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Clinical update

Physical assessment of lower extremity radiculopathy and sciatica

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Abstract

Objective: The purpose is to describe active and passive physical maneuvers that provoke or alleviate lumbosacral radiculopathy and/or sciatica to demonstrate how these maneuvers function in common orthopedic and neurological tests/signs.

Methods: Descriptions of the maneuvers and their countermaneuvers are provided to establish an understanding of their mechanisms and influence on lumbosacral nerve roots and the sciatic nerve. Common tests and signs for lower extremity radiculopathy and sciatica are described to demonstrate the clinical application of the maneuvers. Combinations of common tests are also offered to improve examination efficiency.

Results: Understanding how each maneuver contributes individually or in combination with standard tests will enhance the reader's examination skills.

Conclusion: Improved examination skills lead to improved diagnosis and differential diagnosis of lower extremity radiculopathy and sciatica.

Introduction

Several physical maneuvers are provocative to lumbosacral nerve roots or the sciatic nerve. Provocative maneuvers are intended to reproduce signs and symptoms of lower extremity radiculopathy/sciatica. Other maneuvers counter to the provocative maneuvers (palliative maneuvers) decrease nerve root and sciatic irritation and the related signs and symptoms (Fig 1).

Establishing an understanding of the provocative and palliative maneuvers is priority 1. Priority 2 is to describe common lower extremity radicular/sciatic tests that are composed of the provocative and palliative maneuvers. Priority 3 is to describe how tests for lower extremity radiculopathy/sciatica replicate one another and can be combined to improve examination efficiency and differential diagnosis.

Terminology

The terms *provocative* and *palliative* are used throughout this article to describe the ability of each

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maneuver to reproduce or relieve radicular/sciatic signs and symptoms. The physical maneuvers are also described as *major* or *minor* based on their ability to reproduce or relieve radicular/sciatic signs and symptoms. The terms *active* and *passive* are used to describe movements carried out by the patient and those carried out by the examiner, respectively. The terms *radicular* and *radiculopathy* are used to describe lumbosacral nerve root (L4, L5, S1, S2, and S3) irritation. The term *sciatica* is used to describe irritation of the sciatic nerve formed by the L4, L5, S1, S2, and S3 nerve roots after leaving the lumbosacral spine.

Provocative vs palliative

After reproducing the patient's pain through a provocative maneuver, the doctor may use palliative maneuvers to relieve the pain. The patient may also assume a palliative posture reflexively as a result of pain produced by the provocative maneuver. Testing maneuvers that are palliative do not have to be the exact opposite of the provoking maneuvers. For example, hip flexion does not have to be countered by hip extension. Returning the hip to the neutral position may be palliative enough to reduce symptoms and be diagnostic. Changing the patient's initial testing position (eg, moving from seated to supine) can also be palliative.

Differential diagnosis

It is naive to think that the maneuvers discussed below only affect the lumbosacral nerve roots or the sciatic nerve. In fact, it is naive to think that any orthopedic or neurological test only affects a single tissue or structure. Most orthopedic and neurological tests stress multiple tissues, including nerves, muscles, tendons, ligaments, cartilage, bones, blood vessels, etc. A single maneuver can produce multiple reactions. The reactions vary depending upon which tissue is pathological. This leads to multiple tests that share a mechanism of performance, yet have different names and interpretations. Examiners must consider these facts when performing and interpreting orthopedic and neurological tests.

Major Maneuvers
- Lumbar Lateral Bending
- Hip Flexion
- Knee Extension
- Foot Dorsiflexion

Minor Maneuvers
- Cervical Flexion
- Spinal Flexion
- Hip Internal Rotation
- Hip Adduction
- Great Toe Dorsiflexion
- Increased Intrathecal/Intradiscal Pressure

Fig 1. Maneuvers that increase lumbosacral nerve root/sciatic tension.

Supine
- Straight Leg Raising
- Crossed Straight Leg Raising
- Bragard
- Fajersztajn

Seated
- Bechterew
- Slump
- Sciatic Tension
- Tripod

Standing
- Neri Bowing
- Kemp Standing

Side Lying
- Piriformis Test

Fig 2. Examples of lumbosacral radicular/sciatic tests by position.

Accuracy (sensitivity/specificity and intraexaminer/interexaminer reliability) of the maneuvers and tests described is not stressed, as most of the tests have not been the subject of accuracy studies. Studies that are available are often skewed by inconsistencies in test performance, definitions of positive findings, and interpretations of results among participants. These inconsistencies are compounded in the trenches of clinical practice.[1-4] Radicular/sciatic tests, like many orthopedic and neurological tests, are not the most dependable diagnostic tools. Despite the lack of reliability and limited evidence-based studies, these tests are imbedded in health care education and clinical practice. Emphasis is placed on the understanding of maneuvers that comprise traditional radicular/sciatic physical tests to enhance learning and the use of the tests until more accurate and reliable methods are available.

Major maneuvers

Patient testing position

Nerve root/sciatic tension tests are performed in 4 positions: supine, seated, standing, and side lying (Fig 2).[5,6] Supine is the most common test position, followed in descending order by the seated, standing and side-lying positions. Despite the dominance of the supine testing position, this text promotes the use of seated tests.[7] The reasoning here lies in the nature of the maneuvers described, factors in nerve root/sciatic

irritation, intervertebral disk pathology, practicality, patient comfort, and patient stability.

Disk pathology is a common cause of nerve root/sciatic tension. Thus, radicular/sciatic tests performed in the position that places the greatest stress on the disk would, in theory, increase the likelihood of confirming disk pathology as the etiology of nerve root irritation. Stress on the intervertebral disk as a result of patient posture or position has been measured by Nachemson et al,[8] who studied intervertebral pressure during different postures and activities. The 4 positions used for radicular/sciatic tests were included in the study. The positions in descending order of pressure were seated, standing, side lying, and supine.[8]

Peak pressure in the seated position and minimal pressure in the supine position are consistent with reports of increased pain while sitting and decreased pain while recumbent from patients with disk pathology. This information suggests the seated posture is the optimum testing position for detecting disk pathology and related nerve root/sciatic tension. The preferred order of the 4 common testing positions, based on disk pressure and their likelihood of identifying disk-related nerve root/sciatica, is then seated, standing, side lying, and supine.

Disk pressure is not the only consideration in patient positioning during nerve root/sciatic examination. Patient comfort and stability must also be considered. Based on the author's experience, patient positions in descending order of comfort and stability are supine, seated, side lying, and standing. A final factor in the selection of the optimum patient testing position is the minimal number of nerve root/sciatic tests performed in the side-lying position. The low number of tests and the reduced stability make the use of this position impractical. Correlation of the information above leads to ranking patient testing positions in the following order of preference: seated, supine, standing, and side lying.

Lumbar lateral bending

Patients with lower extremity radiculopathy/sciatica often present with antalgic posturing of the trunk.[9] The antalgic positioning is noticeable by direct observation and at times on lumbosacral radiographs.[5,9,10] Antalgic postures can be conscious or subconscious and are all assumed to obtain relief. In cases of lower extremity radiculopathy/sciatica, the relationship between the direction of the patient's antalgia (lateral bending) and the side of leg pain provides significant diagnostic information.

Most lumbar disk herniations protrude posterolaterally, away from the center of the body. Once lateral, the disk can then lie either lateral or medial to the nerve root. The terms *lateral* and *medial disk herniation* refer to the relationship between the disk and the nerve root, not the relationship to the midline of the body. Both lesions cause leg pain on the side of the herniation. A patient with a lateral disk protrusion often laterally bends the trunk away from the side of leg pain to obtain relief. A patient with a medial disk protrusion often laterally bends the trunk toward the side of leg pain to obtain relief. Antalgia sign is an orthopedic sign based on this observation and the correlation of the antalgia with the side of the patient's leg pain to differentially diagnose lateral and medial disk protrusions.[5] Leaning the patient in the direction opposite of antalgia increases radicular irritation and symptoms for both lateral and medial protrusions. A patient exhibiting an antalgic lean with radicular/sciatic symptoms will typically be antalgic in more than one posture (standing, seated, etc). This factor should be considered when selecting radicular/sciatic tests.

The Kemp test uses lateral bending with extension or rotation of the thoracolumbar spine into and away from the direction of antalgia.[3-5] Correlating the antalgic lean, the side of leg pain, and the symptoms while maneuvering into and away from antalgia assists the examiner in determining if a lateral or medial disk protrusion is present during the Kemp test. The Kemp test can be performed standing or seated. The seated position is recommended over the standing position because of increased intradiskal pressure in the seated position. Increased intradiskal pressure should in theory increase the probability of identifying back and radicular pain due to a disk protrusion. The seated position also stabilizes the pelvis and lower extremities, restricting the testing movements to the lumbar region.

Lateral bending is also a part of lumbosacral range of motion (ROM) testing, the Schepelmann test for thoracic strain or neuralgia, the Foresterier test for ankylosing spondylitis, and the McKenzie slide glide test for scoliosis.[5,6] Antalgia noted before these tests, resistance to lateral bending into and opposing antalgia, and changes in back/leg pain must be considered during the interpretation of these tests.

Hip flexion

Hip flexion places stretch on the sciatic nerve as it passes through and around the structures of the pelvis and traverses down the posterior aspect of the thigh. Hip flexion is 1 of the 2 most common provocative maneuvers used in nerve root/sciatic testing. The other is knee extension. The patient position in most nerve root/sciatic tension tests involves hip flexion and knee extension achieved in sequence, hip flexion followed

by knee extension (Lasegue test), or knee extension followed by hip flexion straight leg raising (SLR).

The position of hip flexion and knee extension is often referred to as the *jackknife position*. The position seems to be essentially the same whether the patient is supine, seated, or standing. However, differences exist in the disk pressure, postural muscles involved, and patient stability during testing. The jackknife position is used for several orthopedic and neurological tests. In addition to SLR and the Lasegue test, the Bechterew test for radiculopathy/sciatica, slump test for neuromeningeal tract tension/sciatica, tripod test for hamstring tension/sciatica, and Kernig test for meningitis all use hip flexion and knee extension (jackknife).[5,6]

The supine jackknife position (SLR) is the least stressful on the disk, yet the most stable for the patient. The standing position (Neri bowing, mannequin) places more stress on the disk but is much less stable for the patient.[11] The seated jackknife position (Bechterew) offers the best overall combination of stress on the disk and patient stability during testing.

Knee extension

Knee extension as described above is one of the most common provocative maneuvers used in lower extremity nerve root/sciatic testing. Knee extension straightens the sciatic nerve, increasing tension and placing it in a position where other provocative maneuvers can increase irritation of the nerve and its roots. The Bragard (dorsiflexing the foot) and Sicard (dorsiflexing the great toe) tests, for example, cannot produce radicular/sciatic symptoms unless the knee is extended.

Knee extension is provocative, whereas knee flexion is palliative. Reflexive flexion of the patient's knee during Neri bowing, mannequin, and SLR tests (Buckling sign) are examples of the palliative nature of knee flexion.[5,6,11] The Lasegue differential test uses knee flexion as a palliative maneuver to confirm a positive SLR or Lasegue test. The test involves passive knee flexion by the examiner after a positive SLR or simply returning to the starting position of hip and knee flexion for the Lasegue test.

Reflexive flexion of the knee due to radicular/sciatic symptoms must be differentiated from flexion associated with hamstring tension during testing. Keys to this differential include unilateral vs bilateral pain, pain above vs below the knee, and how other radicular/sciatic maneuvers influence symptoms. Radicular/sciatica pain is typically unilateral, whereas hamstring tension and pain are typically bilateral. Radicular/sciatic pain typically extends below the knee, whereas hamstring pain typically does not. Other tension maneuvers with the exception of foot dorsiflexion could reproduce radicular/sciatic symptoms but not affect hamstring tension. Dorsiflexion of the foot affects radicular/sciatic tension and hamstring tension.[12,13]

Hip flexion and knee extension are used in SLR (testing the symptomatic leg) and crossed straight leg raising (CSLR) (testing the asymptomatic leg) to identify radicular pain and differentiate between lateral and medial disk lesions.

Straight leg raising of the symptomatic leg reproduces pain in the symptomatic leg if a lateral disk lesion is responsible for the patient's trouble. Straight leg raising of the asymptomatic leg (CSLR) reproduces pain in the symptomatic leg if a medial disk lesion is responsible for the patient's trouble.

Foot dorsiflexion

Dorsiflexion of the foot increases nerve root/sciatic tension, but can only do so if the knee is extended.[12,13] Dorsiflexion of the foot is then limited in its usefulness for identifying nerve root tension/sciatica when used individually.

Three orthopedic/neurological tests are associated with dorsiflexion of the foot: the Bragard, Fajersztajn, and Homan tests. The Bragard test is a confirmatory test for SLR test, and the Fajersztajn test is a confirmatory test for CSLR test. The Homan test uses foot dorsiflexion to detect deep vein thrombosis.[5,6] It must be performed with the knee bent to be diagnostic. Flexion of the knee reduces radicular/sciatic tension, removing it as a factor and leaving pain in the lower leg indicative of deep vein thrombosis.

Minor maneuvers

Cervical flexion

Cervical flexion can influence nerve root/sciatic tension. Cervical flexion places tension on the lumbosacral nerve roots by placing traction on the neuromeningeal tract.

Radicular leg pain in response to cervical flexion often occurs when an epidural mass (disk protrusion, etc) displaces the cord and deforms the dura, reducing their mobility (tethering). Deformation of the dura can transfer tensile stress to the cord and nerve roots.[14]

Flexion of the cervical spine that reproduces lower extremity radicular/sciatic leg pain is termed a *positive Lindner test*.[5,6,14] The test indicates tethering of the cord and/or nerve root.[5]

Lower extremity nerve root pain with cervical flexion must be differentiated from shock-like lower extremity pain with cervical flexion. Lower extremity nerve root pain produced by cervical flexion (Lindner) will be unilateral along the course of the involved nerve root. Bilateral shock-like pain in the upper or lower extremities with cervical flexion (L'Hermitte) is usually a result of cord pathology.[14,15] Cervical flexion is also the primary mechanism for 2 other commonly used tests: the Soto-Hall test for cervical sprain, strain, or fracture and the Brudzinski test for meningitis.[5,6]

Spinal flexion

Spinal flexion, including cervical flexion as described above, places traction on the lumbosacral nerve roots and sciatic nerve. Breig and Marions[16] and Ko et al[17] reported that the dura, root sleeves, cord, and nerve roots move cranially during maximum flexion of the trunk. Maximal flexion of the spine is used in the slump test as described by Maitland.[18]

Several tests use spinal flexion as a primary maneuver. The Schober test for ROM, the Adam standing and seated tests for scoliosis, and the compression fracture test are among many.[5,6,19] The seated Adam and compression fracture tests are reproduced during the slump test.

Hip internal rotation

Internal rotation of the hip stretches the piriformis muscle and can influence sciatic nerve tension.[20,21] As with foot dorsiflexion, internal rotation typically provokes sciatic symptoms when the leg is straight.

The sciatic nerve and piriformis muscle have a special anatomical relationship. In most patients, the sciatic nerve passes under the piriformis muscle as it travels from the pelvis into the posterior thigh. However, 2 variations in the path the sciatic nerve takes through the pelvis exist.[21,22] In approximately 10% of patients, the nerve splits before entering the gluteal region, with the common peroneal portion passing through the piriformis muscle. In less than 1% of patients, after splitting, the common peroneal division passes over the piriformis muscle. Stretching the piriformis can lead to sciatic irritation if the muscle's relationship to the nerve is in part responsible for the patient's sciatica.

Hip adduction

Hip adduction increases stretch on the sciatic nerve as it passes through the pelvic region. This also requires the knee to be extended. Hip adduction can also irritate the sciatic nerve by stretching the piriformis muscle. The Bonnet test uses hip adduction and internal rotation during SLR to help identify nerve root/sciatic irritation.[23]

Great toe dorsiflexion

Dorsiflexion of the great toe increases nerve root/sciatic tension; but like many of the above maneuvers, it can only do so if the knee is extended. Dorsiflexion of the great toe with the knee extended and the hip positioned neutrally (Turyn test) is said to cause radicular/sciatic pain if an extradural lesion is present.[5] The Sicard test involves dorsiflexion of the great toe after SLR. It is identical to the Bragard test with one exception: the great toe is dorsiflexed instead of the foot.[5]

Increased intrathecal/intradiskal pressure

Tests that increase intrathecal pressure are intended to detect space-occupying lesions in the cranium and spine. Tests that increase intrathecal pressure can also influence intradiskal pressure. Increased pressure can provoke thecal sack or disk pathology and in turn can provoke lumbosacral nerve roots.[8]

As with the seated position, tests for space-occupying lesions can help rule disk pathology in or out as the cause of radiculopathy/sciatica. The Dejerine triad (coughing, straining while holding the breath, or sneezing) increases intrathecal and intradiskal pressure. The Valsalva maneuver (straining while holding the breath) is a part of the Dejerine triad.

Test replication

The maneuvers described above are the foundations for most lower extremity nerve root/sciatic physical tests. The maneuvers also replicate some spinal ROMs, providing the examiner information about the quality and quantity of ROM without the need of performing separate tests.

From an educational standpoint, developing an understanding of the maneuvers is advantageous before studying the individually named tests. Instruction in this order will help health care students grasp the mechanism and interpretation of the individual tests faster. The order also helps in the recognition of similarities between tests. Recognizing similarities and understanding the affects of patient positioning on testing will allow the examiner to select the most useful tests during the examination process.

The Bechterew test and SLR use hip flexion and knee extension to provoke pain with nerve root/sciatic tension.[24] The only difference in these tests is the position of testing. Bechterew is performed seated, whereas SLR is performed supine. The seated position creates more pressure in the intervertebral disk and is more likely to produce a positive test if the disk is the culprit. This makes the seated test preferable to the supine test.

The Neri bowing test and the Buckling test are based on the patient's reflexive flexing of the knee when hip flexion and knee extension are used to provoke nerve root/sciatic pain. Neri bowing occurs while the patient is standing, and Buckling occurs while the patient is supine. The standing position creates more pressure in the intervertebral disk and is more likely to produce a positive test again if the disk is the culprit. This makes the standing test preferable to the supine test.

Test combinations

Named orthopedic and neurological tests described in standard text books use 2 to 3 basic maneuvers in combination. This is necessary because most of the maneuvers described above will not provoke nerve root/sciatic pain individually. It is recommended here to take this principle one step further and combine more than 3 maneuvers in a single testing position. Combining maneuvers increases the examiner's capacity to provoke signs and symptoms.

Traditional orthopedic and neurological testing usually begins with the use of the least provocative tests, followed in progression by more provocative tests. The recommendation here is to begin with more provocative tests (tests in combination). This recommendation is made with consideration given to the patient's safety. The provocative mechanisms described here represent minimal risk to the patient, even when used in combination. This is evident in the use of the slump test as a diagnostic test and a therapeutic procedure.[25,26]

These ideas are not new. Breig and Troup,[27] Maitland,[18] and others have used this principle. Breig and Troup for example combined 5 of the maneuvers described above in a supine patient position including hip flexion and knee extension (Lasegue, Bechterew, SLR), foot dorsiflexion (Bragard), internal rotation of the hip, and cervical flexion (Lindner) (Fig 3).[27] The maneuvers are used simultaneously. Maitland combined lumbar flexion, cervical flexion (Lindner), hip flexion and knee extension (Lasegue, Bechterew, SLR), and foot dorsiflexion (Bragard) in sequence for the slump test.[18]

Hip Flexion
Knee Extension
Foot Dorsiflexion
Internal Rotation of the Hip
Cervical Flexion

Fig 3. Maneuvers/tests used in combination by Breig and Troup.[27]

If the 5 maneuvers do not produce nerve root/sciatic pain in combination, then the maneuvers (tests) performed individually are not likely to produce pain. Performing the combined maneuver first with negative (normal) results indicates that the individual tests are negative. This improves examination efficiency and saves time. The examiner can then proceed to other testing procedures.

A positive test (pain) during combined testing indicates the need for the combined maneuvers to be performed individually. It must be stated here that combination testing should never be used unless the doctor can name, perform, and interpret each of the individual tests used in a combination.

The recommendation here is to use one or two combinations of maneuvers to evoke radicular sign and symptoms. One test, the maximal SLR test, is performed with a supine patient position. The other, the modified slump test, is performed with a seated patient position.

Vizniak[23] reports the maximal SLR, consisting of hip flexion and knee extension (Lasegue, Bechterew, SLR), internal rotation and adduction of the hip (Bonnet), foot dorsiflexion (Bragard), neck flexion (Lindner), and coughing (Dejerine). This is essentially the same combination recommended by Breig and Troup with the addition of the coughing (Dejerine).

Miller[24] modified the Maitland slump test, adding bilateral simultaneous hip flexion and knee extension (Lasegue, Bechterew, and SLR) and foot dorsiflexion with coughing. The modified slump test uses the greatest number of provocative maneuvers (7) for identifying radicular/sciatic signs and symptoms: a seated patient position, cervical (Lindner) and trunk flexion, bilateral hip flexion and knee extension (SLR, CSLR, Lasegue, and Bechterew), bilateral foot dorsiflexion (Bragard, Fajersztajn), and coughing (Dejerine).

Most patients report no effect or mild discomfort with the modified slump combination. This indicates a negative result for the combination and its components. If radicular/sciatic sign and symptoms are evoked, the Maitland step-by-step version of the slump

Table 1 The modified slump test: components and tests replicated

TEST AND COMPONENTS	PURPOSE
Spinal Flexion (Slump)	
thoracic and lumbar flexion	ranges of motion
seated Adam's test	scoliosis
compression fracture test	thoracolumbar compression fractures
Cervical Flexion	
cervical flexion	range of motion
Lindner's Test	lower extremity radiculopathy
L'Hermitte's Test	spinal cord meningeal irritation
Brudzinski's Test	meningitis
Soto-Hall Test	cervical sprain, strain or fracture
Hip Flexion and Knee Extension	
hip flexion	range of motion
knee extension	range of motion
straight leg raising	radiculopathy/sciatica
crossed straight leg raising	radiculopathy/sciatica (medial disc)
Bechterew's test	radiculopathy/sciatica
Lasegue's test	radiculopathy/sciatica
tripod sign	radiculopathy/sciatica/hamstring tension
Kernig's Test	meningitis
Foot Dorsiflexion	
foot dorsiflexion	range of motion
Bragard's Test	radiculopathy/sciatica
Fajersztajn's Test	radiculopathy/sciatica (medial disc)
Homan's Test	deep vein thrombosis
Coughing	
Dejerine's Test	space occupying lesions
Valsalva's Test	space occupying lesions (Valsalva's is part of Dejerine's test)

test is recommended to determine which individual maneuvers are evoking the positive response.

The modified slump test has great utility and should be a part of all spinal examination. In addition to using provocative radicular/sciatic maneuvers, the test replicates several other common orthopedic and neurological tests for a variety of pathologies (Table 1). Understanding the multitude of reactions possible with the modified slump test and the pathologies indicated makes the test one of the most efficient and practical orthopedic and neurological tests available.

Conclusion

Dozens of physical tests for identifying lower extremity radiculopathy and sciatica have been described in orthopedic, neurological, and chiropractic literature. Study of these tests is often difficult. Tests are frequently named after the person who first described the test. Surnames have no descriptive value, thus making it difficult for the student to associate the assigned name with the mechanism and meaning of the test. Adding to the confusion is that many of the tests have one or more synonyms. Confusion also results when tests with totally different meanings and names have the same mechanism of performance. The result is that students use rote memorization to learn tests. This means the basic mechanisms of the tests and their links to other tests/pathologies may not be truly understood. Study of the provocative and palliative maneuvers that comprise tests for lower extremity radiculopathy/sciatica creates

a deeper understanding of the performance, interpretation, and clinical use of these tests.

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