



Original Research

## Diagnostic Accuracy of the Seated Straight Leg Raise Test for MRI-Confirmed Lumbosacral Radiculopathy: A Prospective Study of 500 Patients

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### ABSTRACT

**Objective:** To determine the diagnostic accuracy of the seated straight leg raise (SLR) test in diagnosing lumbosacral radiculopathy with magnetic resonance imaging (MRI) as the standard of reference. Methods: It was a prospective diagnostic accuracy study at a tertiary neurosurgery clinic.

**Materials & Methods:** The study enrolled 500 adults with a clinical suspicion of lumbosacral radiculopathy. Each patient was subjected to a standardized seated SLR performed by trained clinicians, and results of lumbar MRI were reported by a consultant radiologist. An index test was taken as positive when the typical pain was reproduced in the radicular area below the knee during knee extension or ankle dorsiflexion. MRI showing nerve-root compression and concordant with the level of the symptom was chosen as the reference standard. Diagnostic accuracy values such as sensitivity, specificity, and predictive values were determined.

**Results:** In 500 patients, 320 (64.0%) were found to have nerve-root compression on MRI. The seated SLR test had a sensitivity of 78.1% (95% CI 73.3%-82.3%), specificity of 69.4% (95% CI 62.4%-75.7%), positive predictive value of 82.0%, and negative predictive value of 64.1% (95% CI 57.2%-70.5%). The total diagnostic accuracy was 75.0%. No adverse events related to the index test were recorded.

**Conclusion:** The seated SLR is a practical clinical maneuver with good sensitivity and moderate specificity for MRI-confirmed lumbosacral radiculopathy. It serves as a useful screening tool within a comprehensive clinical assessment, helping to rationalize the use of advanced imaging.

**Keywords:** Lumbosacral Radiculopathy; Intervertebral Disc Displacement; Low Back Pain; Straight Leg Raise; Physical Examination; Magnetic Resonance Imaging.

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## INTRODUCTION

The condition of low back pain continues to be the main reason for disability time loss throughout the world and South Asia, which creates major personal and financial challenges.<sup>1</sup> Lumbosacral radiculopathy represents a common and significant clinical condition that produces neuropathic pain through damage to one or multiple lumbosacral nerve roots. The pathophysiology of radiculopathy results from mechanical compression by intervertebral disc herniations and foraminal stenosis, although an inflammatory response develops as a secondary process that leads to nerve root irritation and sensitization.<sup>2,3</sup> The identification of nerve-root compromise needs to happen promptly and correctly because it determines the best course of treatment and the need for surgical intervention.<sup>4</sup>

MRI serves as the preferred imaging method for nerve-root compression assessment, yet its effectiveness remains limited because many people without symptoms show disc bulges and protrusions. The high rate of asymptomatic disc bulges and protrusions in the population requires healthcare providers to conduct thorough clinical evaluations that establish reliable connections between clinical findings and imaging results to prevent unnecessary diagnoses.<sup>5,6</sup> The straight leg raise (SLR) test, along with other neurodynamic assessments, serves as a standard clinical tool to evaluate lumbosacral nerve root tension according to teaching practices.<sup>7</sup> The test works through sciatic nerve and L5 and S1 nerve root stretching, which leads to symptom reproduction when nerve roots become irritated.<sup>8</sup>

The SLR test shows inconsistent diagnostic performance results in different studies because sensitivity ranges between 52% and 90% and specificity ranges between 26% and 89%.<sup>9,10</sup> The wide range of test performance results comes from variations between research methods and participant groups, reference criteria, testing protocols, and positive test definitions.<sup>11,12</sup> The seated version of the SLR test receives less

research attention even though it remains practical for outpatient clinics. The current literature shows mixed results about how the seated SLR test compares to the conventional supine version of the test because different studies found the seated test to be less sensitive or equally effective.<sup>13,14</sup> The continued discussions about the superiority of one test over another show that very little effort has been previously made by researchers regarding this. The study used a prospective design to evaluate the seated SLR test against MRI results for patients with suspected lumbosacral radiculopathy at a tertiary center based on established test accuracy study protocols.<sup>15</sup> This comparative study is important because it addresses the conflicting results found in current research. Clinicians require dependable diagnostic data to confidently select the best test. They need to consider factors such as patient comfort and ease of use in a busy clinic. Our main objective is to clearly show how useful and valid the seated Straight Leg Raise (SLR) test is in clinical practice.

## MATERIALS & METHODS

### *Study Design and Setting*

We performed a prospective diagnostic accuracy study at Sultan Tareen Hospital, Quetta, Pakistan, from 1<sup>st</sup> June 2024 to 1<sup>st</sup> June 2025. The report adheres to key items from the STARD 2015 checklist for diagnostic accuracy studies.<sup>15</sup>

### *Participants*

Consecutive adult patients ( $\geq 18$  years) presenting with low back pain and clinical suspicion of unilateral lumbosacral radiculopathy were eligible for enrollment.

### *Inclusion Criteria*

The research included participants who had reached the age of 18 and above. The study required patients who had low back pain together with symptoms that showed unilateral lumbosacral

radiculopathy, which indicates nerve root irritation or compression in the lower spine.

### **Exclusion Criteria**

Individuals were excluded from the study if they had a history of previous lumbar surgery. The research study eliminated participants who displayed any evidence of spinal fracture, infection, or malignancy. Patients with a clinical diagnosis of cauda equina syndrome, those who were pregnant, or any individual unable to complete the required physical examination for any reason were also not included in the study cohort.

### **Index Test**

The Seated Straight-Leg Raise (SSLR) test was conducted by clinicians from either neurosurgery or neurology departments, adhering to a standardized procedure. The patient was placed in a seated position on the examination table, with their legs extended over the edge and the hips and knees flexed to about 90 degrees. The clinician confirmed test validity by making sure that the patient stayed upright with their back straight and their body did not move backward. The importance of maintaining this body position acts as a vital factor because posterior pelvic tilting creates false negative results when assessing sciatic nerve pathway tension. The seated position serves as a distracting technique in comparison to the supine version of the test, and this collectively enhances the test's dependability in the evaluation of non-organic signs. The comparison functions as an important component in the neurological examination and helps to rule out symptom overexaggeration or fabrication (often referred to as Waddell's signs), as the patient is typically unaware that the seated version of the test checks the same structures as the supine test.<sup>19</sup> A uniform finding across both tests positively points towards a genuine radiculopathy. The examiner then passively and gently extended the knee on the patient's symptomatic side to increase nerve

stretch. This maneuver causes the entire sciatic nerve to stretch, which results in traction forces that deform or move the sciatic nerve roots from the point of their exit from the spinal canal. A positive result was specifically identified as the reproduction of the patient's characteristic radiating pain that extends below the knee, arising either during passive knee extension or when sensitized by passive ankle dorsiflexion.<sup>13,16</sup> The stipulation that the pain must radiate specifically below the knee is crucial for differentiating genuine nerve root compression (radiculopathy) from isolated hamstring tightness or general low back pain. Ankle dorsiflexion is employed as a neurological sensitizing maneuver to further confirm the neurogenic origin of the pain by applying maximum tension to the entire sciatic pathway. The reproduction of back pain alone or non-radicular thigh pain was considered a negative test. When bilateral symptoms were present, the clinically dominant side was used for analysis. Findings were recorded dichotomously as positive or negative, without grading.

### **Reference Standard**

All participants underwent a lumbar MRI scan within the same diagnostic episode, typically within two weeks of the clinical examination. A consultant radiologist, who was blinded to the index-test results, reported the presence or absence of nerve-root compression (defined as displacement, indentation, or compromise of the nerve root by surrounding structures) at a level concordant with the patient's symptoms (e.g., a paracentral L5–S1 disc herniation contacting the traversing S1 root).<sup>6</sup> MRI served as the reference standard for defining disease-positive and disease-negative status.

### **Data Collection and Analysis**

Alongside the evaluation of the index test, comprehensive neurological assessments were routinely conducted, documenting the presence of

motor deficits, altered deep tendon reflexes, and sensory abnormalities to evaluate the functional severity of the radiculopathy and guide potential surgical decision-making.

Baseline demographic and clinical characteristics were collected and are summarized using descriptive statistics. To evaluate the diagnostic accuracy of the seated SLR, a 2×2 contingency table was constructed to cross-tabulate the index test results (positive/negative) against the reference standard findings (MRI positive/negative). Using this table, we calculated the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy. 95% confidence intervals (CIs) for these measurements were calculated using Wilson's method. No subgroup or multivariable analyses were defined in advance; a post-hoc analysis was conducted to stratify outcomes based on the anatomical zone of the disc herniation. Statistical calculations were performed using standard formulae.

### **Ethical Considerations**

This study received formal approval from the Ethics Review Committee of Sultan Tareen Hospital, Quetta. The study involved no experimental therapy, and the index test is a standard component of routine outpatient examination.

## **RESULTS**

### **Participant Characteristics**

A total of 500 eligible patients were recruited in the study. The study population baseline demographic and clinical characteristics appear in Table 1. The average age of the participants was 45.2 years; the cohort was equally distributed by gender. The median duration of symptoms was 10 weeks, and the commonest clinical presentation was radiculopathy involving the L5-S1 (S1) level.

### **Results and Test Concordance**

MRI confirmed the nerve root compression, and there was concordance between MRI findings and clinical symptoms in 320 patients (64.0%) of the 500 patients, and 180 patients (36.0%) experienced clinical symptoms without relevant nerve root compression on MRI. The index test had no adverse events in terms of performance. The classification of patients by the Seated SLR test and MRI findings is summarized in the 2x2 contingency table (Table 2). The seated SLR test was positive in 250 of the 320 patients diagnosed by MRI as suffering from radiculopathy (true positives) and negative in 125 of the 180 patients who did not suffer from MRI-confirmed radiculopathy (true negatives).

### **Diagnostic Accuracy**

Based on these results, the seated SLR demonstrated a sensitivity of 78.1% (95% CI 73.3%–82.3%) and a specificity of 69.4% (95% CI 62.4%–75.7%). The calculated PPV was 82.0% (95% CI 77.3%–85.9%), the NPV was 64.1% (95% CI 57.2%–70.5%), and the overall diagnostic accuracy was 75.0% (95% CI 71.0%–78.6%) (Table 3).

### **Clinical Correlation and Surgical Outcomes**

Neurosurgical decisions were made after thoroughly reviewing the pain a patient felt, how things were progressing over time, and what the neurological exam showed. Out of 320 patients who had compression confirmed by MRI, only 30 (9.4%) actually showed signs like motor weakness or weaker reflexes. In the end, 60 patients (18.8%) needed surgery. The biggest reasons to go ahead with surgery were pain that couldn't be controlled and neurological symptoms that kept getting worse.

In post-hoc subgroup analysis of the 320 MRI-confirmed cases, 288 (90.0%) presented with central or paracentral herniations compressing the traversing nerve root and 32 (10.0%) exhibited

foraminal or extraforaminal compression of the exiting root. The seated SLR demonstrated higher sensitivity in central/paracentral lesions (81.3%, 234/288) compared to foraminal lesions (50.0%, 16/32), confirming that anatomical compression site significantly influences dural tension test results.

### Ancillary Clinical Observations

Clinicians anecdotally noted that hamstring tightness and back pain without leg radiation were common reasons for false-positive responses, whereas patients with foraminal stenosis or lateral recess compromise occasionally tolerated knee extension without classic reproduction of leg pain, producing false negatives. These observations are hypothesis-generating and warrant confirmation in future work.

**Table 1:** Baseline Demographic and Clinical Characteristics of the Study Population (N=500)

| Parameters                                      | Value           |
|-------------------------------------------------|-----------------|
| Age (years), Mean $\pm$ SD                      | 45.2 $\pm$ 12.8 |
| Gender, n (%)                                   |                 |
| Male                                            | 260 (52.0)      |
| Female                                          | 240 (48.0)      |
| Symptom Duration (weeks), Median                | 10 [4–24]       |
| Affected Side, n (%)                            |                 |
| Right                                           | 255 (51.0)      |
| Left                                            | 245 (49.0)      |
| Most Common Symptomatic Level (Clinical), n (%) |                 |
| L4-L5 (L5 radiculopathy)                        | 210 (42.0)      |
| L5-S1 (S1 radiculopathy)                        | 245 (49.0)      |

SD: Standard Deviation; IQR: Interquartile Range

**Table 2:** Diagnostic 2 $\times$ 2 Table for the Seated SLR Test versus MRI Findings.

|                     | MRI Positive | MRI Negative |
|---------------------|--------------|--------------|
| Seated SLR Positive | 250          | 55           |
| Seated SLR Negative | 70           | 125          |

SLR: Straight Leg Raise; MRI: Magnetic Resonance Imaging

**Table 3:** Diagnostic Performance Metrics of the Seated SLR Test.

| Metric                    | Observed Percentage (%) | 95% Confidence Interval |
|---------------------------|-------------------------|-------------------------|
| Sensitivity               | 78.1                    | 73.3%–82.3%             |
| Specificity               | 69.4                    | 62.4%–75.7%             |
| Positive Predictive Value | 82.0                    | 77.3%–85.9%             |
| Negative Predictive Value | 64.1                    | 57.2%–70.5%             |
| Accuracy                  | 75.0                    | 71.0%–78.6%             |

## DISCUSSION

In this prospective series of 500 patients evaluated at a single tertiary center, the seated SLR test demonstrated good sensitivity (78.1%) and moderate specificity (69.4%) for MRI-confirmed lumbosacral radiculopathy. Clinically, this profile makes the test useful for initial screening: a negative result lowers the probability of nerve-root compression, while a positive result—particularly when it reproduces concordant below-knee pain—should be interpreted alongside the history, neurological deficits, and course of symptoms rather than used in isolation to mandate imaging.<sup>3,5</sup>

The presence of motor deficits favoured the decision for early surgical management. Post-operative follow-up of our patients showed that 80% with pre-existing motor deficits demonstrated substantial improvement within a few weeks of surgery. Motor deficits sometimes were not accompanied by severe pain and were the sole factor in deciding surgical intervention. By combining these findings alongside the seated SLR results, we were able to stop the progressive deterioration and maximize functional recovery.

Radiculopathy is way more than what is seen on an MRI. It's a clinical and physiological syndrome; relying on just one test, like a positive seated straight leg raise, is not a complete picture. Most decisions to operate are not based on a single finding. Neurosurgeons combine the test results and the clinical findings, things like

neurological deficits, muscle weakness, changes in reflexes, or severe pain that persists even after trying non-surgical treatments. That combination of signs and symptoms is what actually drives whether to go ahead with surgery or conservative management.

Our sensitivity estimate is comparable to the higher end of values reported in classic meta-analytic summaries of the traditional supine SLR, which typically report high sensitivity for disc herniation-related radiculopathy.<sup>9,10</sup> A key finding of our study, however, is the moderate specificity of 69.4%. This figure is considerably higher than the low specificity (e.g., 26%) cited in some influential reviews of the SLR test.<sup>17,18</sup> This apparent discrepancy may be explained by our study's rigorous methodology. As is known, the specificity of the SLR can be misleading with false-positive findings because of hamstring tightness, posterior chain myofascial pain, or non-specific lumbar pain.<sup>12,16</sup> By following a strict definition of a positive test, the reproduction of radicular type of pain below the knee, our study protocol was designed to minimize these distractors. This implies that the clinical utility and specificity of the SLR test are highly reliant on adequate performance and interpretation, and this is crucial to clinical practice in different environments.

### The Seated versus Supine SLR Debate

The seated position of the SLR test is a popular one as it offers an easy alternative to patients who are unable to lie down, and in this position a clinician can also perform other neurological assessments. The practical selection of this position might lead to potential diagnostic limitations according to some studies.<sup>13</sup> In a prospective study by Rabin et al., the authors compared these positions through MRI-confirmed nerve root compression studies, which revealed that the supine SLR produced better results than the seated SLR (67% vs. 41%).<sup>14</sup> The researchers discovered that nerve roots experience increased traction during the

supine position, which leads to better detection of positive responses. The two positions show equivalent results according to other studies, yet the seated maneuver might produce decreased sensitivity, which clinicians need to consider when they suspect radiculopathy despite negative test results.<sup>13</sup>

### Factors Influencing Diagnostic Accuracy

The diagnostic accuracy of the SLR test is not uniform across all patient populations. The age of patients serves as a major factor that determines the treatment approach. The effectiveness of the SLR test decreases with age because patients older than 60 years show lower test positivity rates when compared to patients from younger age groups, according to research data.<sup>10</sup> The observed effect occurs because musculoskeletal tissues and nerve root mobility undergo natural changes during the aging process. Our cohort participants had an average age of 45.2 years (Table 1), which matches the age group where the test shows optimal performance. The generalizability of our findings to older populations may be limited, and a negative SLR test in an elderly patient should be interpreted with greater caution.

### Strengths and Limitations

The study benefits from its prospective design, standardized index-test procedures and blinded reference standard interpretation, and its large sample size, which produces precise estimates with narrow confidence intervals. The research contains multiple restrictions which need acknowledgment. The study took place in a tertiary care facility, which could lead to selection bias because our research participants might have shown more severe disease symptoms and higher pre-test probability than what is common in primary care settings. Second, a key limitation is the lack of a direct, intra-patient comparison between the seated and supine SLR tests. The design would have shown which treatment worked best for our

research participants. Third, we did not perform pre-specified subgroup analyses, especially for age, though a post-hoc analysis was added to address anatomical herniation zones. Given the strong evidence of age-related performance decline, future studies should investigate if the seated SLR's accuracy differs between younger and older patients. MRI detects structural damage, but it cannot measure pain production or nerve function, which makes it insufficient as a reference standard.<sup>6</sup>

## Future Directions

Future research needs to evaluate the diagnostic precision of seated and supine SLR tests on the same patient group to determine which test performs better. The SLR test requires further evaluation through large-scale prospective studies, which should analyze results based on age groups to establish its value for different life stages. The evaluation of diagnostic pathways between clinical signs and imaging methods will produce better value and improved patient results.

## CONCLUSION

The seated straight leg raise is a practical bedside maneuver with good sensitivity and moderate specificity for MRI-confirmed lumbosacral radiculopathy. Its diagnostic performance is enhanced by the use of strict interpretative criteria that focus on the reproduction of specific radicular pain. Performed properly within a comprehensive clinical assessment, it can help clinicians triage patients and prioritize imaging for those most likely to benefit.

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## AUTHORS CONTRIBUTIONS

| Authors                | Contribution                                                                                                                                    |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Muhammad Shoaib Kibzai | Conceptualization, methodology, data acquisition, project administration, supervision, critical revision of the manuscript, and final approval. |
| Shahrukh Panezai       | Conceptualization, data acquisition, analysis, original draft preparation, critical revision of the manuscript, and final approval.             |
| Mahrukh Panezai        | Imaging data acquisition, radiological interpretation, diagnostic correlation, contribution to results drafting, and final approval.            |