

# The Sensitivity of the Seated Straight-Leg Raise Test Compared With the Supine Straight-Leg Raise Test in Patients Presenting With Magnetic Resonance Imaging Evidence of Lumbar Nerve Root Compression

Alon Rabin, DPT, MS, Peter C. Gerszten, MD, MPH, Pat Karausky, RN, BSN, Clareann H. Bunker, PhD, Douglas M. Potter, PhD, William C. Welch, MD

**ABSTRACT.** Rabin A, Gerszten PC, Karausky P, Bunker CH, Potter DM, Welch WC. The sensitivity of the seated straight-leg raise test compared with the supine straight-leg raise test in patients presenting with magnetic resonance imaging evidence of lumbar nerve root compression. *Arch Phys Med Rehabil* 2007;88:840-3.

**Objective:** To compare the sensitivity of 2 methods of performing the straight-leg raise (SLR) test, one in the supine position and the other in the seated position, in patients presenting with signs and symptoms consistent with lumbar radiculopathy.

**Design:** A cohort study in which patients with signs and symptoms consistent with lumbar radiculopathy and magnetic resonance imaging (MRI) results available for review at the time of participation were assessed with both the supine and the seated SLR test.

**Setting:** A large neurosurgical referral office.

**Participants:** Seventy-one consecutive patients with signs and symptoms consistent with lumbar radiculopathy referred for evaluation of low back pain were prospectively recruited.

**Interventions:** Not applicable.

**Main Outcome Measures:** Supine SLR and seated SLR. MRI was used as the criterion standard.

**Results:** The sensitivity of the supine SLR test was .67 compared with a sensitivity of .41 of the seated SLR test ( $P=.003$ ).

**Conclusions:** The traditional SLR test performed in a supine position is more sensitive in reproducing leg pain than the seated SLR test in patients presenting with signs of and symptoms consistent with lumbar radiculopathy and MRI evidence of nerve root compression.

**Key Words:** Neurologic examination; Lumbar region; Radiculopathy; Rehabilitation.

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APPROXIMATELY TWO THIRDS of adults will suffer low back pain (LBP) at some time in their lives, most commonly affecting men and women in the fourth and fifth decades of their lives.<sup>1</sup> Lumbar radiculopathy is a disease of the lumbar nerve root. The features of lumbar radiculopathy include pain, paresthesia, weakness, reflex change, and sensory loss. The pain and paresthesia are uniquely distributed within the territory innervated by the affected nerve root.<sup>2,3</sup> Lumbar radiculopathy is a widespread, often disabling, condition seen in general medical and spine practices.

Magnetic resonance imaging (MRI) is the most common imaging technique used to evaluate lumbar spinal conditions. MRI can show bulging, protruding, or herniated disks and any associated nerve root compression.<sup>4,5</sup> The sensitivity and specificity of MRI in detecting neural structure compromise in the lumbar spine has been reported at 83% and 78%, respectively.<sup>6</sup> The reliability of MRI evaluation of lumbar disk herniation has been reported at  $\kappa$  equal to .74.<sup>6</sup> It has been well established, however, that findings such as bulging or even protruding disks on an MRI are common in completely asymptomatic persons.<sup>7,8</sup> For this reason, it is extremely important to correlate these imaging results to the history and physical examination to establish an accurate diagnosis.

Manipulative tests are used to help confirm the diagnosis of lower lumbar radiculopathy. The straight-leg raise (SLR) test is among the tests commonly used.<sup>9</sup> In a recent literature review<sup>10</sup> of the diagnostic accuracy of the SLR test, the test was shown to have a fairly high sensitivity (91%) but low specificity (26%) in detecting lumbar disk herniation. This high sensitivity rate suggests that, given a negative SLR, the diagnosis of acute lumbar radiculopathy may be ruled out with reasonable confidence.

Historically, the SLR test was described by Lasègue's pupil Forst in 1881 and subsequently reported in further detail by Lazarevic.<sup>11-14</sup> A number of variations and supplemental additions to this manipulative procedure have been described.<sup>14</sup> The SLR test is traditionally performed with the patient in the supine position. The examiner flexes the patient's hip while maintaining the knee in extension. This maneuver causes a gliding of the lumbar nerve roots.<sup>15</sup> When a structural abnormality such as a herniated disk compresses the nerve root proximal to or at the neural foramen, pain may occur as these roots are pulled against the disk herniation and gliding is restricted.<sup>14-16</sup> This may lead to pain radiating down the leg in the appropriate nerve root distribution (generally L4, L5, or S1). The exact cause of the pain is unknown, but the symptoms may be related to decreased blood flow in the nerve roots, increased tension of the nerve, compression of the nerve root, nerve root irritation, or other causes.<sup>15,17,18</sup>

An alternative practice method to assess for acute lumbar radiculopathy has been to perform the SLR test in the seated

From the Department of Neurological Surgery and Orthopaedic Surgery (Gerszten, Karausky, Welch), University of Pittsburgh School of Medicine and the School for Rehabilitative Sciences and Technology, Pittsburgh, PA (Rabin); Biostatistics Facility, University of Pittsburgh Cancer Institute, Pittsburgh, PA (Potter); and Graduate School of Public Health, University of Pittsburgh, Pittsburgh, PA (Bunker).

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Reprint requests to Pat Karausky RN, BSN, CCRC, Dept of Neurological Surgery, UPMC-Health System, Presbyterian University Hospital, Ste B-400, 200 Lothrop St, Pittsburgh, PA 15213, e-mail: [pkarausky@hs.pitt.edu](mailto:pkarausky@hs.pitt.edu).

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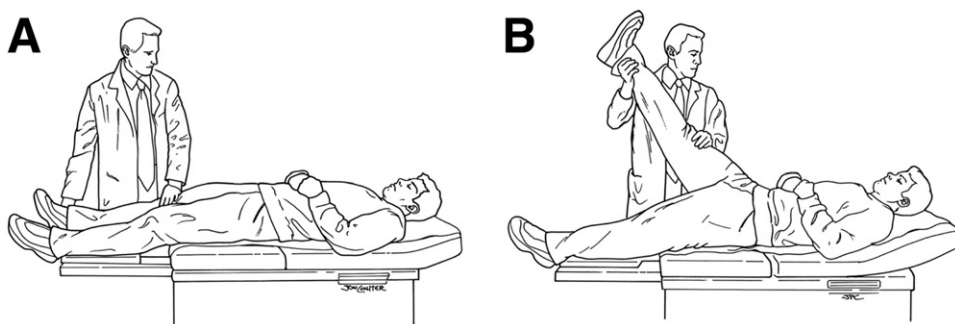


Fig 1. (A, B) The supine SLR test.

position by extending the patient's knee and assessing for the reproduction of symptoms. The origin of this practice is unclear, but it may have originated from previous work by Waddell<sup>19</sup> and Weinstein and colleagues<sup>20</sup> who compared this seated SLR test to the supine SLR test in an effort to examine the presence of nonorganic pain behavior in patients suffering from LBP. This seated SLR test has the potential advantages of not only providing reduced patient discomfort by not placing the patient in a supine position but also expediting the physical examination. Importantly, although there has been a trend to replace the supine SLR test with the seated SLR test, neither the sensitivity nor the specificity of the seated SLR test has been determined.

The aim of this study was to compare a less accepted diagnostic maneuver, the seated SLR test, with a well-accepted diagnostic maneuver, the supine SLR test, in a selected group of patients who had a clinical presentation of lumbar radiculopathy as well as correlating radiographic evidence of nerve root compression. We hypothesized that the seated SLR test is not identical to the supine SLR test, and discrepancies between the 2 tests will exist.

## METHODS

### Study Design, History, and Physical Examination

Seventy-one consecutive patients referred to the outpatient neurologic surgery clinic for evaluation of LBP who met the inclusion criteria were prospectively recruited for this study. Inclusion criteria were age greater or equal to 18 years and a complaint of LBP with pain or paresthesia radiating into either or both lower extremities below the level of the knee for at least 4 weeks. All patients underwent MRI of their lumbar spine before evaluation. Patients who underwent spine surgery within 6 months before their referral were excluded from participation, as were patients with lumbar instability requiring fusion, far-lateral disk rupture, metastatic disease, severe vascular disease, or lumbar infection. The institutional review

board of the University of Pittsburgh approved the study, and all subjects signed a consent form before enrollment.

All subjects underwent a standard clinical evaluation including recording the history of the current condition and general health and psychosocial status. This was followed by a physical examination that included evaluation of lumbar range of motion, myotomal muscle strength, deep tendon reflexes, and dermatomal sensory testing. Other routine examination procedures were performed but not for the purpose of the study. The findings were compared with accepted norms for physical examination. The results of the history and physical examination were determined independently of the lumbar MRI.

The SLR test was performed on all subjects in both supine and seated positions. The supine SLR test was performed by having the patient lie down on a flat examination table in a supine position. Both hips and knees were maintained in a neutral position. The patient's head was not supported by a pillow. The examiner grasped the patient's heel in the cup of his hand. The examiner's other hand maintained the patient's knee in an extended position. The examiner slowly raised the tested leg up to 90° by flexing the hip while maintaining the knee in extension (figs 1A, 1B). When the patient complained of reproduction of symptoms distal to the knee joint, the maneuver was stopped. The examiner then flexed the patient's knee while keeping the hip at the same angle, and the patient was asked to report any change of his/her symptoms. The procedure was performed first on the noninvolved leg (in patients with unilateral complaints) and then repeated on the involved leg.

The seated SLR test was performed with the patient seated on the examination table with his/her hips and knees flexed to 90°. No lumbar support was given. The examiner held the patient's foot in the cup of his hand. The examiner slowly raised the patient's leg extending the patient's knee (figs 2A, 2B). The leg extension was stopped when the patient complained of the reproduction of symptoms distal to the knee joint or full extension was obtained. The examiner then lowered the

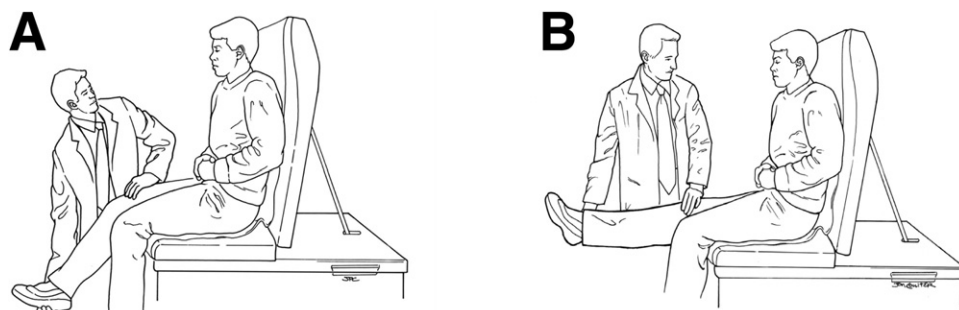


Fig 2. (A, B) The seated SLR test.

**Table 1: Clinical Findings on the Symptomatic Side Suggesting Lumbar Radiculopathy Among Study Participants**

Finding	No. of Participants With Positive Findings
Myotomal weakness	
L1-2 iliopsoas	27
L3-4 quadriceps	29
L4 tibialis anterior	25
L5 tibialis anterior, extensor hallucis	34
S1 gastrocnemius	25
Dermatomal sensory loss	
L4 anterior tibial region	27
L5 great toe, medial foot	31
S1 heel, lateral foot	25
Deep tendon reflexes	
L3-4 knee	28
S1 ankle	40

NOTE. Total exceeds the total number of participants (N=58) because many subjects exhibited findings in more than 1 dermatome, myotome, or reflex.

patient's leg until symptoms were diminished or completely abolished. The procedure was performed first on the noninvolved leg and then repeated on the involved leg.

In both methods of SLR examination, a positive test was defined as clear reproduction of the patient's symptoms distal to the knee joint as the leg was elevated or the knee was extended and diminution or abolishment of the symptoms with knee flexion. The reproduction of back pain only or thigh pain (not extending distal to the knee) was considered a negative test. The sequence of test performance (seated versus supine) was varied to prevent testing bias.

Both the seated and supine SLR tests were performed a second time by a different examiner on a subset of 20 participants to establish the interrater reliability of both maneuvers. Each examiner did not have knowledge of the results of the other examiner when testing this subset of 20 participants.

Before beginning this investigation, both examiners involved in testing the participants of this study underwent training in performing both the seated and the supine SLR versions. Training included agreement on the operational definition of both examination procedures as described previously and training in the performance of the procedures on healthy volunteers before beginning to enroll subjects.

### Radiographic Analysis

All patients had MRI available for review. Any patients with evidence of radiographic instability on either the MRI or plain radiographs were excluded from the trial. These studies were reviewed and rated by an experienced surgeon who did not have prior knowledge of the SLR test results. Similarly, the examiner who performed the physical examination did not have knowledge of the MRI results. The magnetic resonance images were rated as either positive (indicating the presence of nerve root compression) or negative (no evidence of nerve root compression).

### Statistical Analysis

The sensitivity of the seated test was compared with that of the supine test by using the McNemar test, and 95% confidence intervals (CIs) were computed by using the Clopper-Pearson method. Both the test and the confidence intervals were exact. The Cohen  $\kappa$  was used as a measure of interobserver reliability.<sup>21</sup>

## RESULTS

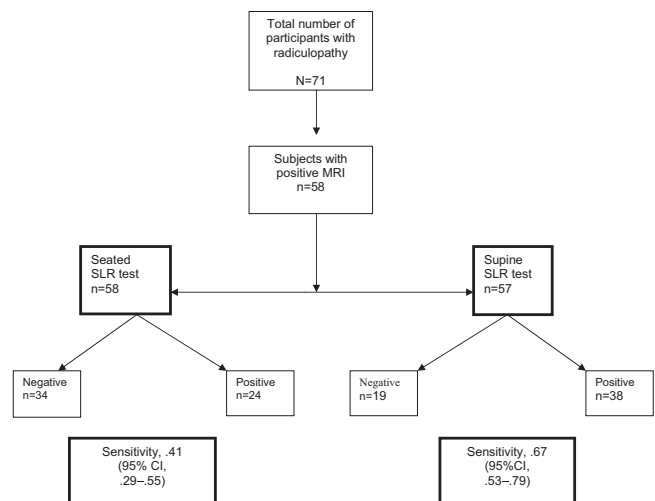
Seventy-one subjects were enrolled in the study. Fifty-eight subjects had an MRI indicating lumbar nerve root compression that correlated with the patient's side and distribution of symptoms. The 13 subjects with a negative MRI were excluded from further analysis because our intention was to assess the sensitivity of the 2 clinical tests. All 58 patients presenting with a positive MRI had at least 1 clinical finding that suggested a lumbar radiculopathy such as myotomal weakness, dermatomal sensory loss, deep tendon reflex diminution, or abolishment on the symptomatic side. These findings are given in table 1. All 58 patients underwent the seated SLR test. Given that 1 subject could not lie flat because of pain, 57 of the patients presenting with a positive MRI underwent the supine SLR test.

The sensitivity (95% CI) of the supine SLR test in reproducing the patient's radicular pain in light of an MRI scan indicating the presence of nerve root compression was .67 (95% CI, .53–.79). The sensitivity (95% CI) of the seated SLR test was at .41 (95% CI, .29–.55) (fig 3). This represented a statistically significant difference with a *P* value of .003. The interrater reliability of the 2 tests, as measured by the  $\kappa$  coefficient, was .69 for the supine test and .60 for the seated test. This represents substantial and moderate agreement, respectively.<sup>22</sup>

## DISCUSSION

A clinical trend that we have noticed has been the substitution of the seated SLR test for the traditional supine SLR test. This substitution shortens the patient assessment time and may reduce patient discomfort. The acceptance of the seated SLR as a clinical equivalent to the supine SLR may be based on the work of Waddell et al.<sup>19</sup> It is important to note, however, that neither Waddell nor subsequent investigators have ever stated that this was the case. Based on the outcome of this study, indeed, this is proven to be false. The supine SLR test definitely has a significantly greater sensitivity than the seated SLR test. Our data, collected under controlled conditions, suggest that the 2 tests are not equivalent and that the supine SLR more accurately reflects the radiologic findings of lumbar nerve root compression.

The design of this study did not allow us to determine the specificity of these 2 tests. Specifically, because most patients



**Fig 3. Flow diagram showing the sensitivity of the seated SLR test versus the supine SLR test.**

presented with positive MRI findings, a sufficient sample size was not obtained to determine the rate of a negative SLR test result (supine or seated) in patients with MRI studies that did not show root compression. Furthermore, we found that the sensitivity of the supine SLR test appears lower than what is commonly believed (67% in our study vs 91% elsewhere).<sup>10</sup> This difference may be because of the fact that other studies have used surgical exploration as the reference test to which the supine SLR test was compared. Additionally, these other investigations were conducted in subjects about to undergo surgery for their complaints, making these studies' populations different from our sample. The lower sensitivity found in our investigation may also be related to our strict interpretation of what constituted a positive test result (ie, clear reproduction of the patient's sciatic pain radiating below the knee). Alternatively, prior and concurrent treatments in our sample such as the use of anti-inflammatory medicines or epidural steroid injections may have reduced the acute nerve root irritation and yielded a lower SLR sensitivity.

### Study Limitations

Our study used MRI findings as the criterion for nerve compression. Physicians must be aware that MRI may have false-positive findings of nerve compression.<sup>6</sup> However, the presence of at least 1 clinical sign suggesting nerve root compression on the symptomatic side in our study sample and the finding of radiologic evidence of nerve root compression on the same side should lessen the concern of false-positive findings in our sample.

### CONCLUSIONS

In patients complaining of LBP and lower lumbar radicular symptoms who present with an MRI scan indicating lumbar nerve root compression, the supine SLR test is more sensitive than the seated SLR test in detecting acute nerve root compression symptoms. Although we recognize that the sensitivity of the supine SLR test in detecting nerve root compression as determined by MRI studies, may not be as high as is commonly believed when a strict interpretation of positive SLR test findings is employed, this test remains as one of the basic components of a good physical examination.<sup>23</sup> Clinicians performing the SLR test exclusively in the seated position may not detect the symptoms of acute lumbar radiculopathy at the same rate as those performing the SLR in a supine position. Further research is needed to establish the difference between the specificity of the seated SLR test versus that of the supine SLR test.

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