NEW

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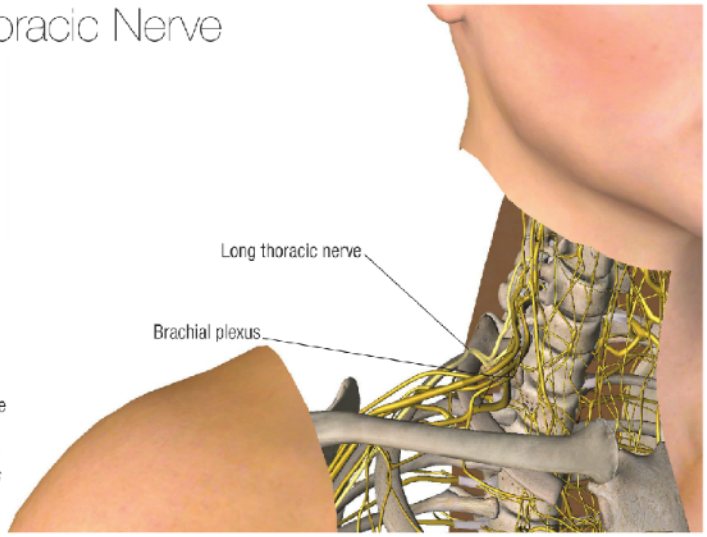
The Long and Winding Nerve

Challenges Involving the Long Thoracic Nerve

By Whitney Lowe

Do you recall sitting in a classroom and thinking that one or two students were getting the lion's share of attention when others had things to contribute as well? It seems the world of soft-tissue pain and injury problems shares this metaphor. Take nerve entrapment, for example. As soon as you say the phrase *upper extremity nerve entrapment*, most people's minds immediately jump to carpal tunnel syndrome. But there are numerous other nerve compression syndromes that also cause significant pain or dysfunction in the upper extremity.

In this newly focused column, my goal is to shed light on current pain science, as well as a host of nerve-related disorders that go undetected or misidentified on a regular basis. Massage therapists often admit to limited focus on the neurological system in their basic education. Yet, neurological sensation is a foundational and critical component of every client's experience. In this first installment, I turn attention to problems involving the *long thoracic nerve* (LTN). This is a tissue many massage practitioners may not be familiar with, but it plays a key role in upper extremity biomechanics and numerous pain complaints.



1 The long thoracic nerve (LTN) in relation to the brachial plexus. *Image courtesy 3D4Medical's Essential Anatomy 5 application.*

ANATOMICAL BACKGROUND

The LTN originates from nerve roots at the lower cervical vertebrae, usually between C5 and C7. Once the nerve root fibers exit the cervical vertebrae, they blend together to form the main trunk of the LTN. The nerve then passes between the anterior and middle scalene muscles immediately adjacent to the other major fibers of the brachial plexus (Image 1).

After passing between the scalene muscles, the nerve courses between the clavicle and first rib. It continues down the lateral aspect of the rib cage to its termination at multiple points along the serratus anterior muscle. This nerve's pathway is quite long, and consequently, there are multiple locations along its path where it is susceptible to compression or traction injury.

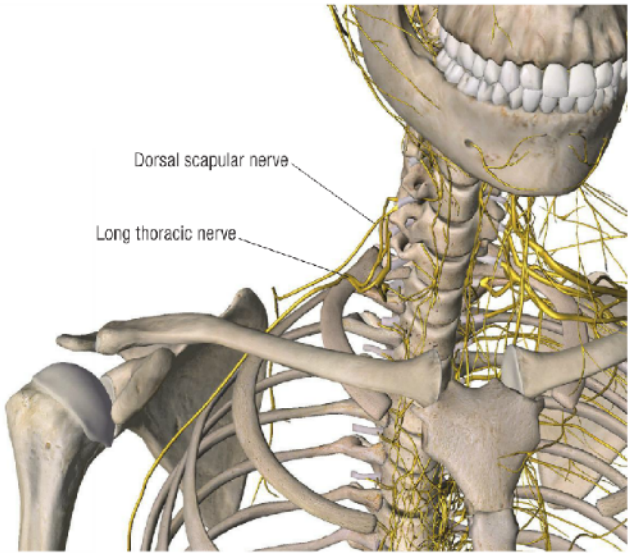
The primary function of the LTN is motor innervation to the serratus anterior muscle, which has several key functions. The major function of serratus anterior is to hold the scapula firmly against the thoracic rib cage. Accordingly, when there is an interruption of motor stimulus to the serratus anterior, the common pattern of scapular "winging" is present.

The serratus anterior has another important role: upward rotation of the scapula. The movement of upward rotation is a key component of proper scapulothoracic mechanics. Later in this column, I will highlight why this role of the serratus anterior is so important and what happens when muscle weakness from nerve impingement affects shoulder biomechanics.

PATHOLOGY

Damage or dysfunction can occur with the LTN from either excessive compression or tension, although compression injuries are most common. There are several locations where compression injuries are likely to occur. Compression could affect LTN roots at the cervical spine from herniated discs, bone spurs, tumors, or other obstructions. Moving distally from the nerve root, the next location of potential compression is between the anterior and middle scalene muscles.

The brachial plexus courses between the anterior and middle scalene muscles



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Proximity of the LTN to the dorsal scapular nerve. Their close proximity sometimes allows for a connecting branch between them. *Image courtesy 3D4Medical's Essential Anatomy 5 application.*

as this large nerve bundle exits the neck region. The LTN is directly adjacent to the major nerve bundles that comprise the brachial plexus. Often, when there is brachial plexus compression, the LTN can be compressed, but symptoms from other nerves likely dominate, so LTN compression may go undetected.

Other causes of nerve compression in this region include falls or blows directly on top of the shoulder, especially those that may include clavicular fracture.[1] You see injuries like these in football. Heavy straps such as those in backpacks, knapsacks, shoulder bags, or even bra straps can also compress the nerve. If you are a massage therapist who carries your table around with a strap over your shoulder, this is something to consider.

Rapid tensile loading on the nerve can also cause damage and dysfunction. The rapid stretch of the nerve is most common in sudden lateral flexion movements of the cervical region, such as those that happen in contact sports or in lateral whiplash injuries from automobile accidents.[2] There are also some associations of LTN injury with sports activities that have a strong single-arm dominance, such as bowling, tennis, or golf.

LTN injuries are most frequently associated with an activity. However, nerve compression can occur from inactivity if the body is in a position that compresses the nerve for long periods, such as awkward sleeping positions or postural strain from a challenging workstation or occupational activity.

There are also reports of LTN injury resulting from surgeries in which the patient was placed in a position on the surgical table for hours at a time.[3] Surgery can also be implicated in LTN damage from direct trauma of the nerve during the surgical procedure. There are reports of LTN injury from mastectomy, first rib resection to treat thoracic outlet syndrome, cardiac surgery, and even spinal fusion surgery to treat scoliosis.[4] In addition to the more common causes of nerve injury described above, some anatomical variations can contribute to LTN pathology. An anatomical anomaly can occur in which there is a connecting branch between the dorsal scapular nerve and the long thoracic nerve (Image 2). When a connection exists between two nerves, each is less mobile and more susceptible to tension injury.[5]

DYSFUNCTIONAL BIOMECHANICS

As noted earlier, the LTN is the motor supply nerve for the serratus anterior muscle. The serratus anterior's function is to hold the scapula firmly against the thoracic rib cage and contribute to upward rotation of the scapula. However, this function should not be oversimplified because it plays a key role in scapulothoracic mechanics.

When the shoulder is moved in abduction, there is a coordinated movement between the scapula and humerus called the *scapulo-humeral rhythm*. This coordinated pattern is such that for every three degrees of abduction, two degrees occur at the glenohumeral joint and one occurs at the scapulothoracic articulation. This coordinated movement allows the shoulder to abduct as fully as possible. The upward rotation of the scapula helps make a greater range of motion than would be possible with just glenohumeral abduction alone.

In a situation of LTN compression, weakness of the serratus anterior means that full upward rotation of the scapula does not occur during abduction. Consequently, range of motion in abduction is diminished. However, when the scapula does not move in full upward rotation, the lateral edge of the humeral head is more likely to contact the underside of the acromion process during abduction, leading to shoulder impingement and potential damage to soft tissues in the subacromial region, including the bursa, supraspinatus, or joint capsule.

SYMPTOMS OF LTN PATHOLOGY

Because the LTN is primarily a motor nerve, it does not have many sensory fibers. Thus, the usual indicators of nerve compression, such as sharp pain or paresthesia, are not always present or may be diminished. Those with LTN injury may report weakness in the shoulder along with pain sensations. Keep in mind shoulder pain can result from impingement problems that are directly caused by the biomechanical dysfunction. Attempting to address shoulder impingement and not recognizing the contribution of LTN involvement can lead to poor results and continual problems.

Sometimes people describe weakness with various shoulder motions. The weakness might be accompanied with pain, but could also occur without any pain or sensory deficit. The client may also describe some difficulty performing activities overhead, as these motions usually involve a significant degree of scapular upward rotation to complete.

TREATMENT STRATEGIES

As with any nerve compression or tension injury, the key factor for success is reducing the mechanical load. That means getting pressure off the nerve if it is a compression problem, or relieving the excess tensile stress if it is a nerve traction injury. A thorough client history is extremely important in identifying the primary causative factors that may have led to nerve compression or tension injury.

Keep in mind that, especially with compression injuries, the longer the force has been applied to the nerve, the slower and longer the healing time. Symptom relief may take many months or even a year or longer.[6] During the healing process, the person should avoid aggravating activities like carrying heavy loads on the affected side.

When compression occurs from external forces such as heavy shoulder straps, removing the offending activity may be sufficient for healing. However, in many cases, there still may be soft-tissue involvement that can benefit from massage. There are a few key areas that are important to address to make sure the nerve has the greatest potential for proper healing.

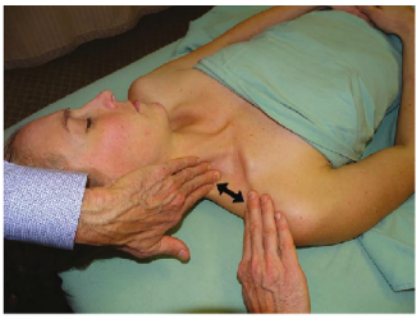
If LTN compression is occurring between the anterior and middle scalene muscles, it is often hypertonicity or taut bands within these muscles that are compressing the nerve. In these cases, the key treatment goal is to reduce muscle tightness to prevent further compression. However, diving in with deep pressure on these muscles when they may already be tight can be counterproductive and cause more irritation to the nervous system. Light, gentle pressure in this case can be even more effective in helping restore proper tone.

Begin with the client in a supine position. Turn the client's head slightly to the opposite side and, if possible, laterally flex the head toward the affected side. This position will slightly shorten the scalene muscles and reduce any stretch tension perceived by the muscle. Place the fingertips of one hand near the superior portion of the muscle and the fingertips of the other hand near the inferior portion of the muscle near the clavicle and first rib (Image 3). Apply a gentle pulling force, separating your two hands, and hold for about 2 minutes.

After holding this position, very slowly and gradually let go of the pulling force. Slowly releasing this force allows the brain to adapt to a different sensation coming from the muscles and is more likely to have a longer lasting effect. After pressure is released, take the client's head, then slowly and gently move it back and forth in slight flexion and lateral flexion toward the affected side, trying to keep from overstretching the muscles that have just been treated. These gentle and easy movement patterns help retrain the neuromuscular pattern perceived by the brain. If you're not forcibly stretching the muscle, the brain does not have to perceive any potential tissue damage and will not cause as much reactive resistance to the movement.

A similar technique can be applied to the muscles on the top of the shoulder along the path of the long thoracic nerve. Place one hand near the base of the neck and the other hand near the distal

3 Treatment of scalene muscles to reduce LTN compression.



4 Treatment of shoulder muscles to reduce LTN compression.

5 Serratus anterior treatment (direction 1).

6 Serratus anterior treatment (direction 2).

end of the clavicle. Slightly laterally flex the client's head toward the affected side. Apply a traction force to the skin with your hands, gently pulling them apart (Image 4). Hold this for about 2 minutes. At the end of that period, very slowly and gently let go and once again move the neck and shoulder slowly and easily within a comfortable range of motion to help re-encourage safe and pain-free movement.

There can be bind and restriction in the lower portions of the long thoracic nerve as well. These restrictions can be addressed with the client in a side-lying position. Have the client hold one arm across the front of the body and use the other hand to keep the drape in place so the lateral aspect of the rib cage is accessible.

With one or both hands, push the surface layer of skin across the lateral rib cage and hold this position for a few moments (Image 5). Then, slowly let go and push in a slightly different direction (Image 6). Pushing and pulling the skin perpendicular to the direction of the nerve can help to mobilize the nerve and make sure it is not being entrapped, bound, or restricted by adjacent tissues.

CONCLUSION

When you begin to explore the anatomy of the nervous system, it is clear there are many more locations where nerves are vulnerable to excessive compression or tension than most of us realize. While stories of carpal tunnel, thoracic outlet, or nerve root compression dominate most of the focus of nerve compression problems, there is a whole host of other disorders involving other nerve tissues throughout the body. Massage therapists are ideally positioned to help address these complaints, and future versions of this column will focus on these fascinating issues. For a full list of references and some additional information on long thoracic nerve injury, visit our blog at www.academyofclinicalmassage.com. m&b

Notes

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3. J. G. Skedros et al., "Complex Scapular Winging Following Total Shoulder Arthroplasty in a Patient with Ehlers-Danlos Syndrome," *Case Reports in Orthopedics* (2015): 680252.
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6. M. Pecina, A. Markiewitz, and J. Krmpotic-Nemanic, *Tunnel Syndromes: Peripheral Nerve Compression Syndromes* (Boca Raton, FL: CRC Press, 2001).

Whitney Lowe is the developer and instructor of one of the profession's most popular orthopedic massage training programs. His texts and programs have been used by professionals and schools for almost 30 years. Learn more at www.academyofclinicalmassage.com.