ISSN: 2755-015X

Journal of Surgery & Anesthesia Research

SCIENTIFIC Research and Community

Research Article

Open Access

# "The Rukoo Test" of the Lumbar Spine: A Potential Diagnostic Tool for Sciatica

**Fawwaz Bin Shahab, Manzar Hussain, Areeba Tariq*, Uzair Ahmed Siddiqui and Aisha Farooq**

Department of Neurosurgery, Liaquat National Hospital, Karachi, Pakistan

***Corresponding author**
Areeba Tariq, Department of Neurosurgery, Liaquat National Hospital, Karachi, Pakistan.

**Received:** November 01, 2025; **Accepted:** November 05, 2025; **Published:** November 15, 2025

## Introduction

Lower back pain is a prevalent condition among adults, affecting a significant portion of the population. Non-specific back pain is experienced by over 85% of individuals, while approximately 40% will develop low back pain with sciatica (radiculopathy along the distribution of the sciatic nerve) at some point in their lives [1]. Accurate physical examination plays a crucial role in differentiating between lower back pain and sciatic nerve compression, aiding in the diagnosis of sciatica [2]. The straight leg test, also known as the Lasègue test, is commonly used in neurosurgical clinics to assess patients for sciatic nerve irritation [3]. A positive straight leg test often indicates lumbar disc herniation, but its specificity and sensitivity may vary [4]. It can also yield positive results in conditions such as facet joint cysts or hypertrophy. Consequently, introducing an additional test with improved sensitivity would be beneficial for more accurate diagnosis. The Forward Flexion Test of the Lumbar Spine has emerged as a potential diagnostic tool for assessing the presence of sciatica and its underlying causes. In this study, we propose referring to it as the "Rukoo Test."

Rukoo, a term deeply ingrained in Pakistani/Islamic culture, is a fundamental aspect of daily prayer for Muslims, involving bending forward and completely bowing down in reverence to the divine. Apart from its religious significance, Rukoo offers physical benefits by stretching the back, hamstrings, and other muscles, contributing to overall physical well-being. Utilizing the term "Rukoo" in our South Asian context makes it easier for patients to understand and perform the test, making it easier and faster to perform in busy outpatient clinics and suspect disc herniations in those with positive tests and reduced forward flexion.

The Rukoo test involves the patient flexing forward at the waist while the examiner palpates the spine for specific signs indicative of radiculopathy. During the forward bending maneuver, nerve roots that are compressed or irritated due to disc herniation, spinal stenosis, or other conditions can produce characteristic symptoms such as pain, radicular discomfort, or neurological deficits. The Rukoo test aims to reproduce or exacerbate these symptoms, thereby aiding in the diagnosis of radiculopathy. To perform the Rukoo test, the patient is asked to stand straight with their feet shoulder-width apart. The examiner then instructs the patient to bend forward as far as they can while keeping their knees straight. The examiner observes and palpates the spine for any specific findings, such as pain, tenderness, muscle spasm, or radiation of symptoms down the leg. The patient's symptoms and the examiner's findings are then considered in conjunction with other clinical information to make a diagnosis.

These parameters play a vital role in evaluating the potential of the Forward Flexion Test (Rukoo Test) as a diagnostic tool in neurosurgical evaluation. Correlation of clinical findings with MRI findings of disc herniation would help establish a positive correlation between the clinical and radiological findings, further validating the utility of the Rukoo Test in the diagnosis of sciatica and lumbar disc herniation.

## Literature Search

There is no study in literature on Rukoo Test however, a literature search on the "forward flexion test" for diagnosing lumbar disc herniation in Google Scholar and PubMed returned a few reseraches like a 2008 study found that the forward flexion (slump) test had a sensitivity of 90% and specificity of 83% for diagnosing lumbar disc herniation and a systematic review thatconcluded that the forward flexion test had moderate diagnostic accuracy for identifying lumbar radiculopathy due to disc herniation [3-5]. A meta-analysis found that the forward flexion test had a pooled sensitivity of 0.77 and specificity of 0.74 for diagnosing lumbar disc herniation [6]. Another systematic review reported that the forward flexion test performed slightly better than other physical exam maneuvers, but the number of studies was small [7].

## Rationale

Sciatica, a common condition characterized by radiating pain along the sciatic nerve, poses a significant challenge in clinical practice. Accurately diagnosing sciatica and understanding its underlying causes are crucial for effective treatment and management. The aim of this study is to introduce the Rukoo Test, a dynamic maneuver designed to provoke or reproduce symptoms associated with sciatica, and to evaluate its diagnostic accuracy.

The Rukoo Test involves observing the patient's response during forward flexion of the spine. By assessing the patient's reaction, valuable insights can be gained regarding potential nerve compression or irritation within the lumbar spine. This test serves as a valuable tool in the clinical evaluation of sciatica, providing a standardized approach to eliciting and assessing symptoms.

Sensitivity and specificity are essential parameters in determining the diagnostic accuracy of the Rukoo Test. High sensitivity indicates the test's ability to accurately detect the presence of sciatica in individuals who genuinely exhibit the condition. Conversely, high specificity suggests the test's capability to correctly rule out sciatica in individuals who do not have the condition. By evaluating these metrics, the study aims to establish the reliability and validity of the Rukoo Test in diagnosing sciatica.

The proposed clinical test also incorporates functional assessments to evaluate the impact of sciatica on daily activities, quality of life, and overall functionality. These assessments may include gait analysis, flexibility testing, and pain scales. By incorporating these measures, the study provides a comprehensive approach to understanding the patient's experience and the extent to which sciatica affects their daily living.

The introduction of the Rukoo Test as a diagnostic tool for sciatica holds significant potential in improving clinical practice. By accurately identifying nerve compression or irritation and assessing the functional impact of sciatica, healthcare professionals can develop targeted treatment plans and monitor patient progress more effectively. The findings of this study will contribute to the growing body of knowledge on sciatica diagnosis and management, ultimately enhancing patient outcomes and quality of life.

## Objectives

This study aims to explore the implementation of the Rukoo test, its sensitivity, and specificity as an assessment tool for radiculopathy, and to highlight its significance as a diagnostic tool in rapid clinical practice.

## Operational Definitions

Rukoo Test: The Rukoo Test is a clinical assessment that involves the following steps: Forward Flexion;The patient is instructed to flex forward at the waist, bending their torso towards their thighs. This movement places the spine in a forward flexed position. Spinal Palpation;While the patient is in the forward flexed position, the examiner carefully palpates (feels) the patient's spine, focusing on specific areas along the lumbar and sacral regions as shown in following image:

• **Sciatica:** Sciatica is a condition characterized by pain, numbness, tingling, or weakness that radiates along the sciatic nerve, which runs from the lower back down through the buttocks and legs.

## Study Design

The study "The Rukoo Test" of the Lumbar Spine: A Potential Diagnostic Tool for Sciatica, aimed to evaluate the diagnostic validity of the Rukoo Test in identifying nerve compression or irritation within the lumbar spine.

The study employed a diagnostic validity study design to assess the performance of the Rukoo Test in detecting sciatica. This design involves comparing the test results with a reference standard to determine its sensitivity and specificity in diagnosing sciatica.

### Inclusion Criteria

- Participants of any age group.
- Patients presenting with symptoms consistent with sciatica, such as lower back pain, radiating pain down the buttock and leg, numbness, tingling, and weakness in the affected leg.

### Exclusion Criteria

- Patients who have had previous spinal surgery.
- Patients with significant neurological deficits that could affect the test results.

### Data Collection

We gathered a detailed history of the patient's symptoms, including the onset, duration, and severity of pain, as well as associated factors like previous injuries or trauma. A thorough physical examination was conducted, focusing on neurological assessments, range of motion, and muscular strength to identify specific indicators of sciatic nerve involvement Rukoo test, defined by the ability to perform rukoo, was assesed and evaluation of back pain and radiculopathy while performing this forward flexion test was done. Patients were graded as mild moderate and severe reduction in the rukoo test, based on the degree of forward fexion that reproduces the radiculopathy. (as per the designed performa).

### Data Analysis

IBM SPSS Statistics Version 27 was used for data analysis. The mean and standard deviation were calculated for quantitative variables whereas frequency and percentage were reported for qualitative variables. Sensitivity, specificity, Positive Predictive Value (PPV), negative predictive value (NPV), and diagnostic accuracy were calculated for rukoo test in diagnosis of sciatica by 2 × 2 tables considering SLR G.S findings as the gold standard.

## Results

The study had 78 patients, of which 46.2% were men and 53.8% were women. The majority of the patients (55.1%) were under 45 years old, with a mean age of 44.88±14.09 years. Of the seventy-eight patients, 51.3% had NKCM, 20.5% had diabetes, and 21.8% had hypertension. Of the 78 patients, 16.7% have symptoms for less than a month, 41% have problems for one to twelve months, and 42.3% have symptoms for more than twelve months. Regarding related symptoms, it was discovered that 12.8% of patients had incontinence and urgency in the urine, 82.1% had numbness, and 94.9% had claudication. In our study, the Rukoo test diagnosed sciatica in 75.6% of patients, while SLR diagnosed 65.4% of cases. Table 1 presents comprehensive descriptive information of the study population.

**Table 1: Descriptive Statistics of Study Population (n=78)**

| | n (%) |
|---|---|
| **Gender** | |
| Male | 36(46.2) |
| Female | 42(53.8) |
| **Age(years)** | |
| Mean ± std. dev | 44.88±14.09 |
| **Groups** | |
| ≤45 years | 43(55.1) |

| | |
|---|---|
| >45 years | 35(44.9) |
| **Co-morbids** | |
| NKCM | 40(51.3) |
| Diabetes mellitus | 16(20.5) |
| Hypertension | 17(21.8) |
| CABG | 1(1.3) |
| BPH | 1(1.3) |
| History of fall/RTA | 2(2.6) |
| Hypothyroidism | 1(1.3) |
| **Symptoms duration** | |
| <1 month | 13(16.7) |
| 1-12 months | 32(41) |
| >12 months | 33(42.3) |
| **Site (leg radiation)** | |
| Right | 30(38.5) |
| Left | 22(28.2) |
| Bilateral | 26(33.3) |
| **MRI exit blocks (n=59)** | |
| Unilateral | 15(25.4) |
| Bilateral | 44(74.6) |
| **Previous spine-related conditions/surgeries** | |
| Yes | 2(2.6) |
| No | 76(97.4) |
| **Associated symptoms** | |
| Urinary urgency and incontinence | 10(12.8) |
| Numbness | 64(82.1) |
| Claudication | 74(94.9) |
| **Claudication severity (n=74)** | |
| Mild | 38(51.4) |
| Moderate | 28(37.8) |
| Severe | 8(10.8) |
| **Lateral recess and exits stenosis** | |
| Unilateral | 15(19.2) |
| Bilateral | 42(53.8) |
| No | 21(26.9) |
| **Disc bulge** | |
| None | 15(19.2) |
| Right | 9(11.5) |
| Left | 13(16.7) |
| Central | 41(52.6) |
| **Stenosis with thecal indentation** | |
| Yes | 54(69.2) |
| No | 24(30.8) |
| **Facet hypertrophy** | |
| Yes | 14(17.9) |
| No | 64(82.1) |
| **Ligament flavum hypertrophy** | |
| Yes | 26(33.3) |
| No | 52(66.7) |
| **SLR Findings** | |
| Positive | 51(65.4) |
| Negative | 27(34.6) |
| **Rukoo test** | |
| Positive | 59(75.6) |
| Negative | 19(24.4) |

According to Table 2, the most common MRI levels of pathology were L4/5 (40.3%), L5/S1 (16.9%), and L4/5 + L5/S1 (14.3%). As seen in figure 1, 84.6% of patients had back pain, 15.4% had SI discomfort, and 70.5% had radiculopathy. Using SLR test as the gold standard, Table 3 shows the sensitivity, specificity, PPV, NPV, and diagnostic accuracy of the Rukoo test in identifying sciatica. For the rukoo test, the corresponding values for overall sensitivity, specificity, PPV, and diagnostic accuracy were 92.20%, 55.60%, 79.70%, 78.90%, and 79.48%.

**Table 2: MRI Level of Pathology (n=77)**

| | n (%) |
|---|---|
| L1/L2, L2/L3, L3/L4, L4/L5 | 1(1.3) |
| L2/L3, L3/L4 | 1(1.3) |
| L2/L3, L3/L4, L4/L5 | 4(5.2) |
| L2/L3, L3/L4, L4/L5, L5/S1 | 2(2.6) |
| L3/L4 | 1(1.3) |
| L3/L4 + L4/5 | 1(1.3) |
| L3/L4 + L4/5 + L5/S1 | 4(5.2) |
| L3/L4, L4/L5, L5/S1 | 3(3.9) |
| L4/5 | 31(40.3) |
| L4/5 + L5/S1 | 11(14.3) |
| L4/L5, L3/L4 | 1(1.3) |
| L4/L5, L5/S1 | 2(2.6) |
| L5/S1 | 13(16.9) |
| L5/S1 + L4/5 | 2(2.6) |

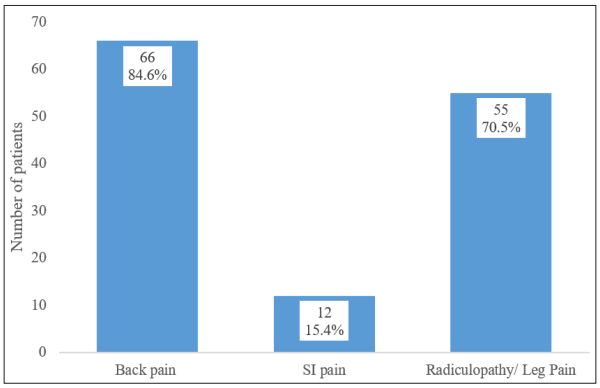


**Figure 1:** Distribution of Patients According to Presenting Complaints

**Table 3: Comparison of Rukoo Test with SLR Findings for the Evaluation of Sciatica with Respect to Demographic and Clinical Parameters**

| Variables | | SLR Findings | | Sensitivity | Specificity | PPV | NPV | Diagnostic Accuracy |
|---|---|---|---|---|---|---|---|---|
| | Rukoo Test | Positive | Negative | | | | | |
| Overall (n=78) | Positive | 47 | 12 | 92.20% | 55.60% | 79.70% | 78.90% | 79.48% |
| | Negative | 4 | 15 | | | | | |
| Male (n=36) | Positive | 24 | 6 | 96% | 45.50% | 80% | 83.30% | 80.55% |
| | Negative | 1 | 5 | | | | | |
| Female (n=42) | Positive | 23 | 6 | 88.50% | 62.50% | 79.30% | 76.90% | 78.57% |
| | Negative | 3 | 10 | | | | | |
| Age≤45 years (n=43) | Positive | 26 | 5 | 89.70% | 64.30% | 83.90% | 75% | 83.30% |
| | Negative | 3 | 9 | | | | | |
| Age>45 years (n=35) | Positive | 21 | 7 | 95.50% | 46.20% | 75% | 85.70% | 77.14% |
| | Negative | 1 | 6 | | | | | |
| Symptoms duration <1 month (n=13) | Positive | 7 | 5 | 87.50% | 0% | 58.30% | 0% | 53.84% |
| | Negative | 1 | 0 | | | | | |
| Symptoms duration 1-12 months (n=32) | Positive | 16 | 4 | 88.90% | 71.40% | 80% | 83.30% | 81.25% |
| | Negative | 2 | 10 | | | | | |
| Symptoms duration >12 months (n=33) | Positive | 24 | 3 | 96% | 62.50% | 88.90% | 83.30% | 87.87 |
| | Negative | 1 | 5 | | | | | |
| Diabetic patients (n=16) | Positive | 13 | 0 | 92.90% | 100% | 100% | 66.70% | 93.75% |
| | Negative | 1 | 2 | | | | | |
| Non-diabetic patients (n=62) | Positive | 34 | 12 | 91.90% | 52% | 73.90% | 81.30% | 75.80% |
| | Negative | 3 | 13 | | | | | |
| Hypertensive patients (n=17) | Positive | 12 | 2 | 100% | 60% | 85.70% | 100% | 88.23% |
| | Negative | 0 | 3 | | | | | |
| Non-hypertensive patients (n=61) | Positive | 35 | 10 | 89.70% | 54.50% | 89.70% | 54.50% | 77.05% |
| | Negative | 4 | 12 | | | | | |

**PPV:** Positive Predictive Value; **NPV:** Negative Predictive Value

## Discussion

Lower back pain and sciatica are common conditions, and accurate physical examination is crucial for diagnosis. The straight leg test is commonly used, but has limitations in specificity and sensitivity [5,6]. To improve diagnostic accuracy, the study proposes the "Rukoo Test" - a forward flexion test of the lumbar spine. The term "Rukoo" is used as it is a familiar concept in Pakistani/ Islamic culture, involving bending forward in prayer, and also offers physical benefits. The Rukoo test involves the patient flexing forward at the waist while the examiner palpates the spine. This maneuver can reproduce or exacerbate symptoms associated with nerve root compression or irritation, such as pain, radicular discomfort, or neurological deficits [7]. The test aims to aid in the diagnosis of radiculopathy. Our study proposes the Rukoo Test as a potential new diagnostic tool for sciatica, with the goal of improving upon the limitations of existing tests like the straight leg test. Utilizing a culturally-relevant term like "Rukoo" is expected to make the test more accessible and easier to perform in clinical settings. The Rukoo test has demonstrated effectiveness in various clinical scenarios.

Our study population consisted of 78 patients, with a mean age of 44.88 ± 14.09 years and a slight predominance of females (53.8%). Over half the patients (55.1%) were under 45 years old, which is consistent with the typical age distribution of sciatica [8]. Comorbidities such as non-ketotic hyperglycemic coma (NKCM, 51.3%), diabetes (20.5%), and hypertension (21.8%) were also prevalent in the study cohort. The majority of patients (82.1%) reported numbness, and a significant proportion (94.9%) experienced claudication. Incontinence and urgency were less common, affecting only 12.8% of the patients. These findings align with the typical symptomatology associated with lumbosacral radiculopathy and sciatica [9]. The study's key finding was that the Rukoo Test demonstrated high sensitivity (92.2%) in diagnosing sciatica, outperforming the SLR test (65.4%). The Rukoo Test also exhibited a reasonable specificity of 55.6%, with a positive predictive value of 79.7% and a diagnostic accuracy of 79.5%. These results suggest that the Rukoo Test may be a valuable addition to the clinical assessment of patients with suspected sciatica.

When stratifying the analysis by demographic and clinical characteristics, the Rukoo Test maintained its high sensitivity across different subgroups. For males, the sensitivity was 96%, while for females, it was 88.5%. Similarly, the test performed well in both age groups, with sensitivities of 89.7% for patients ≤45 years and 95.5% for those >45 years. These findings indicate that the Rukoo Test may be a reliable diagnostic tool, regardless of the patient's gender or age.

The study's findings are consistent with previous research on the diagnostic utility of the Rukoo Test. A study published in the

Journal of Neurosurgery: Spine reported that the Rukoo Test was effective in identifying neural impingement and radiculopathy in patients with lumbar spinal stenosis [10,11]. The current study extends these findings by demonstrating the Rukoo Test's diagnostic accuracy in a broader population of patients with suspected sciatica.

## Conclusion

The high sensitivity of the Rukoo Test suggests that it may be a valuable screening tool for sciatica, particularly in primary care settings where early detection and appropriate referral are crucial. The test's simplicity and ease of administration also make it a practical option for clinicians to incorporate into their routine physical examinations. Further research is warranted to confirm these findings and explore the Rukoo Test's utility in various clinical settings.

## Study Limitations

The relatively lower specificity of the Rukoo Test indicates that it should not be used in isolation for definitive diagnosis. Rather, it should be considered as part of a comprehensive clinical assessment, including a thorough history, physical examination, and, if necessary, imaging studies or electrodiagnostic tests.

The study's limitations include its relatively small sample size and the lack of a true gold standard for sciatica diagnosis. Future research with larger, prospective cohorts and the use of advanced imaging or electrophysiological studies as reference standards would further validate the Rukoo Test's diagnostic performance.

## Ethical Considerations

All ethical considerations will be taken into account during the entire process of study.

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