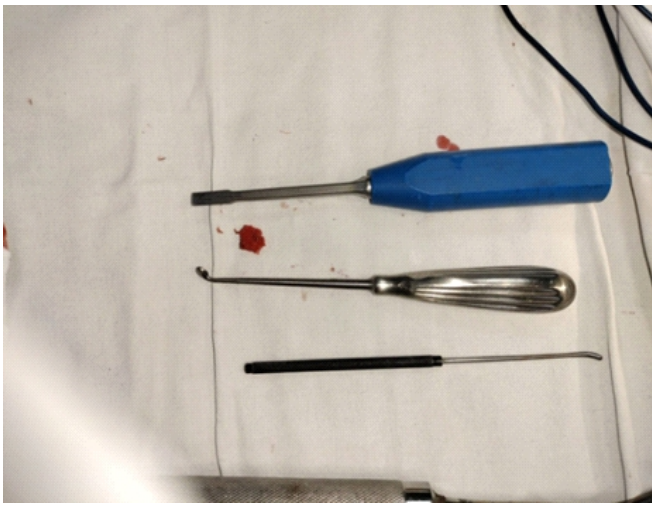


Figure 5: Intraoperative excision of fibrous tissues.

lumbar disc herniation, spinal canal stenosis, infection, previous lumbar surgery, and spinous process abnormality.

All patients underwent direct pars repair using the Smiley Rod technique under general anesthesia. Clinical outcomes were assessed using the Visual Analog Scale (VAS) for pain and the Oswestry Disability Index (ODI). Assessments were performed preoperatively and at 3 months, 6 months, and 1 year after surgery. Radiological assessment included plain radiographs and CT at 1-year follow-up (Fig. 3). Pars fusion was classified as complete or partial according to trabecular continuity across the defect. Return to routine activity and complications were documented during follow-up.

Given the small sample size, statistical analysis was descriptive. Continuous variables were expressed as mean ± standard deviation, and categorical variables were presented as frequencies and percentages. Trends in outcomes were analyzed descriptively without inferential statistical testing.

Surgical technique

All procedures were performed under general anesthesia with the patient placed prone on a radiolucent operating table. The operative level was confirmed using fluoroscopy. A midline posterior incision centered over L5 was made, followed by subperiosteal dissection to expose the L5 spinous process, lamina, and pars interarticularis bilaterally (Fig. 4).

The pars defect was identified. Fibrous tissue within the defect was excised (Fig. 5), and sclerotic margins were curetted until healthy bleeding cancellous bone was encountered. Autologous cancellous iliac crest bone graft was packed into the defect.

Pedicle screws were inserted bilaterally into the L5 pedicles under fluoroscopic guidance (Fig. 6). A 5.5-mm rod was contoured into a U-shaped configuration and passed beneath the base of the spinous process. The rod ends were secured to the pedicle screws, and controlled compression was applied across the pars defect (Fig. 7). Final tightening was performed after confirming construct position. Hemostasis was achieved, and the wound was closed in layers over a suction drain.

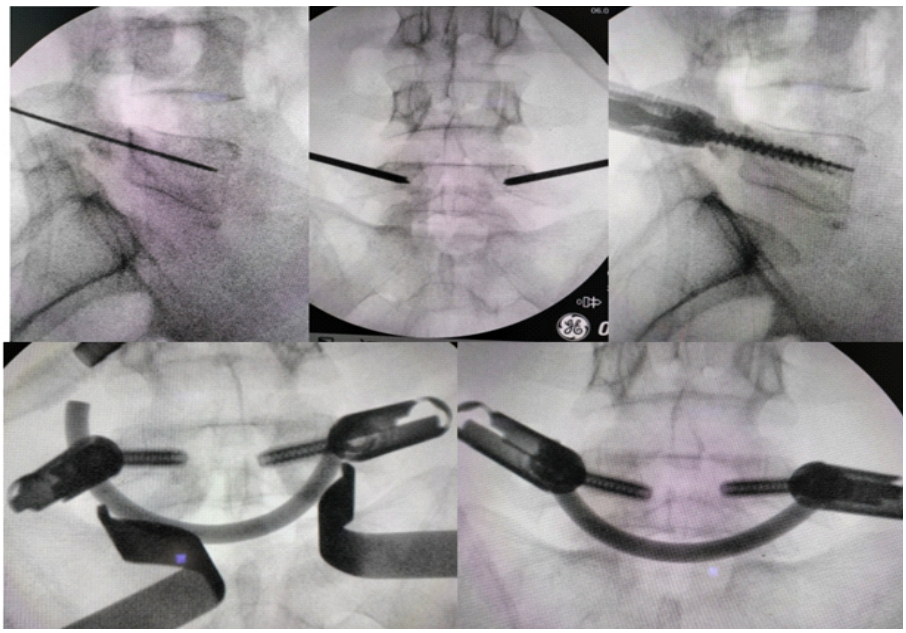


Figure 6: Intraoperative fluoroscopic image showing L5 pedicle screw placement.

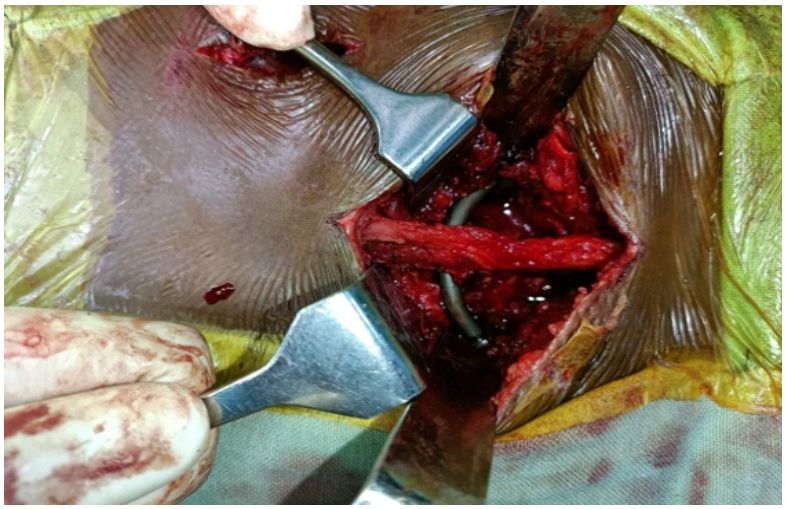


Figure 7: Smiley rod construct after placement of the contoured U-shaped rod and compression across the pars defect.

Results

All ten patients completed a minimum follow-up of 1 year. The mean age was 26.8 ± 5.4 years (range: 18–40 years). There were seven males and three females. L5 was the affected level in all cases. Four patients had associated Grade I spondylolisthesis, while six had no listhesis.

All patients demonstrated progressive improvement in pain and functional status. The mean VAS score improved from 6.1 ± 0.7 preoperatively to 3.2 ± 0.6 at 3 months, 2.1 ± 0.5 at 6 months, and 1.3 ± 0.4 at 1 year (Fig. 8). The mean ODI improved from 58.4% ± 6.2% preoperatively to 33.1% ± 5.8% at 3 months, 22.6% ± 4.9% at 6 months, and 14.8 ± 3.6% at 1 year (Fig. 9).

CT at 1 year demonstrated complete pars fusion in six patients (60%) and partial fusion in four patients (40%). No non-union was identified. Patients with partial fusion remained clinically asymptomatic at final follow-up. All patients returned to routine daily activities within a mean duration of 5.6 ± 1.1 months. No implant-related complication, neurological deficit, surgical site infection, or adjacent segment degeneration was observed (Table 1).

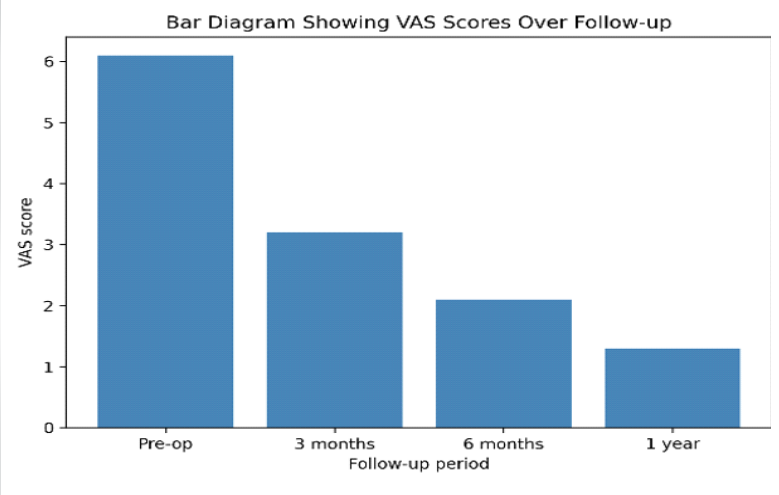


Figure 8: Bar diagram of Visual Analog Scale score follow-up over 1 year.

Table 1: Summary of clinical and radiological outcomes

Parameter	Pre-operative	3 months/6 months	1 year
Visual Analog Scale score	6.1±0.7	3.2±0.6/2.1±0.5	1.3±0.4
Oswestry disability index score (%)	58.4±6.2	33.1±5.8/22.6±4.9	14.8±3.6
Pars fusion	Not applicable	Not assessed	Complete: 6 patients; Partial: 4 patients
Return to routine activity	Not applicable	Progressive return	Mean 5.6±1.1 months
Complications	Not applicable	None recorded	No implant-related complications, neurological deficits, infections, or adjacent segment degeneration

Discussion

The present study shows that direct pars repair using the smiley rod technique produced substantial pain relief and functional improvement in selected patients with symptomatic L5 spondylolysis. These findings support the role of motion-preserving surgery in young patients with preserved disc integrity.

Fusion can provide reliable symptom relief, but long-term concerns include altered lumbar biomechanics and adjacent segment degeneration [9,10,11,12,13]. This issue is particularly relevant in young and active patients, in whom preserving physiological motion may be important for long-term function.

Direct repair techniques, including Buck screw fixation, hook-screw constructs, and pedicle-based repairs, were developed to restore the pars defect without sacrificing the motion segment [14,15,16,17]. The Smiley Rod technique applies compression across the pars defect through pedicle screws and a U-shaped rod construct. This provides stable fixation while preserving the adjacent disc and facet-mediated motion. Recent reports have shown favorable outcomes with this technique

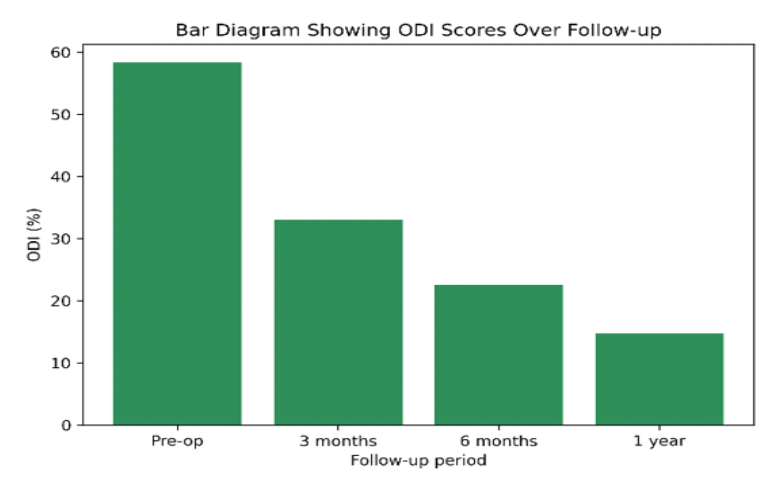


Figure 9: Bar diagram of oswestry disability index score follow-up over 1 year.

and have suggested advantages compared with fusion in selected cases [18,19,20].

In the present series, complete fusion was observed in 60% of patients, while the remaining 40% had partial fusion. Importantly, patients with partial fusion were clinically asymptomatic at 1 year. This suggests that clinical improvement may depend not only on complete radiological union but also on adequate stabilization, pain generator control, and restoration of posterior element mechanics. However, this observation should be interpreted cautiously because of the small sample size.

The absence of implant-related complications, neurological deficits, infections, and adjacent segment degeneration is encouraging. Early return to routine activity was also observed. Nevertheless, the study has limitations. The sample size was small, no control group was included, and follow-up was limited to 1 year. Advanced dynamic imaging and biomechanical assessment were not performed. The findings are applicable only to carefully selected patients with preserved disc health and low-grade or absent listhesis. Larger comparative studies with longer follow-up are needed.

Limitations

This study has some limitations. The small sample size and single-center design limit the generalizability of the findings, while the absence of a comparison group prevents direct comparison with other pars-repair or fusion techniques. The 1-year follow-up is also insufficient to determine long-term clinical and radiological outcomes. The study population was highly selected, and diagnostic pars block, dynamic radiographs, and objective assessment of segmental motion were not performed. In addition, only VAS and ODI were used for clinical assessment, and return to activity was not evaluated using standardized work- or sports-specific criteria. Further multicenter studies with larger cohorts, comparative groups, objective motion assessment, and longer follow-up are required to validate these findings.

Conclusion

Direct pars repair using the Smiley Rod technique is a useful motion-preserving option for selected adult patients with symptomatic L5 spondylolysis who fail prolonged conservative treatment. In this prospective case series, the technique provided meaningful pain relief, functional improvement, satisfactory radiological outcomes, and no observed implant-related or neurological complications at 1-year follow-up. Careful patient selection remains essential, particularly with respect to disc integrity and degree of listhesis.

Clinical Message

In young adults with symptomatic L5 spondylolysis, preserved disc health, and low-grade or absent spondylolisthesis, the Smiley Rod technique offers a motion-preserving alternative to fusion with favorable short-term outcomes.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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