Agreement and Correlation Between the Straight Leg Raise and Slump Tests in Subjects With Leg Pain

Jeremy Walsh, MManipTher,[a] and Toby Hall, MSc[b,c]

Abstract

Objective: The straight leg raise (SLR) and slump tests have traditionally been used to identify nerve root compression arising from disk herniation. However, they may be more appropriate as tests of lumbosacral neural tissue mechanosensitivity. The aim of this study was to determine agreement and correlation between the SLR and slump tests in a population presenting with back and leg pain.

Methods: This was an observational, cross-sectional study design. Forty-five subjects with unilateral leg pain were recruited from an outpatient Back Pain Screening Clinic at a large teaching hospital in Ireland. The SLR and slump tests were performed on each side. In the event of symptom reproduction, the ankle was dorsiflexed. Reproduction of presenting symptoms, which were intensified by ankle dorsiflexion, was interpreted as a positive test. An inclinometer was used to measure range of motion (ROM).

Results: There was substantial agreement between SLR and slump test interpretation ($\kappa = 0.69$) with good correlation in ROM between the 2 tests ($r = 0.64$) on the symptomatic side. In subjects who had positive results, ROM for both tests was significantly reduced compared to ROM on the contralateral side and ROM in subjects who had negative results.

Conclusions: When the SLR and slump tests are interpreted as positive in the event of reproduction of presenting leg pain that are intensified by ankle dorsiflexion, these tests show substantial agreement and good correlation in the leg pain population. When interpreted in this way, these tests may be appropriate tests of neural tissue mechanosensitivity, but further criteria must be met before a definitive conclusion in relation to neural tissue mechanosensitivity may be drawn. (J Manipulative Physiol Ther 2009;32:184-192)

Key Indexing Terms: *Low Back Pain; Sciatica; Physical Examination; Pain Measurement; Neurologic Examination*

Leg pain is present in up to 57% of patients with low back pain.[1] Such leg pain may arise from neural or nonneural structures. In relation to neural structures, axons of a spinal nerve or neurons in the dorsal root ganglion may give rise to leg pain.[2] Leg pain may also be referred from somatic structures. For example, noxious stimulation of the disk,[3] facet joint,[4] and lumbar muscles[5] have been shown to cause referred pain into the lower limb that can extend below the knee.

The straight leg raise (SLR) and slump tests are well-known clinical tests used in the examination of low back-related leg pain. Positive findings in response to these tests were attributed, by early authors, to nerve root compression due to disk herniation or stenosis.[6,7] In fact, Deville et al[8] found that, up to 1997, there had been 17 publications evaluating the accuracy of the SLR test in diagnosing herniated disks, using surgery as the reference standard.

As the sciatic nerve and nerve roots are subjected to movement and strain during the SLR and slump tests,[9-12] it is reasonable to suggest that interference with this movement due to nerve root compression may lead to positive SLR and slump test findings. Rabin et al[13] reported sensitivity of 0.67 for the SLR test and 0.41 for the seated SLR test in patients presenting with magnetic resonance imaging evidence of lumbar nerve root compression. Although a recent study has found high specificity for the SLR (0.89) and slump (0.83) tests in patients with lumbar disk herniation,[14] a more common finding in the literature is that, although test sensitivity is reasonable, the specificity of the SLR to identify disk herniation or nerve root compression is poor.[8,15,16] A systematic review of the accuracy of the SLR test in diagnosing herniated disks revealed that pooled sensitivity was 0.91, whereas that for specificity was 0.26.[3] Poor diagnostic accuracy of the SLR test was also

[a] Lecturer, School of Physiotherapy, Royal College of Surgeons in Ireland, Ireland.
[b] Adjunct Senior Teaching Fellow, School of Physiotherapy, Curtin University, Perth, Australia.
[c] Director, Manual Concepts, Perth, Australia.
This work should be attributed to the Discipline of Physiotherapy, Trinity College Dublin, Dublin, Ireland.
Submit requests for reprints to: Jeremy Walsh, MManipTher, Lecturer, School of Physiotherapy, Royal College of Surgeons in Ireland, 123 St Stephen's Green, Dublin 2, Ireland (e-mail: *jeremywalsh@rcsi.ie*).
Paper submitted September 9, 2008; in revised form November 25, 2008; accepted January 5, 2009.
0161-4754/$36.00

doi:10.1016/j.jmpt.2009.02.006

demonstrated by Thelander et al[17] who found no correlation between disk protrusion size, shape, or location and SLR limitation and also noted that any decrease in protrusion size over time was not accompanied by improvement in SLR response. This poor diagnostic accuracy may be because the SLR and slump tests may also be positive for reasons other than the direct mechanical effects of disk herniation or nerve compression pathologic conditions. Furthermore, lumbar nerve root compression does not always result in SLR limitation.[18,19]

Macrophages play a major role in the inflammatory process arising from disk herniation. Activated macrophages secrete cytokines (eg, interleukin-β, tumor necrosis factor-α [TNFα], cathepsins, collagenases, and other lytic enzymes) that have potent effects to sensitize adjacent neural tissues.[20] It has been suggested that the presence of TNFα in the nucleus pulposus cells may be a key factor in mediating nucleus pulposus-induced nerve root dysfunction and sciatica.[20] Interestingly, a positive association has been demonstrated between the inflammatory marker, E-selectin, and SLR test findings.[21]

Pain and limitation of movement during the SLR test are probable in the presence of disk pathologic condition, but mechanosensitization arising from leaking inflammatory mediators from the adjacent disk may be the cause rather than direct nerve root compression. Eliav et al[22] found that inflammation of the rat saphenous nerve, with no apparent axonal loss, leads to pain-related behaviors, hyperalgesia, and allodynia on sensory testing. Furthermore, Dilley et al[23] demonstrated that the rat sciatic nerve became sensitive to pressure and stretch after local inflammation of the nerve trunk but not after the application of saline. These studies show, at least in animal models, that neural tissues may become mechanosensitized, in the presence of inflammation and the absence of compression.

As both the SLR and slump tests elongate the sciatic nerve and associated nerve roots,[9-12] pain responses to these tests may be seen as a sign of increased sensitivity to elongation rather than nerve compression. Clinically, sensitivity to neural tissue elongation along with local tenderness over the nerve trunks are the main signs of neural tissue mechanosensitivity.[23,24] Although there is an abundance of literature in relation to the use of the SLR test in the identification of disk herniation and nerve root compression,[8] research into the use of the SLR and slump tests as tests of neural tissue mechanosensitivity is lacking. This may be due to the lack of a gold standard for neural tissue mechanosensitivity.

The use of nerve conduction studies as a gold standard in studies of mechanosensitivity tests cannot be supported as it has been shown that nerves can be mechanosensitized in the absence of axonal damage,[22,25] and mechanosensitivity does not necessarily exist in the presence of nerve compression.[18,19] Indeed, there is controversy as to whether nerve conduction studies are useful in the identification of neural pain syndromes, at least in the upper limb.[26,27] Real-time ultrasound has been used in the investigation of neural tissue pain disorders in the upper limb[28-30] and sciatic nerve movement in the lower limb.[31,32] However, at this stage, the usefulness of this procedure may be restricted to the measurement of nerve movement rather than mechanosensitivity. Recent advances in magnetic resonance (MR) imaging of nerves has ensured that MR neurography is capable of providing information about nerve compression, nerve inflammation, nerve trauma, systemic neuropathies, nerve tumors, and recovery of nerve from pathologic states.[33,34] However, MR neurography has yet to be used to correlate these findings with mechanosensitivity.

Therefore, clinical tests may be the best current means of determining lumbosacral neural tissue mechanosensitivity. Hall and Elvey[35] have proposed a list of clinical criteria thought to indicate symptoms resulting from neural tissue mechanosensitivity as follows: antalgic posture, active movement dysfunction, passive movement dysfunction, adverse responses to neural tissue provocation tests (including the SLR and slump tests), hyperalgesic responses to palpation of specific nerve trunks, and evidence of a local area of pathologic condition. The first 4 criteria all involve postures or movements that elongate neural tissue. However, these criteria have not been validated and so require further scientific enquiry.[36] Although the SLR and slump tests are only 2 of several clinical indications used in these criteria, a logical first stage in this process of scientific enquiry may be to validate the individual tests. The focus of this article is on the SLR and slump tests.

Movement and strain of the sciatic nerve and nerve roots during the SLR and slump tests[9-12] are increased by the addition of ankle dorsiflexion.[9,37] The qualifying maneuver of dorsiflexion is important to differentiate between a somatic or neural source of symptoms during both test procedures.[38-40] As both the SLR and slump tests involve movement of the lumbar spine,[41,42] both somatic (e.g. disks and facet joints) and neural structures will be affected during these tests. Somatic structures in the lower limb (particularly in the posterior thigh), such as subcutaneous connective tissues, skin, blood vessels, and fascia, may also be affected by these tests[43,44] Hence, these tests may give rise to either somatic referred pain or pain of neural origin. However, the addition of ankle dorsiflexion loads the neural tissue more than the somatic structures.[38,39] Thus, intensification of symptoms in response to the addition of ankle dorsiflexion may implicate a neural rather than a somatic referred source of leg pain. Although traditionally these tests have been used as tests of disk herniation and nerve compression, it is our opinion that these tests may be more appropriate if used to differentiate between leg pain of somatic referred or neural origin. A positive test may be a sign of pain in response to neural tissue elongation, that is, neural tissue mechanosensitivity, whereas a negative test may exclude