

## Clinical Evaluation of the Sensitivity and Induced Pain Pattern on Passive Straight Leg Raising Test in Patients with Lumbosacral Root Pain

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### ABSTRACT

**Background:** The straight leg raising test (SLR) is widely used to evaluate patients with sciatica. The SLR was evaluated in many previous studies; however, there is no agreement about the characterization of the test.

**Objective:** To investigate the patterns of pain on passive SLR in patients with sciatica and to evaluate the effects of various maneuvers on this test.

**Study design:** Case series study.

**Setting:** Rheumatology division, Ibn Sinna Teaching Hospital, Mosul, IRAQ.

**Methodology:** Seventy patients with unilateral sciatica for less than 2 years duration, their ages are between 20 to 50 years, were studied. A detailed history was obtained from the patients and they were subjected to full physical examination for their current problem. The SLR was performed, the angle of elevation was recorded and the effect of ankle dorsiflexion and maximal neck flexion was evaluated. After that, the SLR repeated but with lumbar flexion, the angle of the SLR was also recorded. Then crossed SLR was performed.

**Results:** SLR was positive in 91.4% of cases. Ankle augmentation was positive in 95.3% of cases, while neck flexion increased pain in 28.1% only. Cross SLR test was positive in 17.1% of cases. Increased SLR angle by contralateral hip flexion was seen in 81.3% of cases; mean SLR angle with the contralateral hip extension was 47.8±12.4 degree, while contralateral hip flexion increased the mean SLR angle to 58.9±16.9 degree. The patterns of pain induced by SLR were: low back pain only in 50% of cases, leg pain only in 42.1% of cases, low back and leg pain in 7.9% only.

**Conclusion:** The patterns of pain that were induced by passive SLR were: low back pain only, leg pain only, low back and leg pain. This could bear relation to the position of the prolapsed disc.

The use of sensitizing maneuvers (ankle dorsiflexion, neck flexion) increases pain in patients with sciatica with positive SLR test, so we recommend the conduction of these maneuvers in patients with positive SLR. Measurement of SLR was influenced by the position of the contralateral hip (flexed Vs. extended).

**Keywords:** Low Back Pain, Sciatica, Straight Leg Raising Test.

### التقييم السريري لحساسية ونمط الألم المستحث في اختبار رفع الساق المستقيمة عند مرضى ألم جذر العصب القطني والعجزي

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## الخلاصة

**الخلفية:** يستخدم إختبار رفع الساق المستقيمة بصورة واسعة لتقييم حالة المرضى الذين يعانون من عرق النسا. وقد تم تقييم هذا الإختبار في العديد من الدراسات السابقة، ومع ذلك، لا يوجد إتفاق حول توصيف الإختبار.

**الهدف:** للتحقق من أنماط الألم في إختبار رفع الساق المستقيمة السلبي لدى المرضى الذين يعانون من عرق النسا وتقييم آثار مناورات مختلفة في هذا الإختبار.

**تصميم الدراسة:** دراسة سلسلة الحالات .

**الإعداد:** قسم أمراض المفاصل، مستشفى ابن سينا التعليمي، الموصل، العراق .

**المنهجية:** تم فحص سبعون مريضاً يعانون من عرق النسا في جهة واحدة لمدة أقل من سنتين، أعمارهم تتراوح بين 20 إلى 50 سنة. وقد تم الحصول على تاريخ مفصل من المرضى وكانوا يخضعون للفحص السريري الكامل لمشكلتهم الحالية. أثناء تنفيذ إختبار رفع الساق المستقيمة يتم تسجيل زاوية الإرتفاع ويتم تقييم تأثير الإحناء الظهرى للكاحل والثني الكامل للعنق . بعد ذلك يتم تكرار إختبار رفع الساق المستقيمة وتسجيل زاوية إرتفاعه ولكن مع ثني أسفل الظهر . ثم يتم تنفيذ إختبار رفع الساق المستقيمة المعاكس .

**النتائج:** كان إختبار رفع الساق المستقيمة إيجابياً في 91.4 % من الحالات. تقوية الإختبار بواسطة الثني الظهرى للكاحل كان إيجابياً في 95.3 % من الحالات، في حين ان ثني الرقبة أدى الى إزدياد الألم عند 28.1 % من المرضى فقط. كان إختبار رفع الساق المستقيمة المعاكس إيجابياً في 17.1 % من الحالات. بعد ثني الورك المقابل إزدادت زاوية رفع الساق لدى 81.3 % من الحالات؛ كان متوسط زاوية رفع الساق مع بسط الورك المقابل هو  $12.4 \pm 47.8$  درجة، في حين أن ثني الورك المقابل زاد متوسطاً لزاوية إلى  $16.9 \pm 58.9$  درجة. كانت أنماط الألم الناجم عن إختبار رفع الساق المستقيمة هي: آلام أسفل الظهر فقط في 50% من الحالات، ألم في الساق فقط في 42.1% من الحالات، آلام أسفل الظهر والساق بنسبة 7.9% فقط .

**الاستنتاج:** كانت أنماط الألم التي سببها إختبار رفع الساق المستقيمة: آلام أسفل الظهر فقط ، ألم في الساق فقط ، آلام أسفل الظهر والساق. هذا يمكن أن يكون له علاقة مع موقع القرص المنزلق .

إستخدام مناورات تحسين الإختبار (الثني الظهرى للكاحل، ثني الرقبة) يزيد من الألم في المرضى الذين يعانون من عرق النسا مع إختبار رفع الساق المستقيمة، لذلك نحن نوصي بتطبيق هذه المناورات في المرضى الذين لديهم إختبار رفع الساق المستقيمة إيجابياً. هذا الإختبار يتأثر من موقع الورك المقابل (إثناء أو إنبساط).

**الكلمات المفتاحية:** آلام أسفل الظهر، عرق النسا، إختبار رفع الساق المستقيمة.

## INTRODUCTION

Sciatica is defined as radiating pain that follows the distribution of lumbar nerve roots<sup>1</sup>. It affects about 5-10 % of patients with low back pain<sup>2</sup>. It may be accompanied by neurological dysfunction, such as weakness and numbness<sup>3</sup>. The diagnosis of Sciatica is based mainly on history taking and physical examination<sup>2</sup>. The straight leg raising test (SLR) is the most commonly applied diagnostic test used to evaluate patients with sciatica<sup>4</sup>, and it is considered to have high sensitivity but low specificity<sup>5</sup>. The estimated sensitivity and specificity of SLR is 91% and 26% respectively<sup>4</sup>.

The SLR test is done by passive elevation of the leg on the symptomatic side with the patient in the supine position<sup>5</sup>; however, there is no agreement about the characterization of the test especially the site of pain which is considered a positive test. Many previous reports considered below knee pain as a positive SLR test<sup>5,6</sup>. In another study, the SLR

was considered positive if it produced lower extremity pain and/or back pain<sup>7</sup>. Urban in its review article reported SLR to be positive when it caused pain anywhere<sup>8</sup>.

The use of structural differentiation during SLR test is of crucial importance in the successful interpretation of the test. Flexion of the cervical spine and dorsiflexion of the ankle are some examples of structural differentiating maneuvers<sup>9</sup>.

Therefore this study was designed to investigate the patterns of pain on passive SLR in patients with sciatica and to evaluate for the effect of various maneuvers on this test.

## SUBJECTS AND METHODS

The present study had approval from the scientific research committee of Mosul health directorate, Mosul- Iraq.

**Inclusion criteria:** Patients with unilateral sciatica

**Exclusion criteria:**

- 1- Systemic manifestations.
- 2- Suspicion of neoplastic or infective spinal conditions.
- 3- Compression fractures.
- 4- Major trauma or past spinal surgery.
- 5- Chronic inflammatory joint/spinal diseases.
- 6- Spondylolisthesis.
- 7- Specific neurological problems (stroke, multiple sclerosis, peripheral neuropathy).
- 8- Steroids for more than 3 months.
- 9- Diabetes.
- 10- Pregnancy.

### Subjects

Seventy patients participated in this case series collection study, whose ages were range from 20 to 50 years, and they were suffering from unilateral sciatica for less than 2 years duration with or without low back pain (LBP).

### Methods

A detailed history was obtained from the patients and they were divided into three groups: acute (those with pain less than 6 weeks), subacute (from 6 – 12 weeks) and chronic (when the pain lasting more than 12 weeks)<sup>10</sup>.

The patients then subjected to full physical examination for their current problem, including observation of the patient gait, assessment of the range of motion of the lumbar spine.

The straight leg raising test (SLR) was performed in the supine position with the knee in full extension, the examiner put one hand on the patient's knee to keep it extended and the other hand under the heel, then slowly raises the patient's leg until pain is produced anywhere in the lower extremity and/or the back or a degree of 90 is reached without pain. The angle of elevation was recorded using plastic goniometric. SLR with 70 degrees or more without pain was considered to be normal<sup>7</sup>. At the endpoint, the effect of ankle dorsiflexion, and maximal neck flexion were evaluated as well. After that the SLR repeated but with lumbar flexion by flexing the contralateral hip to 90 degrees, the angle of the SLR was also recorded. Crossed straight-leg raising test was performed. A positive crossed SLR is defined as the reproduction of sciatic pain in the symptomatic

leg when passive SLR is performed on the asymptomatic leg<sup>11</sup>. Femoral stretching test was also performed by flexing the knee with the patient lying prone, pain in the anterior thigh and/or lumbar region indicates a positive test<sup>11</sup>. Neurological assessment for all patients was also done.

### RESULTS

**Table 1** shows the demographic features of the patients participating in this study. The mean age of patients was  $33.2 \pm 8.46$  years, 55.7% of patients were males.

The main clinical features of the 70 patients with sciatica participated in this study are shown in **Table 2**.

**Table 3** shows the results of the sciatic nerve stretch test and the femoral nerve stretch test for the 70 patients participated in the study. Sixty four patients had positive SLR test with angle less than 70 degrees.

**Table 1:** Demographic features.

Total no.	70 patients
Males	39 ( 55.7% )
Females	31 ( 44.3% )
Mean age	33.2 (± 8.46)
Mean duration of pain in weeks	23.2 (±17.7)

**Table 2:** clinical characteristics of the studied group.

Features	No. of patients (%)	
Duration class	Acute	30 (42.9%)
	Subacute	17 (24.3%)
	Chronic	23 (32.9%)
Lumbar pain	53 (75.7%)	
Buttock pain	45 (64.3%)	
Rt. Sciatica	29 (41.4%)	
Lt. sciatica	41 (58.6%)	
Stress pain	35 (50%)	
Mobility weakness	50 (71.4%)	
Tendency to fall	30 (42.9%)	
Numbness	41 (58.6%)	
Gait abnormality	17 (24.3%)	
Painful flexion &/or extension	55 (78.6%)	
Painful side bending	41 (58.6%)	
Limited flexion	21 (30%)	
Limited side bending	8 (11.4%)	
Sensory deficit	23 (32.9%)	

The mean SLR angle degree was 47.8 degrees, and it was increased when the SLR performed after flexing the contralateral hip as shown in **Table 4**.

**Table 5** shows the site of the pain induced by the SLR test. Lumbar pain was induced in 50% of the patients.

**Table 3:** Results of 1- Sciatic stretch test (SLRT) in the 70 patients and the augmentation or ameliorating tests in the 64 patients with positive SLRT. 2- Crossed SLRT and femoral stretch test in the 70 patients.

Sciatic n. stretch	No.	Percent
Positive SLRT (angle < 70)	64 / 70	91.4 %
Positive ankle augmentation	61 / 64	95.3 %
Increased pain by neck flexion	18 / 64	28.1%
Decreased pain by neck flexion	2 / 64	3.1 %
Increased SLR angle by contralat. hip flexion	52 / 64	81.3 %
Decreased SLR angle by contralat. hip flexion	6 / 64	9.4 %
Crossed SLR test	12 / 70	17.1 %
<b>Femoral n. stretch</b>		
Positive	35 / 70	50 %

**Table 4:** Mean SLR angle degrees with and without contralateral hip flexion.

SLR method	Mean (±SD)	p-value
Mean SLR angle degree (64 patients)	47.8 (±12.4)	0.00*
Mean SLR degree with contralateral hip flexion (64 patients)	58.9 (±16.9)	

\* = significant according to independent sample t-test.

**Table 5:** Pain sites induced by positive SLR test (64 patients).

Pain site	No.	Percent	Positive ankle effect
lumbar pain	32	50	31 (96.8%)
leg pain	27	42.1	25(92.5%)
lumbar & leg pain	5	7.9	5 (100%)
Total	64	100.0	

## DISCUSSION

Seventy patients with unilateral sciatica were included in this study. Sixty four patients (91.4%) elicited positive SLR test; the mean SLR angle was  $47 \pm 12.4$  degrees.

In their study, Keer *et al* 1988, found that SLR was positive in 98% of patients. However, the test was only considered positive if it caused sciatic pain<sup>12</sup>. In the case-control study of Demircan *et al*. 2002, the SLR was positive in 93% of their operated patient's' group, but the characterization of the positive SLR was not mentioned in the study<sup>13</sup>. Straight leg raising test is not necessarily limited even in patients with severe sciatica due to disc prolapse. One explanation for that is the presence of far lateral or minor disc protrusion<sup>7</sup>. Another possible explanation is that movement may not be transmitted to the root, and fibrous adhesion could explain this<sup>14</sup>.

Straight leg raising limitation is a mechanism that involuntarily protects the lower spinal nerves and the dura from painful traction. Under normal conditions, the lumbosacral nerve roots are relatively mobile<sup>7</sup>. Straight leg raising places tension on the sciatic nerve and thereby pulls the sciatic nerve roots (L4, L5, S1, S2, and S3) distally for few millimeters and stretches them near the anterior wall of the spinal canal<sup>15</sup>. In the presence of nerve roots irritation, such as by a herniated disk, further tension on the nerve root by straight-leg raising will result in radiating pain in the limb<sup>1</sup>. If the nerve can't move freely, SLR on the affected side is usually markedly restricted<sup>15</sup>.

The patterns of pain that were induced by passive SLR fell into 3 well- defined groups: low back pain only, leg pain only, low back and leg pain. Previous studies have shown that the pattern of pain on passive SLR seems to be related to the position of the prolapsed disc. Within the horizontal axis, the protrusion may be situated in a central, intermediate, or lateral position. Patients with central protrusion tend to have low back pain only; patients with lateral protrusion tend to have leg pain only, while those with intermediate protrusion tend to have low back pain and leg pain<sup>16</sup>. The centrally protruded disc impinges the dura only, intermediate protrusion irritates the dura and nerve root, while the lateral protrusion irritates the nerve root alone<sup>8</sup>. So the production of back pain on passive SLR is probably due to dural irritation<sup>17</sup>.

However alternative explanations are possible. O'Connell suggested that pain in the back on SLR may be related to the movement of the lumbar spine<sup>18</sup>. Steindler suggested that back pain in patients who have spinal nerve compression might be due to referred pain along the posterior primary ramus<sup>19</sup>. Subtle variations, such as adhesions of the dura or dural sheath in the spinal canal to the ligamentum flavum, annulus fibrosus, or the apophyseal joints capsules may all account for back pain during SLR<sup>20</sup>.

In this study, results showed that measurement of SLR was influenced by the position of the contralateral hip (flexed vs. extended); in that, a greater SLR angle occurred with the opposite hip flexed than with the opposite hip extended. Our finding was in agreement with a previously published paper by Cameron et al<sup>21</sup>. A possible explanation of this finding (as Goddard and Reid found) is that contralateral hip flexion decreases lumbar lordosis, as a result, the intervertebral foraminal space will become wider, and this lets the roots to run a more direct course outward, and appears to cause some slackening<sup>14</sup>. This will provide some relief of root pressure, and accordingly, higher SLR angle is required to induce pain. Our results point out the need to keep the contralateral hip fully extended during the SLR test.

The crossed straight leg raising test was positive in 12 patients (17.1%). It points out severe impingement and it is almost always due to large disc herniation. Compared with SLR test, it has high specificity (88%) but low sensitivity (29%) for lumbar disc herniation<sup>4</sup>. The explanation of the crossed SLR test is that it involves the movement of the dura and contralateral root medially and distally when the unaffected limb is raised. It usually indicates a large more medially placed prolapse<sup>8</sup>.

Straight leg raising test is a neurodynamic test which doesn't only stretch neural tissue but also causes an increase in local muscle tone. Straight leg raising has been shown to activate hamstring and gluteal muscle when the hip flexion is held at maximally tolerated position<sup>22</sup>. Successful interpretation of SLR testing mandates the use of structural differentiation maneuvers during the test in order to highlight the rule of neural tissue in opposition to musculoskeletal tissue in making a

change in the test outcome. Flexion of the cervical spine and dorsiflexion of the ankle are some examples of structural differentiation maneuvers<sup>9</sup>. These maneuvers increase tension exerted on the spinal dura and lumbosacral nerve roots. So the use of these maneuvers may increase the SLR diagnostic and predictive accuracy<sup>23</sup>. If the added neck flexion worsens the pain, it would be logical to think of a structure running from the occiput to beyond the knee; in such a case we exclude the hamstrings or sacroiliac joint as the cause of pain, but think of involvement of the dura matter.

Many previous reports considered ankle dorsiflexion and neck flexion as sensitizing maneuvers for SLR<sup>7,24,25</sup>. When we performed these 2 confirmatory tests on our patients we found that 61 patients (95.3%) had a positive response on ankle dorsiflexion and 18 (28.1%) patients had a positive response on neck flexion.

## CONCLUSION

Straight leg raising test is positive in the majority of patients with sciatica. The patterns of pain that were induced by passive SLR fell into 3 well-defined groups: low back pain only, leg pain only, low back and leg pain. This could bear relation to the position of the prolapsed disc. The use of sensitizing maneuvers (ankle dorsiflexion, neck flexion) increases pain in patients with sciatica with positive SLR test, so we recommend the conduction of these maneuvers in patients with positive SLR. Measurement of SLR was influenced by the position of the contralateral hip (flexed Vs. extended), so we recommend measurement of SLR with contralateral hip kept in extended position.

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