

Conservative treatment for thoracic outlet syndrome

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Thoracic outlet syndrome (TOS) is caused by compression of the nerves and vessels of the upper extremity. The thoracic outlet is a space between the neck and shoulder through which the nerves, arteries, and veins travel. Narrowing or scarring in that space leads to painful symptoms and signs. The compression can be extrinsic in nature, meaning adjacent structures, such as muscle, bone, or ligaments are pressing on the neurovascular bundle, or intrinsic in nature, meaning a stretch injury or repetitive activities are aggravating the brachial plexus [1,2].

Most patients with TOS have neurogenic symptoms although vascular problems can be present. The primary complaint is pain or a sensation of heaviness and fatigue in the shoulder and neck region, usually accompanied by paresthesias that radiate from the shoulder to the ring and little finger. Various activities or postures, including deep breathing, may aggravate these symptoms [2–4].

Diagnosing neurogenic TOS requires a systematic evaluation, including any possibility of trauma, subjective complaints, palpation, provocative tests, and EMG testing [1–7]. Symptoms range from mild to severe, depending on the duration and extent of injury. Mild symptoms are intermittent and include fatigue or numbness after exercise or with percussion near the clavicle (Tinel's sign). Severe symptoms may be constant and may include severe headaches, upper extremity swelling, numbness, and Raynaud's-like symptoms in the hand. Often the patient with TOS has a confusing presentation; for example, a double-

crush syndrome is common [5,8,9]. Other pathologies might include Raynaud's phenomenon, reflex sympathetic dystrophy, tendonitis, bursitis, or adhesive capsulitis [4].

Goals of treatment

A good treatment program starts with a complete upper quarter evaluation, together with a postural assessment including the spine [1,2,10]. Patient history and complaints may be more important than findings, because symptoms can become worse only after exertion or at night [11]. Although some patients require immediate surgical intervention, many patients with TOS are successful with conservative treatment [1,2,7, 11–18].

In most cases conservative treatment is effective unless there is significant neural loss or vascular compression. According to Leffert, if muscle atrophy or arterial occlusion is present, then surgery is required immediately [3,4]. Kenny suggests the conservative routine should continue for 4–6 months before surgery is considered [19]. Most investigators agree that failure to respond to conservative measures indicates surgical intervention [11].

Conservative treatment focuses on decreasing extrinsic pressure and reducing intrinsic irritation. By reducing inflammation in the thoracic outlet and shortening or lengthening the surrounding musculature for proper balance, pressure against the neurovascular bundle is decreased. Patient education for all activities and training with good body mechanics and proper posture decreases internal friction and ultimately restores muscle balance in the upper quadrant [1,4]. Obesity and a heavy breast mass in women also may need to be

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addressed to achieve good long-term results [3,15]. Postural correction is extremely important and probably the hardest to change, because of its habitual nature especially in adults [3,4].

Pain control

After the patient has been evaluated and diagnosed with TOS, pain reduction is the initial goal [20]. Judicious use of trigger point injections with an anesthetic and steroid solution can be helpful in symptom control. Anti-inflammatory and pain medication, muscle relaxants, and therapeutic modalities are implemented immediately.

The latter might include heat and pain-reducing modalities such as transcutaneous electrical nerve stimulation (TENS), micro current and cranial electrotherapy stimulation (Alpha-Stim, Electromedical Products Intl., Inc.; Mineral Wells, TX), high-voltage pulsed current, manual massage, phonophoresis, and gentle range of motion. Biofeedback techniques are also helpful; relaxation exercises, playing soft music, and deep breathing exercises can further reduce pain.

Edema control

After pain control has been addressed, edema control should be initiated. Edema control would include edema gloves, compressive garments and sleeves, elevation, active range of motion, and retrograde massage. Edema may be localized at the thoracic outlet area or in the entire upper extremity and hand. Edema gloves, elastic sleeves, or even an edema pump are helpful for reducing edema in the distal extremity, whereas massage may be more beneficial if swelling is localized at the base of the neck. Exercises to glide the muscles, tendons, and nerves in the brachial plexus area and upper extremity minimize edema, enhance tissue nutrition, and help alleviate traction neuropathy by minimizing adhesions.

Phonophoresis treatments (ultrasound with steroid gel) seem to help with pain and edema control. This also potentially helps control inflammation and scar contraction.

Education

Early in the treatment program, patient education is introduced [10,14,15,17]. This includes edema control, nerve protection, ergonomics, behavior modification, relaxation techniques, posture and body mechanics, and weight or nutritional management. The treatment goals are

the same with any intervention: to increase the space in the thoracic outlet and reduce pressure on the neurovascular structures [11].

General concepts of conservative treatment should be explained to the patient as a basis for the home program. The patient has to understand fully its purpose and benefits [14,15]. To treat TOS the therapist therefore has to be a good teacher. Education may include handouts and a written home program with pictures for clarification. The patient should be encouraged to be compliant for a given period of time, because the benefits may not be apparent for a few months.

Posture

Education includes ergonomics and posture education [3,4,6,10,14,15]. There are certain postures and activities that aggravate TOS symptoms and others that reduce the symptoms. The head-forward posture aggravates TOS symptoms [3,4,11]. This posture combines rounded spine and forward head with protracted shoulders. It is commonly referred to as “slouching.” Activities that aggravate TOS are reaching above shoulder level and carrying heavy weights.

Good posture alleviates symptoms and is as follows: bring shoulders back to a relaxed but retracted position; head should glide back automatically when shoulders are in correct position, weight should be distributed equally on both feet and low back should retain its normal lordosis. Patient may need to look in a mirror at front and side views. The patient can attempt a rigid military stance and then relax the position to improve comfort and compliance. Proper posture should be maintained when sitting, standing, or walking.

When sleeping, the patient should lie on the unaffected side with one head pillow of appropriate height and another pillow in front of the body to prop the affected arm. The patient also could lie on his or her back with one head pillow and one pillow under each upper arm. The three pillows form an inverted “U” shape and hands can rest on the abdomen. Sometimes cervical support pillows are helpful in achieving better sleeping posture by keeping the lordosis of the neck intact. The patient should avoid sleeping with arms overhead, sleeping prone with head turned to one side, or sleeping on the affected side.

Ergonomics

Work posture should be discussed, and this may require a job site evaluation. If the patient

works at a desk, the height of the chair and desk need to be considered. If the chair is too low the patient's shoulders and arms are elevated, and if the chair is too high the patient's low back and shoulders bend forward. The relative heights should be such that the forearms rest comfortably on the work surface without the shoulders being elevated or depressed. The patient should not lean over or work with arms higher than shoulder level. A step stool should be close by if overhead work is required.

If the patient works while sitting in an armchair, the chair should support the forearms with the arms and shoulders in a natural position. The goal is to support the arm, thereby taking the weight off the neck and shoulder. Care should be taken not to have the patient lean on the cubital tunnel, especially if the patient has a double-crush diagnosis. The patient should avoid carrying heavy objects in one arm. Purses or briefcases should be carried on the uninvolved side and close to the body.

If the patient works at a computer the chair height should be adjusted so that the patient's feet rest solidly on the floor with hips and knees at a 90° angle. The spine should be supported especially at the lower back, keeping the natural curve intact. The computer monitor ideally should be positioned so that the screen is slightly below eye level and angled upward to prevent neck hyperextension. The patient should be able to look at the screen comfortably without turning or straining of the neck. If the patient stands while using the computer, one foot at a time can be propped onto a small stool to keep proper low back posture and prevent slouching.

The keyboard should be positioned so that the upper arms are vertical and the forearms are horizontal with the elbow at a 90° angle. Wrists should rest in a neutral position while typing. A wrist pad may be needed for support. The keyboard "feet" should not be flipped out, because this forces the wrist into extension while typing.

While driving, the patient should hold the steering wheel securely but relaxed, keeping hands low on the steering wheel. An armrest or small pillow could be used to support the elbow; this relaxes the shoulders. As a passenger, the patient is to rest forearms on a pillow and therefore support the shoulders and relax the thoracic outlet area. A small pillow or lumbar roll also should be used to support the low back. Prolonged car rides are discouraged, because the jostling around in a vehicle can aggravate muscle spasm in the neck.

Relaxation

Relaxation exercises such as deep breathing, mild aerobic, or contract-relax exercises are important in preventing muscle guarding around the shoulder girdle [21]. The patient may want to involve family members to remind them of good posture. Repetitive activities should be stopped before symptoms arise.

Hot showers, heating pads, and massages also may be beneficial. Cold temperatures should be avoided, as this tends to increase muscle tension around the neck and upper trapezius area. The patient can wear multiple light layers to stay warm, because heavy coats can weight down the shoulders and aggravate symptoms. Air conditioning that is too cold or blows directly on the patient also can irritate TOS symptoms. The patient may need a sweater that is put on and taken off easily during the summer when air conditioning is used.

Other general considerations include not letting arms hang at side while sitting or standing. The patient can place his or her hands in coat or pant pockets to relax shoulders. Strenuous exercises that create labored breathing can aggravate TOS symptoms. Obesity also contributes to poor posture and the continuation of symptoms. This should be addressed by a physician and treated; weight control may be an important aspect of TOS treatment. Thin bra straps can dig into the shoulder and be painful. To solve this problem the patient may prefer wearing a strapless bra. A bra with wide straps or strap padding that dissipates the pressure over the shoulder area is helpful, especially for women with heavy breasts.

Exercises

Because TOS usually is caused by pressure on the nerves and blood vessels in that space, some degree of upper extremity edema is unavoidable. Tendon gliding exercises (TGE) and brachial plexus gliding (BPG) exercises are given to help glide the nerves in the tight space and milk out any extra fluid build-up [22,23]. Brachial plexus gliding combines range of motion exercises of the neck, shoulder, and entire upper extremity. Although no studies prove that the brachial plexus actually glides, ROM of the joints in the upper extremity should increase nerve movement.

Exercise protocols vary slightly, but all attempt to improve posture by restoring balance of the neck and shoulder girdle muscles [3,4,15,17,21].

This involves relaxing the shoulder girdle and upper trapezius musculature, stretching the scalene and pectoral muscles, and strengthening the cervical extensors, scapular adductors, and shoulder retractors.

The following exercises are the most common exercises given to patients with TOS at the Pennsylvania Hand Center:

1. Neck. The patient is to sit with the arms resting on pillows, back straight, and low back supported.
 - a. Neck side bending. This exercise stretches the scalene muscles. Bring right ear toward right shoulder without shrugging the shoulders and hold for 5 seconds. Then bring left ear toward left shoulder in the same way and hold for 5 seconds. This exercise is to be repeated five times.
 - b. Neck rotation. This stretches the cervical muscles and improves neck rotation. Turn head to side and look over right shoulder while keeping body facing forward; hold for 5 seconds and repeat five times. Repeat for left side.
 - c. Neck flexion. This exercise stretches the cervical extensors and upper trapezius muscles. Bend neck forward to chest and hold for 5 seconds then return neck to neutral. Repeat five times.
 - d. Chin tucks. This exercise stretches the cervical extensors and strengthens the paraspinal muscles. Try to make a double chin, feeling a stretch behind neck and holding for 5 seconds. Repeat five times, relaxing between efforts.
 - e. Neck half-circles. Roll head slowly from one ear to same side shoulder then chin to chest and then the other ear to the other shoulder slowly five times in each direction. This exercise combines all the neck exercises and improves ROM.
2. Shoulder exercises. These are done standing up.
 - a. Pendulum exercises. First do pendulum exercises with or without a 1-lb weight for 1–2 minutes. This exercise loosens the shoulder girdle by putting gentle traction on the upper quadrant.
 - b. Shoulder shrugs. Elevate shoulders up to ears and then slowly lower, repeating five times. This exercise strengthens and relaxes the upper trapezius muscles and encourages scapular retraction and cervi-

cal extension. One exercise protocol prescribed this exercise without weights for 1 week, then with 1-lb weights for 1 week, and then with 3-lb weights for 1 week; the results were good in the eight patients involved [15,19]. Another protocol promotes shoulder shrugs and abduction with 2-lb weights [24]. Novak, however, found that shoulder elevation exercises with weights exacerbated TOS symptoms.

- c. Shoulder circles. Roll shoulders forward five times then backward five times. This exercise alternately strengthens and stretches the entire shoulder girdle.
- d. Elbow pinches. Place hands on waist and move elbows behind back attempting to touch the elbows together. Hold for 5 seconds, then relax and repeat five times. This stretches the pectoral musculature and strengthens the scapular adductors.
- e. Corner stretch. Stand in a corner or doorway and put one hand on each wall or doorframe and then slowly let the upper part of the body lean forward into the corner or doorway. Though standing, the body's position resembles a push-up and stretches the pectoral muscles while strengthening the scapular muscles.
- f. High swings. As a cool-down exercise, stand with arms to side, swinging both arms forward and backward as a pendulum as high as possible in each direction. Repeat five times.
- g. Side swings. Swing arms forward crossing each other at shoulder level and then swing arms back and try to make shoulder blades touch together. Repeat five times. This loosens the shoulder girdle.

After the exercises the patient could use ice for 10 minutes to decrease edema and inflammation. Finish with deep breathing and a relaxation tape to facilitate relaxation and prevent muscle guarding. Sometimes ice actually can increase guarding and irritate the thoracic outlet; in this case ice should be avoided.

Other exercises

Other exercises may assist in achieving good corrective posture and strengthening. These include lying supine, knees bent, with a small rolled towel between scapula for 15 minutes several times per day [24]. This stretches the pectoral muscles.

Scapula muscle strengthening may include laying prone on floor or bench and lifting arms toward ceiling at shoulder level with palms down and elbows straight. This is sometimes referred to as scapular “airplane” exercises.

Lindgren had patients do isometric exercises of the neck cervical extensors (chin tucks), scalene muscles, and the anterior muscles of the cervical spine to reduce tension in these muscle groups [25].

Nerve gliding exercises

Nerve gliding also can be implemented to glide the brachial plexus through the thoracic outlet to minimize scarring and pressure. These exercises, however, are based on author preferences, with no factual basis [26,27].

Nerve gliding patterns for the thoracic outlet include motions of the neck and entire upper extremity. For example, the neck bends to the right while the right elbow extends and the wrist flexes and then the neck side bends to the left shoulder while the right elbow flexes and the wrist extends. The basic concept is that while pulling on the nerve in one direction, tension in the other direction is relieved, thus gliding the nerve (see article on nerve gliding elsewhere in this issue).

Nerve gliding exercises are sometimes difficult to remember even with pictures; therefore, the patient may need to start them in therapy with supervision and then move to a home program. They need to be modified for each patient and should be done in a pain-free range.

Manual therapy and soft tissue techniques

Manipulation of the scapula and thoracic outlet area is believed to be beneficial. Smith introduced this for patients with TOS with attention to sternoclavicular joint, scapula, and the first rib articulations. Jackson added acromioclavicular mobilization to Smith’s program and Walsh includes thoracic articulation mobilization [11,20].

Often patients with TOS have muscle guarding in the upper trapezius as a protective mechanism because of the thoracic outlet pain and muscle imbalance. Deep fascial and trigger point massage release especially of the trapezius and rhomboid muscles therefore may be helpful [28].

Some therapists use the Feldenkrais method of body awareness therapy and report good results with this technique. This method uses biofeed-

back to improve ROM, posture, and pain control [29].

Summary

A few specific exercises and posture education programs have been developed with a variety of protocols. Initially it is important to decrease painful symptoms. Next work starts to effect a more permanent change through education. Stretching and strengthening exercises are introduced early and should continue for many months.

Keeping in mind that all patients with TOS present a little differently and at different stages, the following is a sequenced program combining many treatment plans.

Stage 1. Acute

Pain management

TENS

Heat before/ice after exercises

Light massage

Ultrasound/phonophoresis

Pain, anti-inflammatory, and muscle relaxant medication

Other diagnoses such as tendonitis are addressed

Edema control

Edema gloves

Elastic sleeves

Elevation

ROM

Increase gliding and ROM

Pendulum exercises

Gentle AROM in comfortable range with TGE, BPG, and nerve gliding

Address posture/ergonomics

Nerve protection education for TOS and possible double-crush areas

Postural/ergonomics education

Sleeping posture may be the main focus initially

Feldenkrais method and body awareness

Stage 2. Subacute

Pain management

Continue with helpful modalities and medication

Add deep breathing

Relaxation and stress management

Deep fascial and trigger point massage

Increase gliding and ROM

Continue TGE, BPG, and nerve gliding

Add AROM and gentle PROM

Start manual manipulation

Education

Continue with posture education: have patient include family members for more consistent postural correction

Address obesity and breast mass

Add stretching exercises to postural muscle groups that are shortened (usually pectoral muscles, neck extensors, and low back)

Add strengthening to postural muscle groups that are weak (usually scapular, upper back, and abdominal muscles)

Strengthening

Start with light weights or Thera-Band (The Hygienic Corporation; Akron, OH) to increase threshold strength and endurance

Start aerobic exercises, walking, or swimming

Stage 3. Reconditioning**Pain management**

Wean off medication and modalities except for flare-ups

Continue deep breathing and stress management

Relaxation tapes, yoga, meditation, calm music

Gliding**AROM****PROM**

Brachial plexus gliding exercises

Nerve gliding

Wean manual manipulation

Education

Incorporate and review all postural, ergonomic and nerve protection education

Weight management program continued and in progress

Strengthening

Continue stretching

Strengthening of upper extremity and trunk musculature

Continue aerobic and endurance exercises

Stage 4: chronic/recurrent

During the course of treatment, modifications may need to be made. If exacerbation occurs, return to stage one (pain management) and move through the stages again according to tolerance. Recurrence of symptoms is common even after a year or two of no symptoms. Conservative treatment can be re-implemented and usually symptoms are relieved once again.

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