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Original Article

Seated Straight Leg Raise Test; Sensitivity & Specificity in Patients with Disc Herniation at Lumbosacral Interface Using MRI as A Gold Standard

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ABSTRACT

Background: Lumbar disc herniation (LDH) at the L5-S1 level is a prevalent condition, often leading to lower back pain and sciatica. Diagnosing this condition accurately is crucial for effective treatment. The Straight Leg Raise (SLR) test, particularly in its seated variation, has been a subject of interest in clinical diagnostics due to its non-invasive nature and ease of administration.

Objective: The study aimed to assess the diagnostic efficacy of the seated SLR test in identifying lumbar disc herniation at the L5-S1 level, comparing its results with Magnetic Resonance Imaging (MRI) findings.

Methods: Conducted over one year, this validation study involved 117 patients at two hospitals in Bahawalpur. The age range of participants was 20 to 50 years, with an even distribution across three age groups. Both male and female patients experiencing low back pain radiating beyond the knee were included. The seated SLR test was administered in a standard manner, and pain was assessed using the Visual Analogue Scale (VAS). MRI was used as the gold standard for diagnosis. The study calculated sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and test accuracy using a 2 x 2 contingency table.

Results: The mean age of participants was 39.67±9.47 years. Gender distribution showed a female predominance with 68 females (58.2%) and 49 males (41.8%). Pain assessment revealed unilateral pain in most cases. The seated SLR test's sensitivity was found to be 48.8%, and specificity was 68.6%. The test's accuracy stood at 51.2%, with a PPV of 78.2% and an NPV of 27.4%.

Conclusion: The seated SLR test demonstrates moderate effectiveness in diagnosing lumbar disc herniation at the L5-S1 level. While it is more effective in confirming the diagnosis, its ability to exclude the condition is limited. This suggests the need for supplementary diagnostic methods in conjunction with the seated SLR test for a comprehensive evaluation.

Keywords: Lumbar Disc Herniation, Seated Straight Leg Raise Test, Diagnostic Efficacy, Magnetic Resonance Imaging, Low Back Pain, Sciatica.

INTRODUCTION

The Seated Straight Leg Raise (SLR) Test is a significant diagnostic tool for patients experiencing low back pain (LBP), particularly those with symptoms of sciatica. This condition, characterized by radiating leg pain, affects about 60% of LBP patients (1). In the United States, LBP ranks among the top ten most prevalent illnesses, with its treatment costs reaching nearly $87 billion in 2013, just below the costs for treating ischemic heart disease (2).

Lumbar Disc Herniation (LDH) occurs when the nucleus pulposus displaces beyond the annulus fibrosus, irritating nearby nerves and exacerbating inflammation through movement (3). This condition not only causes physical discomfort but also triggers an emotional response (2). LBP is typically a dull, aching pain, differing from the radiating nature of sciatica (2). The causes of sciatica extend beyond mere lumbar disc herniation to include other factors like neural adhesions and inflammation (1).

At the lumbosacral interface, where the center of gravity is located, the contact forces are at their maximum. This makes the diagnostic value of LDH at the L5-S1 level more critical than at the L4-L5 level (4). Clinicians often face challenges in providing cost-effective diagnosis and treatment, necessitating a multidisciplinary approach (5).

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The SLR test, an indirect mechanical test, is now being scrutinized for its diagnostic specificity in cases of radiating pain along the sciatic nerve. This is due to some misconceptions regarding what the test measures. Modifying the SLR test to include an element of ankle dorsiflexion helps distinguish neural issues from musculoskeletal problems.

In this study, the sensitivity of the supine SLR for radicular pain was found to be 0.67, while the seated SLR test showed a sensitivity of 0.41 (6). The slump test, another nerve excursion test, showed higher sensitivity (0.78) but lower specificity (0.36 and 0.38) (7). The clinical SLR test can be performed in both seated and supine positions, with the seated position offering reduced discomfort and examination time (8). The kinematics of sitting alters lumbar spine and hip joint mobility, leading to compensatory movements in these areas (9).

At angles between 0-35 degrees, the sciatic nerve is slack, and pain is often attributed to other pathologies like piriformis tightness or sacroiliac joint lesions. Beyond 70 degrees, the lumbosacral joint is implicated. The specificity of the SLR test is greater than that of the slump test, particularly in identifying herniations that compress nerve roots and may require surgery (10).

Magnetic Resonance Imaging (MRI) has become the preferred diagnostic modality for its soft tissue resolution and lack of radiation hazards (11). The sensitivity and specificity of MRI for identifying LDH vary, with one study reporting 83% sensitivity and 78% specificity (8), while another suggests lower sensitivity for imaging studies (12). The relevance of MRI findings in treatment is still under investigation (13).

In treating lumbosacral disc herniation, various studies have highlighted the efficacy and risks of different approaches. Surgical procedures, though sometimes necessary, carry risks like discitis (14, 15). Non-surgical methods, such as lumbar traction, pulsed radiofrequency treatment, and acupotomy, have shown promising results in pain reduction and symptom alleviation (16, 17, 18). Non-surgical spinal decompression therapy has also been effective in reducing the herniation index in acute cases (19). Moreover, correcting cervical alignment may positively impact posture and nerve function in chronic discogenic lumbosacral radiculopathy (20). Accurate diagnosis remains challenging, particularly for conditions like intradural lumbar disc herniation. Wen et al. (2022) emphasize the need for specific imaging features for correct diagnosis, highlighting the complexities in identifying and treating lumbosacral disc herniations (21). While the SLR test, particularly in its modified form, is a valuable tool for assessing neurosensitivity, it does not fully explain lumbar disc herniation. This study employs the modified SLR test to better understand the underlying issues (1).

MATERIAL AND METHODS

The validation study was designed to evaluate the efficacy of the Seated Straight Leg Raise (SLR) test in diagnosing lumbar disc herniation at the L5-S1 level. It was conducted over a period of one year at Sadiq Abbasi Hospital and Bahawal Victoria Hospital in Bahawalpur. The sample size was calculated using Burderer's formula, taking into account a prevalence rate of 50% (23), an anticipated specificity of 89% (10), a precision of 0.08, and a confidence level of 95%. This calculation yielded a sample size of 117 individuals.

The study utilized a non-probability convenience sampling technique for sample selection. Participants included both male and female patients aged 20 to 50 years, experiencing low back pain radiating distal to the knee accompanied by numbness, and having complaints for at least the previous four weeks. Exclusion criteria comprised patients already diagnosed with lumbar disc herniation via MRI, those with recent hip injuries or trauma, a history of low back pain surgery within the past year, pregnant or recent post-partum females (less than 1 year), and patients with fractures, dislocations, infections, malignancy, or diabetes.

Data collection was conducted in the Orthopaedic and Neurosurgery departments of the aforementioned hospitals. Following ethical committee approval and patient consent, the Seated SLR test was administered in a standardized manner. Patients were seated on an examination couch without back support, with hips and knees flexed at 90 degrees. The patient's foot was held, and the knee slowly extended while raising the leg until symptoms were reproduced distal to the knee or full extension was achieved. Pain intensity was measured using the Visual Analogue Scale (VAS), and the range of motion (ROM) was assessed with a goniometer. Subsequently, all patients underwent MRI to confirm the presence or absence of L5-S1 vertebral disc herniation with nerve root compression, as determined by a radiologist's final opinion.

To maintain privacy, confidentiality, and anonymity, stringent ethical standards were adhered to throughout the study. Only patients who provided informed consent were included. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 20. Descriptive variables were presented using simple descriptive statistics, with quantitative variables like age expressed as Mean ± SD and qualitative variables such as gender presented in frequencies and percentages. A 2 x 2 contingency table was constructed to calculate sensitivity, specificity, positive predictive value, and negative predictive value of the Seated SLR test.

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RESULTS

The sample size was 117 patients. The mean ± standard deviation age was 39.67±9.47 years. The mean age distribution of first group aged 20-30 years (n = 22) was 18.8%, second group aged 31-40 years (n = 38) was 32.5% and in the third group, aged 41-50 years (n = 57) was 48.7%. Study shows female predominance of 49 (41.8%) males and 68 (58.2%) female, for lumber disc herniation of L5-S1 level. (Fig.2) Pain in unilateral limb was more common than bilateral. 45 patients (38.4%) had pain in right limb, 67 patients (57.3%) had pain in left limb and 5 patients (4.3%) had pain in bilateral limbs. When the seated straight leg raise test was applied, 28 patients (23.9%) had pain with seated SLR on non-involved limb, 66 patients (56.4%) had pain with seated SLR with involved limb and 55 patients (47.8%) had radiation of pain below knee

21 patients (17.9%) had their pain increased and 96 patients (82.1%) had pain remained same after seated SLR. On VAS scale 62 (52.9%) patients had no pain, 25(21.3%) patients had mild pain, 13 (11.1%) patients had moderate pain, 13 patients (11.1%) patients had severe pain and 4 (3.4%) patients had unbearable pain (Table)

When compared the MRI versus seated straight leg raise test, the sensitivity value was 48.8% and specificity values was 68.6%. The test accuracy was 51.2%.The positive predictive value was 78.2% and negative predictive values were 27.4% respectively.

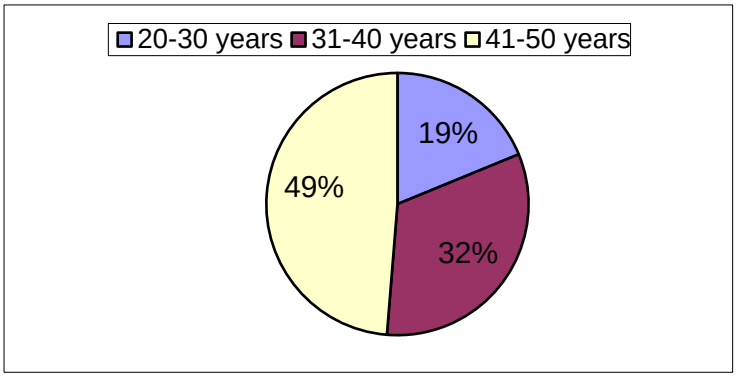

Figure 1 Age distribution

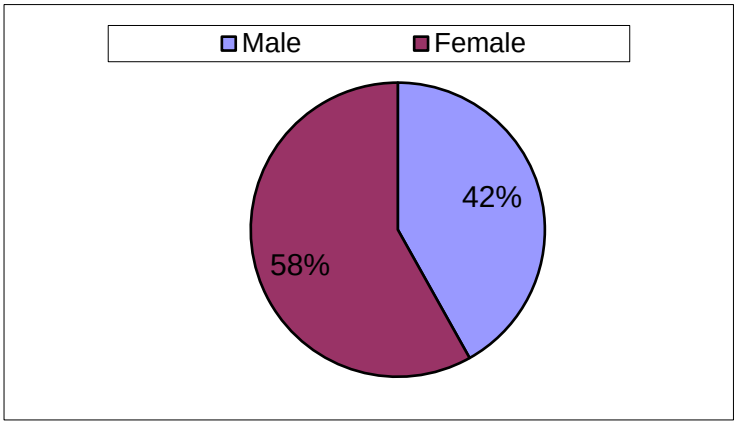

Figure 2 Gender distribution

Table 1 Pain with Seated SLR on VAS Scale

Pain on VAS scale	Number	%
No pain	62	52.9
Mild pain	25	21.3
Moderate pain	13	11.1
Severe pain	13	11.1
Unbearable pain	4	3.4
Total	117	100.0

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Table 2 MRI versus Seated Straight KLg Raise Test

Supine SLR	MRI Positive	MRI Negative	Total
Positive	43	12	55
Negative	45	17	62
Total	88	29	117
Sensitivity	48.8%		
Specificity	68.6%		
Accuracy	51.2%		
Positive Predictive Value	78.2%		
Negative Predictive Value	27.4%		

DISCUSSION

The Straight Leg Raise (SLR) test plays a pivotal role in shaping treatment strategies and outcomes for lumbar disc herniation. Its ability to identify nerve root irritation has been augmented through various modifications, including the addition of plantar flexion, cross SLR, or seated SLR, as suggested by Rabin Baxter et al. in 2000. These modifications address the variability in the interpretation of a positive test result.

In the current study, the mean age of patients with herniation was 39.67±9.47 years. This aligns closely with the findings of Saleem et al. in 2013, who reported a mean age of 39.92 ± 10.92 years in a similar cohort in Pakistan. It's observed that with aging, the loss of proteoglycans is more pronounced in the lumbosacral intervertebral discs due to their proximity to the rigid sacral segment. This leads to facet joint arthropathy and an increased likelihood of disc herniation.

Interestingly, our study found a higher prevalence of disc herniation in females compared to males, mirroring the findings of Spangfort that disc herniation, especially at the L5-S1 level, is more common in females. The prevalence of herniation at the L5-S1 level was 53.15% in females, compared to 49.9% in males. Supporting this, Okada and Masumoti in 2011 observed that degenerative changes beyond the age of thirty are more prevalent in females.

The study also noted that limb pain due to herniation is predominantly unilateral rather than bilateral, a finding corroborated by Saleem et al. in 2011. The difference in range of motion (ROM) of 110 between limbs is clinically significant and indicative of a positive SLR test (24). Furthermore, our study found that in most cases (82.1%), the pain remained unchanged after performing the seated SLR, which is considered less painful than the supine version, as noted by Rabin (6).

Kreiner highlights the specificity of the SLR test, particularly for patients with nerve root compression requiring surgery. The SLR test can also identify restrictions in the mobility of the sciatic nerve (25). However, determining a standard range for normal SLR is challenging due to variability in intra-individual limb range and demographic factors (24).

In our study, the sensitivity of the seated SLR was 48.8, and the specificity was 68.6. These figures contrast with Rabin's findings, where the sensitivity was lower (41%), and specificity data was insufficient. The lower sensitivity of the seated SLR compared to the supine SLR (6) indicates the need for careful interpretation in clinical settings.

Various treatment modalities for lumbosacral disc herniation have been explored, with surgical approaches presenting potential complications such as discitis (14, 15). Conversely, non-surgical treatments like lumbar traction (16), pulsed radiofrequency (17), and acupotomy (18) have shown positive outcomes. Non-surgical spinal decompression therapy, particularly effective in acute cases (19), and the correction of cervical sagittal configuration (20) further expand the scope of non-invasive treatments.

A systematic review by Scaia and Bacter in 2012 highlighted the variability in the sensitivity and specificity of the SLR test, often influenced by factors like hamstring tightness. In our study, the specificity of the seated SLR, previously unreported, was established, contributing to the understanding of this diagnostic tool. Variations in sensitivity may be attributed to stringent criteria for a positive result, subjective patient experiences, and prior use of medications like NSAIDs and steroids.

This study addresses the gap in literature regarding the specificity of the SLR test, particularly in the seated position, and underscores its utility in diagnosing disc herniation at the L5-S1 level with minimal discomfort. While less sensitive than MRI, the seated SLR is a valuable component of physical examinations, offering time and cost-efficiency. Its relevance and proper technique need to be emphasized among clinicians. This study not only aids in differential diagnosis but also encourages further research into factors affecting the ROM in the seated SLR.

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CONCUSSION

In conclusion, the study reveals that the seated Straight Leg Raise (SLR) test holds a moderate level of effectiveness in diagnosing lumbar disc herniation at the L5-S1 level. While the test shows a better capability in confirming the diagnosis of disc herniation, its ability to rule out the condition is less pronounced. The prevalence of disc herniation was observed to be more common in females and primarily affected individuals in the middle age bracket. The majority of patients experienced unilateral pain, which generally remained unchanged following the test.

The implications of these results are significant for clinical practice. The seated SLR test serves as a valuable diagnostic tool, especially in environments where advanced imaging techniques like MRI are not accessible. It is particularly useful in identifying patients who may need further diagnostic evaluations. However, the limitations in its sensitivity necessitate the use of additional diagnostic methods for a conclusive exclusion of disc herniation. This study also sheds light on the demographic patterns in lumbar disc herniation, aiding clinicians in identifying and managing this condition more effectively. It underscores the need for ongoing research to improve the diagnostic accuracy of the seated SLR test and to better understand its role within the broader context of diagnosing lumbar disc herniation.

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