



## Validation of a Novel Clinico-Radiological Scoring System to Decide on the Need for Fusion in Cases of Lumbar Degenerative Spondylolisthesis

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### Abstract

**Background:** Degenerative spondylolisthesis is a common cause of lower back pain, creating challenges in determining the best treatment approach—either standalone decompression or fusion. The absence of a standardized scoring system complicates decision-making. This study intends to validate a clinico-radiological scoring system to guide treatment decisions and improve patient outcomes.

**Material & Methods:** A cohort of 112 patients with degenerative lumbar spondylolisthesis was evaluated using the new scoring system. Independent assessments by spine consultants, fellows, and residents determined whether patients required standalone decompression or fusion. Inter- and intra-observer variability was measured. Patients' recovery and functional outcomes were tracked using VAS score (for back pain & leg pain), Oswestry Disability Index (ODI) and SF-36 score.

**Results:** A total of 112 cases were divided into four groups: Group 1A (8.9%), 1B (71.4%), 2A (13.4%), and 2B (6.3%). Complications were minimal, and re-surgery rates were low. Significant improvements were observed in back pain, leg pain, and ODI scores, with no major differences in postoperative outcomes across groups.

**Conclusions:** The scoring system effectively guides surgical decision-making in degenerative spondylolisthesis, reducing unnecessary fusion and improving outcomes. Further research should explore its broader application.

**Keywords:** Degenerative spondylolisthesis, Stand-alone decompression, Fusion, scoring system

### Introduction

Degenerative spondylolisthesis has become a prominent cause of lower back pain and disability, especially as the global population ages and adopts more sedentary lifestyles. The management of this condition presents significant challenges for both patients and healthcare providers. A critical decision in treatment involves choosing between non-surgical approaches such as physical therapy, medications, or lifestyle changes, and opting for surgical intervention [1]. This decision is influenced by clinical, radiological, and patient-specific factors. However, a widely accepted standardized scoring system to guide these

decisions is lacking. Furthermore, there is ongoing debate regarding the most appropriate surgical approach, with some advocating for decompression alone [2–10] and others supporting decompression combined with spinal fusion [2, 11–13].

Several classification systems, including the Meyerding classification [14], Wiltse classification [15], and Clinical and Radiographic Degenerative Spondylolisthesis Classification (CARDS) [16], have been introduced to assist in surgical decision-making for degenerative lumbar spondylolisthesis. While these systems offer insights into spinal instability and the



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DOI: <https://doi.org/10.13107/jmt.2024.v10.i02.226>

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severity of the condition, they often fail to account for the complexities of individual cases. A key issue is the tendency to treat degenerative spondylolisthesis as a homogenous condition, leading to potential overtreatment or undertreatment [7]. For instance, the widely used Meyerding classification is limited as degenerative spondylolisthesis slips rarely exceed grade I or 30% [14]. This study seeks to validate a new clinico-radiological scoring system proposed by Kulkarni et al. in 2020 [7] aimed at addressing these limitations and offering a more comprehensive, patient-centered approach to surgical decision-making in degenerative lumbar spondylolisthesis.

### Aims and Objectives

**Aim:** Validation of a Novel Clinico-Radiological Scoring System to Decide on the Need for Fusion in cases of Lumbar Degenerative Spondylolisthesis

**Objectives:** 1) Calculate the score for all patients with degenerative lumbar spondylolisthesis using the new scoring system. 2) Analyze and assess the functional outcomes of surgically treated patients. 3) Study the reliability of variables used in the new clinico-radiological scoring system. 4) Compare interobserver and intraobserver reliability of the new scoring system.

### Materials and Methods

This prospective study was conducted at a tertiary care center between October 2022 and December 2024. After receiving institutional ethical and scientific committee approval, patients were selected based on specific inclusion and exclusion criteria. Thorough explanations of the study's nature were provided to patients and their relatives, and informed consent was obtained from all participants. The sample size comprised approximately 112 skeletally mature patients diagnosed with degenerative lumbar spondylolisthesis.

### Eligibility Criteria

**Inclusion criteria:** 1) Skeletally mature patients diagnosed with lumbar degenerative spondylolisthesis. 2) Patients who failed conservative treatment. 3) Patients with spondylolisthesis at one or two levels. 4) Patients who provided written informed consent.

**Exclusion criteria:** 1) Patients under 18 years of age. 2) Patients diagnosed with spondylolisthesis subtypes other than degenerative (e.g., dysplastic, isthmic, traumatic). 3) Patients previously managed surgically.

A new clinico-radiological scoring system proposed by Kulkarni et al. in 2020 [7] was applied to calculate scores for all patients. Patients scoring <5.5 were classified as stable and advised standalone decompression. Scores  $\geq 5.5$  indicated instability, requiring fusion surgery [7].

Patients were divided into two main groups:

Group 1: Operated according to the new scoring system

(Group 1A: standalone decompression, Group 1B: decompression with fusion).

Group 2: Operated based on the surgeon's preference, contrary to the scoring system (Group 2A: decompression with fusion, Group 2B: standalone decompression).

Postoperative follow-ups were conducted at 6 weeks, 3 months, 6 months, and 1 year. Functional outcomes were measured using VAS, ODI, and SF-36 Health Survey scores. Intra-operative and post-operative complications were monitored.

Seven independent observers were selected to evaluate a set of clinical cases twice, at intervals of 2-3 months, for interobserver and intraobserver reliability. Observers were blinded to each other's assessments and their prior evaluations. The data was analyzed using Cohen's Kappa statistic [16] to assess both inter-observer and intra-observer reliability. Kappa (k) values, expressed with 95% confidence intervals, ranged from -1 to 1, with higher values indicating better agreement.

Statistical analysis was performed using SPSS version 24.0. Comparisons were conducted using the Chi-Square test for categorical data and ANOVA for continuous variables, with Bonferroni post-hoc tests for multiple comparisons [17-19].

### Results

A total of 112 cases were analyzed and categorized into four groups: Group 1A (10 cases), Group 1B (80 cases), Group 2A (15 cases), and Group 2B (7 cases). The majority of cases belonged to Group 1B (71.4%), followed by Group 2A (13.4%), Group 1A (8.9%), and Group 2B (6.3%). The highest mean age was observed in Group 2A ( $67.80 \pm 8.15$  years), with a significant age difference between Group 2A and Group 1B ( $P < 0.05$ ). The male-to-female ratio in the study was 0.75:1. Group 2B had a significantly higher proportion of male patients (85.7%), while Group 1B had the largest proportion of female patients (61.2%).

BMI varied across the groups, ranging from  $24.91 \pm 4.45$  kg/m<sup>2</sup> in Group 1A to  $26.15 \pm 2.94$  kg/m<sup>2</sup> in Group 2B, but no significant differences were found ( $P > 0.05$ ). Co-morbidities such as hypertension, diabetes, ischemic heart disease (IHD), and hypothyroidism were prevalent.

Intra-operative complications occurred in 8.8% of Group 1B cases and 20% of Group 2A cases, primarily dural tears. Post-operative complications, including infection and cage migration, were minimal, occurring in 6.2% of Group 1B and 6.7% of Group 2A cases. No complications were reported in Groups 1A and 2B. Re-surgery was required in 2.5% of Group 1B and 6.7% of Group 2A cases, while Groups 1A and 2B had no re-surgeries.

Back pain, leg pain, Oswestry Disability Index (ODI), and SF36 scores were analyzed to assess outcomes. Group 1A had significantly lower pre-operative back pain scores (Mean = 3.70, SD = 3.09) compared to other groups ( $P < 0.05$ ). However, post-operative scores showed no significant differences at 6 weeks, 3 months, 6 months, and 1 year ( $P > 0.05$ ). The percentage

improvement in back pain scores at 1 year ranged from 64.95% in Group 1A to 78.11% in Group 1B, with no significant differences between groups ( $P>0.05$ ).

For leg pain, Group 1A had significantly higher pre-operative scores (Mean = 8.60, SD = 0.84) than Group 1B (Mean = 6.76, SD = 1.59), with no significant differences between other groups. At the 1-year follow-up, leg pain scores were significantly lower in Groups 1B and 2B compared to Group 2A ( $P<0.05$ ), with percentage improvement ranging from 64.64% in Group 2A to 88.76% in Group 2B.

ODI scores were similar across all groups pre-operatively. At the 1-year follow-up, Groups 1A and 1B had significantly better scores compared to Group 2A ( $P<0.05$ ), with percentage improvement ranging from 46.52% in Group 2A to 54.50% in Group 1B.

SF36 pain scores showed no significant pre-operative differences between the groups ( $P>0.05$ ). At 1 year, Group 2B had the greatest improvement, with a 398.89% increase in pain scores, followed by Group 1A (368.15%), Group 1B (330.83%), and Group 2A (264.81%). Physical functioning scores also improved significantly across all groups post-operatively, with Group 2B showing the greatest improvement at 1 year (257.14%).

The interobserver agreement for parameters such as Mechanical Back Pain, age, and activity showed very high reliability, with Cohen's kappa values ranging from 0.999 for MBP and activity to 0.687 for Arvind's score. Segmental Kyphosis and Facet Effusion had substantial agreement (kappa values ranging from 0.630 to 0.946). However, variability was noted in the assessment of Segmental Dynamic Spondylolisthesis (kappa values of 0.379 to 0.682), and technical factors showed the lowest agreement (kappa range 0.323 to 0.718). Intraobserver reliability mirrored these trends, with high agreement across most parameters, though certain parameters like Arvind's score and technical factors displayed slight variability.

### Conclusion

The results of the study showed significant improvements in patients who underwent surgical treatment, whether it was standalone decompression or decompression with fusion. The study further compared these findings with Kulkarni's study, highlighting similar trends in the reduction of pain scores, though with varying degrees of improvement. The interobserver reliability of the scoring systems used in this study is generally high, certain parameters, particularly those involving more subjective assessments, could benefit from further refinement to enhance consistency. The robust agreement in most parameters underscores the reliability of the scoring systems, yet highlights the importance of continuous evaluation and training to ensure the highest standard of clinical assessments. In conclusion, the study validates the efficacy of the new clinico-radiological scoring system, which could

potentially standardize the decision-making process in surgical treatment of degenerative spondylolisthesis, ensuring better patient outcomes and minimizing unnecessary fusion surgeries.

### Clinical Message

The validation of a new clinico-radiological scoring system to determine the need for fusion holds significant clinical importance and have potential of transforming the management of degenerative spondylolisthesis. The scoring system standardizes the decision-making process, reducing the variability that currently exists among surgeons. This standardization ensures that patients receive consistent and appropriate care, regardless of the treating surgeon.

A subgroup of patients with Degenerative Spondylolisthesis can get away with just stand-alone decompression, without the need of fusion which is more morbid surgical intervention. This have benefits of reduced surgical risk, reduced surgical time, shorter recovery time, preservation of motion, lower cost of surgery, etc. By accurately identifying patients who can benefit from decompression alone, the system helps avoid unnecessary fusion surgeries, thereby minimizing the associated morbidity and healthcare expenses.

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Conflict of Interest: Nil

Source of Support: None

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Year of Acceptance of Thesis: 2024

**How to Cite this Article:** Jajoo SO, Hadgaonkar S, Kothari A, Aiyer S, Bhilare P, Sancheti P, Murari AS, Sonawane D. Validation of a Novel Clinico-Radiological Scoring System to Decide on the Need for Fusion in cases of Lumbar Degenerative Spondylolisthesis. *Journal Medical Thesis.* 2024 July-December ;10 (2) : 20-23.