CHAPTER 13

SPINAL RADICULOPATHY AND ITS IMPORTANCE IN PODIATRIC MEDICINE

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Back pain is one of the most common symptoms that forces people to see their physician. In fact, it has been estimated that one out of five American adults suffers from back pain at one time or another. From a public health care perspective, back pain is the leading cause of employee absence, health care dollar consumption, and of course disability. The purpose of this paper is three-fold. First, to serve as a review and resource describing the lower extremity dermatomes and innervation to corresponding musculature. Secondly, to define and characterize the pain syndromes associated with back pain and radiculopathy. And finally, to describe essential maneuvers in the physical examination to evaluate lower extremity pain and weakness masquerading as spinal radiculopathy.

REVIEW OF ANATOMY

The vertebral column consists of 33 vertebrae: 7 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 4 coccygeal segments. The vertebrae consist of three anatomic parts, the body, vertebral foramen, and bony processes. The vertebral bodies are separated by an intervertebral disc, which is composed of a gelatinous material that is 80% water and lies within a fibrous ring called the annulus fibrosis. The spinal cord travels within the vertebral foramen, ending at the L1 level, and its spinal roots exit laterally at each level of the vertebral column. Each nerve root exits below the vertebra it is named for (i.e,. the L5 root exits between L5 and S1).

In radicular pain syndromes caused by intervertebral disc protrusion, the compressed root usually is the lower segment (i.e., L4-L5 disc compression affects the L5 root). This is due to the posterolateral anatomic location of the disc protrusion that catches the nerve root (Fig. 1).

The stability of the spine is dependent upon the integrity of the vertebral bodies with intact intervertebral discs, and the massive ligamentous and muscular attachments. These paravertebral structures are indeed strong, however, the bending and rotational forces that are applied to the spine can easily violate these supporting structures.

In proximity to the vertebral foramen, a dorsal and ventral nerve root join to form a spinal nerve. Dorsal roots are sensory in nature and receive information from the body. Dorsal roots of each spinal nerve segment supply a specific area of sensation to the integument, known as a dermatome (Figs. 2A, 2B) Ventral roots are motor in nature, and they convey impulses from the spinal cord to the end organ (i.e., skeletal muscle) (Fig. 3). Lesions of the ventral root result in paralysis of the corresponding muscle or muscles if all the fibers are affected, or paresis if partially affected.

Typical physical examination findings of lower motor neuron paralysis ("flaccid paralysis") include decrease in muscle tone, weak or absent deep tendon reflexes, fibrillation, and fasciculation. Lesions of the dorsal roots may produce pain with

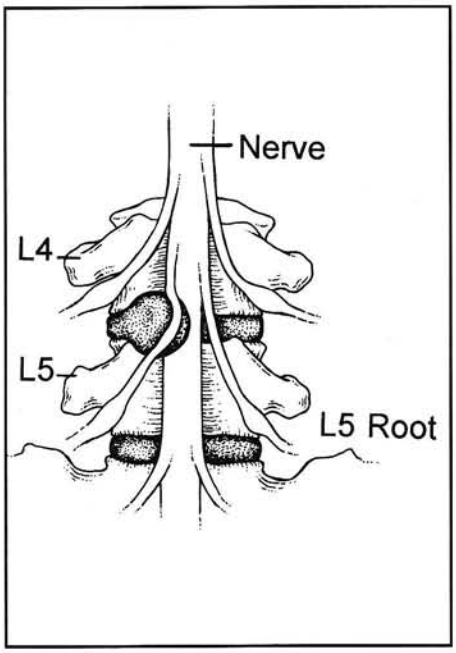

Figure 1. The anatomic location of disc protrusion.

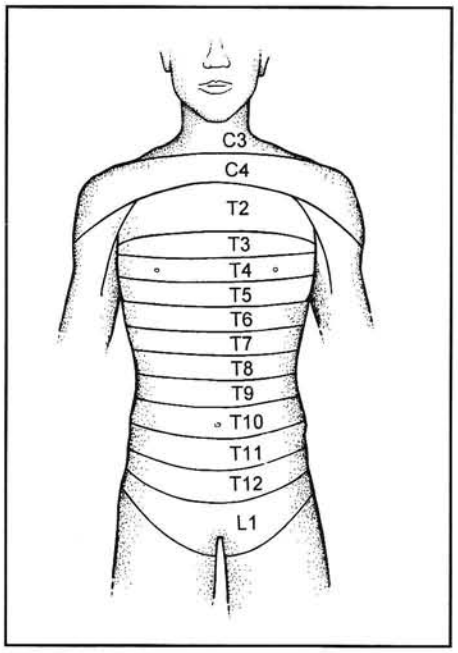

Figure 2A. The dermatomal innervation of the trunk.

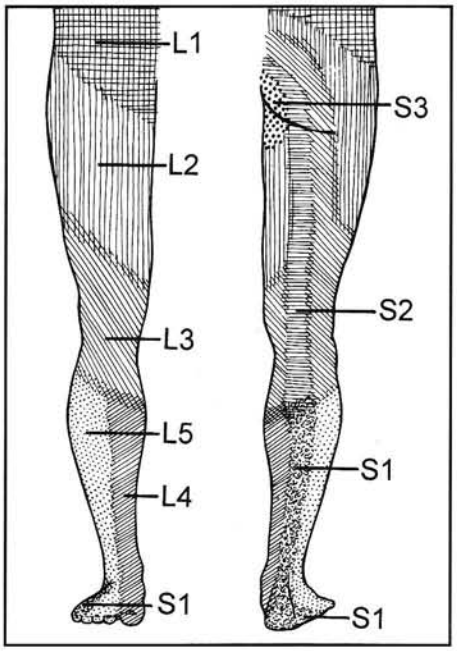

Figure 2B. The dermatomal innervation of the lower extremity.

a radicular distribution. Since dermatomes overlap, destruction of one dorsal root may result in partial sensory loss (hypethesia). When several consecutive dorsal roots are affected, complete loss of sensation (anesthesia) may occur. Irritation of dorsal roots may provoke a number of symptoms which include aberrant sensations known as parasthesias, excessive sensibility to stimuli known as hyperesthesia, and there may also be involvement of the autonomic nervous system resulting in dermatomal vasodilation.

ASSESSMENT OF PAIN

The etiology of back pain with associated lower extremity symptoms needs be differentiated into a non-neurogenic or a neurogenic source. Non-neurogenic sources of back pain include spondylogenic, vascular, and viscerogenic. Spondylogenic is the most common cause of non-neurogenic back pain with the pain originating in the spinal column. Violation or irritation of paravertebral soft tissue structures such as intervertebral discs, tendons, ligaments, muscles, and joints are sources of pain. Vascular sources of pain include abdominal aneurisms and vascular insufficiency to the superior gluteal artery. Abdominal aneurisms characteristically cause a deep-seated boring pain in the lumbar region. Vascular insufficiency to the

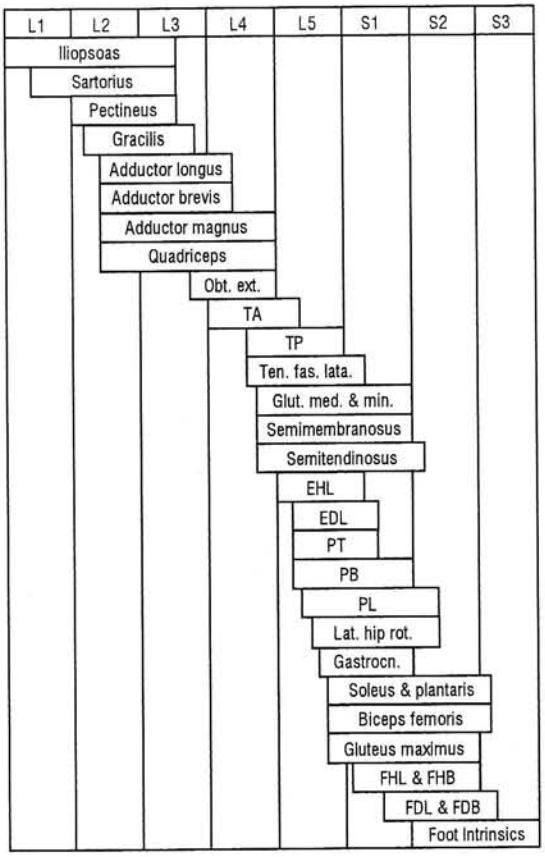

Figure 3. The innervation of the lower extremity muscles.

superior gluteal artery frequently will result in claudication to the buttocks with symptoms radiating down the leg. Viscerogenic back pain results from tumors of the retroperitoneum, diseases of the kidneys and pelvic viscera. This type of pain is more or less constant with little relief of symptoms. Unlike spondylogenic and vascular sources of back pain, position or activity does not alter the intensity of viscerogenic pain.

Neurogenic pain is caused by diseases of the spinal cord. Rare causes include tumors such as neurofibromas, astrocytomas and ependymomas. The most common cause, and scope of this paper, involves root compression due to acute or chronic intervertebral disc degeneration.

There are three types of pain that will be discussed, local, referred, and radicular pain. Local pain is steady and aching. It may be intermittent, sharp, diffuse, and always symptomatic at or near the area of the spine affected. The painful areas are easily palpated. Tissues that are usually involved include bone, periosteum, muscle, ligaments, and tendons. Position and activity alters intensity of the pain. Local pain is usually consistent with a spondylogenic source.

Referred pain can be either projected from the pelvic and abdominal viscera to the spine or vice versa. Referred pain from the upper lumbar spine is usually projected to the anterior thigh and leg. Referred pain from the lower lumbar spine is usually directed toward the buttock and posterior thigh. Referred pain usually parallels with intensity and duration of the local pain of the spine. Therefore, activity and positional changes equally affect local and referred pain. It is also uncommon for referred pain to extend distally beyond the knee.

Radicular pain is similar to referred pain, but has notable exceptions. First and foremost, there is a much greater intensity with radicular pain, and distal radiation beyond the knee is common. Additionally, pain is always located within a nerve root territory, and there are different factors that exacerbate radicular pain.

Radicular pain nearly always radiates from a central portion of the spine to some part of the lower limb. Coughing, sneezing, and straining evoke sharp radiating pain. Any maneuver that stretches a nerve or increases intraspinal pressure will evoke pain. Common findings include paresthesias, superficial sensory loss, and soreness of the skin. Often there is tenderness in circumscribed regions along the nerve, accompanied by lancinating radicular pain. The intense lightning-like radicular pain is superimposed on a dull steady ache of referred back pain. If anterior roots are involved, there may be associated loss of deep tendon reflexes, paresis, atrophy, and fasciculations. An important clinical point to be made is that "psuedoradicular" pain (back pain referred to the thigh), as a rule does not project distal to the knee.

The most common root compressions are L5 and S1. Less common is L4, and L3 is rare. When an L3 compression is diagnosed, there should be a high index of suspicion for a tumor. An L5 compression will yield pain and paresthesias in the hip, groin, posterolateral thigh, and lateral calf. The foot may also be affected, especially the dorsum, including the hallux, second, and third toes. A key diagnostic feature may be paresis of the extensors of the foot including extensor hallucis longus. Therefore, weakness of great toe extension (even a grade 4/5) is highly suggestive of an L5 lesion (Fig. 4).

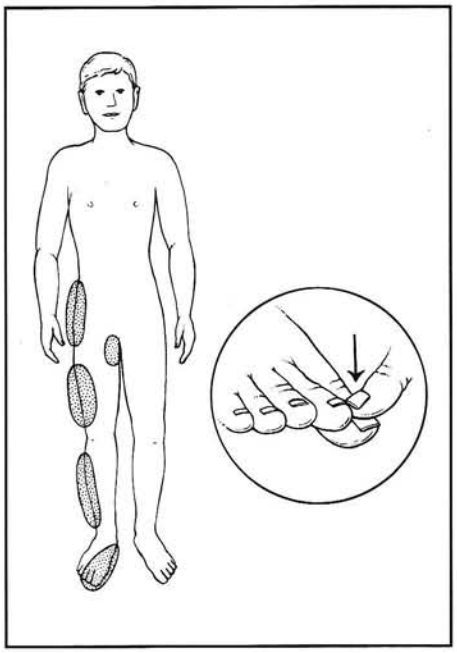

Figure 4. Symptomatology of an L5 lesion.

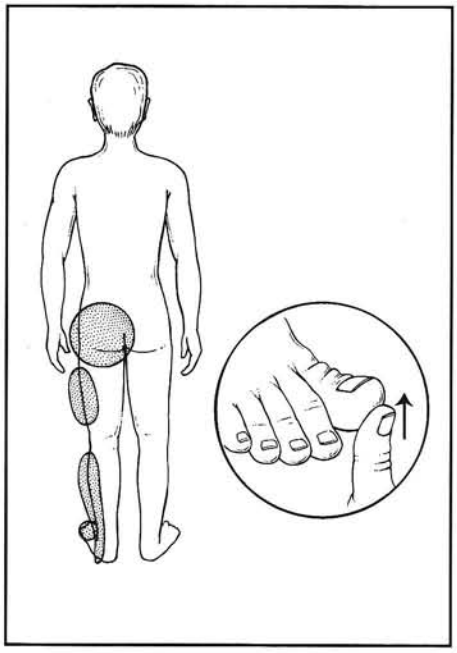

Figure 5. Symptomatology of an S1 lesion.

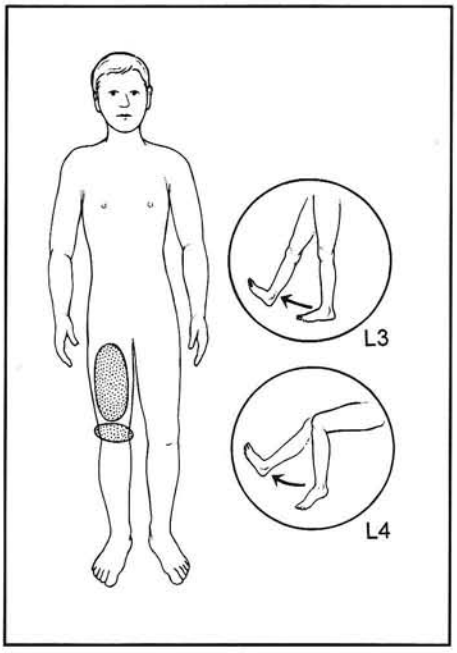

Figure 6. Symptomatology of L3 and L4 lesions.

S1 root compressions yield pain and paresthesias in the mid-gluteal region, posterior thigh, posterior calf to the heel, and to the sole of the foot. Symptoms may extend over the dorsum of the foot, including the fourth and fifth toes. Muscle weakness usually includes the flexors of the foot, including the great toe, abductors of the toes, and the hamstring muscles. The ankle jerk is usually hyporeflexive or absent (Fig. 5).

L3 and L4 lesions are rare. These generally yield pain in the anterior thigh and knee, extending distally to the anteromedial leg (especially L4). L3 lesions are accompanied by paresis of the quadriceps and iliopsoas muscles. Weakness of the tibialis anterior muscle is a common finding with L4 compression, and the patella deep tendon reflex is usually absent (Fig. 6).

PHYSICAL EXAMINATION

When evaluating lower extremity pain and weakness, there are several simple maneuvers and observations to help confirm diagnoses. The physical examination always begins with general appearance. Posture and gait abnormalities can provide invaluable information. Check the back for excess curve, pelvic tilt, or asymmetry of the gluteal fold. The typical posture includes flexion or flattening of the spine. The patient usually leans toward the side of pain. This can be seen best by asking the patient to bend down and reach his toes. This maneuver usually results in bending toward the painful side. Sitting is usually uncomfortable. The posture of the affected leg is positioned to decrease the tension on the sciatic nerve. Gait examination usually reveals a limp, pelvic tilt, and shortening of stride.

A thorough lower extremity examination is conducted. Areas of scrutiny include the neurological and manual muscle tests. Dermatomes are inspected for decreased epicritic sensation. Deep tendon reflexes, as well as plantar response is evaluated. Manual muscle testing is of paramount importance. A careful examination with emphasis on flexors and extensors of the great toe and ankle should be made.

There are a number of special maneuvers that have been described in the literature for evaluation of suspected lumbar disc herniation. These all have one common feature of stretching the affected nerve root. The more common tests or signs include the straight leg raise, cross leg lift, Lasegue's sign, and the bowstring sign. Of all the special maneuvers, the straight leg test has been proven to be the most reliable test when correlated with intraoperative findings.

Straight Leg Raise

The straight leg raise is performed by having the patient lying down in a supine position and raising the affected leg with the knee in full extension (Fig. 7). Pain in the popliteal fossa is not a positive finding. For a positive test, pain must be elicited in the back or thigh/leg. There are some additional maneuvers utilized in conjunction with the straight leg test that enhances its diagnostic value which include the Lasegue's sign, and abolishment of pain after flexing the knee.

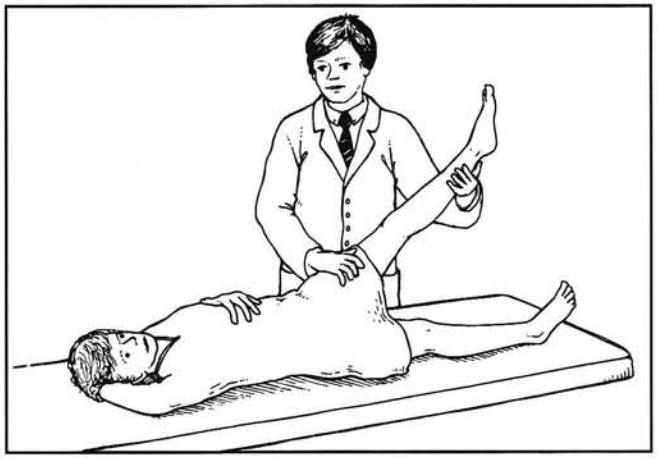

Figure 7. The Straight Leg Raise.

Lasegue's Sign

To confirm a positive straight leg raise, the examiner raises the leg to elicit pain, then actively dorsiflexes the ankle to exacerbate pain (positive Lasegue's sign) (Fig. 8). Additionally, flexion of the knee should reduce or even eliminate pain. Of clinical importance, flexion of the knee will almost always eradicate sciatica due to reducing the stretch of the sciatic nerve.

The Bowstring Sign

Again, a straight leg raise is performed. Once elevated to the level eliciting pain, the leg is lowered, knee flexed, and the posterior ankle is placed on the examiner's shoulder. The medial and lateral knee is held with the examiner's hands, both thumbs are placed on the patella, the middle fingers are placed in the popliteal fossa. The examiner then applies firm pressure in the popliteal fossa to compress the posterior tibial nerve (Fig. 9). The reproduction of pain in the back or extremity is significant for root compression. As with the straight leg raise, pain in the popliteal fossa alone does not confirm the diagnosis.

Figure 8. Lasegue's Maneuver.

Figure 9. The Bowstring Sign.

Cross Leg Lift

Upon performing a straight leg raise of the opposite leg, pain will be referred to the symptomatic side. Some investigators feel this test is more reliable than Lasegue's sign. Of clinical importance, pain is always referred to the diseased side regardless of which leg is elevated.

DISCUSSION

Spinal radiculopathy is a common entity seen in a medical practice. When evaluating lower extremity pain, weakness, and neuropathy, especially in light of a history including back pain, the podiatrist should always investigate and rule out any radicular syndrome. A careful history and physical examination will provide the information needed to make the diagnosis. Once a working diagnosis of spinal radiculopathy is made, the appropriate neurology consultation is warranted.

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