INOR AND RECURRENT soft-tissue injuries often do not receive as much attention as traumatic sports injuries. Athletes are often encouraged to “play through” minor injuries, never quite allowing themselves to heal. The ubiquitous hamstring strain is no exception. Hamstring strains account for up to 15% of all injuries and 30% of missed playing time among athletes; recurrent strain injuries account for more than 80% of game time missed.1,2 The recurrent nature of hamstring injuries might be a result of insufficient rehabilitation, a premature return to participation, or a missed diagnosis.

Several factors have been identified as contributing to hamstring strains. These factors include insufficient warm-up, poor flexibility, strength imbalance, muscle weakness, and fatigue.3 Recent sports-medicine literature has presented the concept of neural tension (NT) as a causative factor in hamstring injuries.3,4 A variety of injury mechanisms can produce NT, and a failure to address this condition can slow rehabilitation and increase the likelihood of reinjury. This column, the first of two parts, presents an approach for identifying NT in patients who present with posterior thigh pain. Part 2, in the next issue, will address treatment strategies for NT.

Neural Tension

Because the neural system is contiguous, actions that affect the system can produce symptoms within it.5 Normal neural tissue is nonpainful both at rest and during motion. Pathologic neural tissue, on the other hand, which has been referred to as neural tension in the literature, might precipitate pain and motion restriction.5 NT has been defined as abnormal physiological and mechanical responses in nervous-system structures when the normal range of movement and stretch capabilities are exceeded.4 Neural tissue has an abundant blood supply to satisfy its high oxygen requirements, but this supply is easily disrupted when nerves are stretched beyond the normal range. Three sheaths, composed mostly of fat and collagen, with the collagen oriented longitudinally to resist tensile forces, surround peripheral nerves. Nerves are highly reactive to trauma, which can result from compressive or distractive forces.6 Compressive forces on nerve tissue are believed to contribute to NT by creating venous stasis and hypoxia in the innermost sheath, the endoneural tube.4,6 Traumatic tensile forces can disrupt the connective-tissue sheaths, without damaging the nerve fiber, which interrupts blood flow and produces edema in the epineural or endoneural tubes.6 The endoneural tube has no lymphatic vessels to remove edema, resulting in formation of scar tissue and adhesions that can reduce normal mobility of the nerve within its sheath.5 When this occurs, the nervous tissue no longer moves in synchrony with surrounding soft tissues as body position changes. Lack of normal extensibility might cause sharp pain or a burning sensation when an athlete attempts to stretch the involved limb.

Neural tension can also result from extraneural sources, such as a loss of mobility of the pain-sensitive structures in either the vertebral canal or intervertebral foramina or in the soft tissues through which a nerve passes.4,7,8 If the inflammatory process produces adhesions in the soft tissue, the nerve can become “tethered” to it, resulting in loss of mobility and increased intraneural pressure, thereby creating pain...
with movement. With hamstring injuries, NT might be experienced as the patient performs knee extension while maintaining hip flexion. This tension produces pain that might present either proximally or distally to the source of tension. Consequently, clinicians who focus their exam on musculoskeletal pathology, without considering the neurogenic etiology of the patient’s symptoms, are likely to be confounded. Failure to correctly identify the cause of the symptoms can contribute to the chronic nature of hamstring injury.4,7

**Identifying Neural Tension**

NT can occur with any soft-tissue injury. When obtaining a history, clinicians should be aware of descriptors associated with NT. These descriptors include sharp or burning pain, which are symptoms that are not generally associated with muscle-strain injuries. An athlete might also report a dull pain located deep in the buttocks or posterior thigh, associated with prolonged sitting.9

Minor soft-tissue injuries typically present with mild spasm and swelling, whereas more severe injuries might demonstrate a defect in the muscle belly. Care must be taken during palpation to localize the area of soreness or pain. Muscle soreness, either general or localized, is common in mild and moderate muscle strains, but point tenderness is not. Clinicians should be attentive to taut, cordlike structures in the soft tissue. These structures are peripheral nerves, which are generally not tender unless inflamed.7

Strength and range of motion should be carefully evaluated in athletes with mild to moderate strains. Strength deficits associated with minor muscle injury are generally too subtle to be identified with manual muscle testing. Indeed, it might be impossible to differentiate between strength loss attributed to muscle damage and that which is secondary to pain inhibition. Range-of-motion restrictions should be carefully evaluated, with an awareness of end feel and patient response. If a clinician suspects NT, aggressive stretching that could further traumatize the nerve must be avoided.9

Range of motion is best evaluated with either a passive or active knee-extension test. Either test is preferred to the straight-leg raise for evaluation of hamstring length.10 The passive knee-extension test is performed with the athlete seated in a supine position (Figure 1). The involved hip is flexed to 90° while the knee is also flexed to 90°. The knee is then passively extended, while the hip is maintained at 90° flexion and neutral rotation. The active knee-extension test is performed with the athlete seated on the edge of a table (Figure 2). The hip is maintained in 90° of flexion, and the lumbar spine is maintained in a neutral position, while the knee is actively extended to a point of hamstring tension. Both the passive and active knee-extension tests allow the lumbar spine to be maintained in a neutral position during knee extension.10

Muscle spasm or guarding might serve as a protective mechanism for injured muscle or neural tissue. Differentiation of hamstring-muscle tightness and NT is achieved with the slump test.11 The traditional slump test is performed with the athlete seated on the edge of a table (Figure 3). In this position, the athlete assumes a slumped position in which the sacrum remains...
vertical while the thoracic and cervical spine is flexed. The athlete is instructed to dorsiflex the ankle and to initiate knee extension as overpressure is applied to the proximal (head) and distal (foot) aspects of the neural system. A positive slump test is indicated by a reduction of knee extension that is partially or fully resolved with cervical extension. The athlete might complain of a burning or stinging sensation at the end range of the motion or report sharp pain, as opposed to a stretching sensation. Nerve irritation associated with hamstring strain is likely to be located in the popliteal fossa, adjacent to the fibular head, or in the lumbar spine. To self-monitor progress in recovery, the athlete can perform an unassisted version of the slump test.

**Conclusions**

Minor soft-tissue injuries are often underreported by athletes, perhaps because minor injuries often do not preclude continued sports participation. In many cases, the athlete does not seek formal treatment for posterior thigh soreness, tightness, or spasm. These seemingly benign symptoms should be carefully evaluated, with a focus on identifying nerve pathology. Identifying and treating NT can hasten recovery and return to play for athletes with posterior thigh pain.

**References**


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