NTOS from the Physical Therapists' Point of View

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Abstract

The purpose of this chapter is to discuss the evaluation by a physical therapist of a patient who has been diagnosed as having neurogenic thoracic outlet syndrome (NTOS). Such an evaluation is designed to obtain the facts that will guide both the technique and vigor of treatment. The initial evaluation can be separated into three sections: First, subjective evaluation of the history of symptoms (with emphasis paid to characteristic pain patterns and their persistence), numeric assessment of current symptoms, and functional assessment (ideally using a standardized functional questionnaire). Second, an objective evaluation, including assessment of active movements and palpation, to determine both the sensitivity of the nervous system and to help differentiate various other problems from NTOS. Emphasis is placed on tests that are performed at every treatment session to assess the effect of the treatment. Finally, emphasis on evaluation of motor dysfunction (Kabat test), breathing, and neurodynamics of the brachial plexus are performed.

Introduction

Neurogenic thoracic outlet syndrome (NTOS) can present with signs and symptoms indicating the presence of neurological problems relating to the basic pathology as well as musculoskeletal consequences related to the chronicity of the condition. The purpose of the physical therapist's evaluation is threefold: First, examine the nervous system to determine its degree of sensitivity, second, to ascertain whether NTOS or another entity exists and, if both, to determine which predominates [1], and, third, obtain the data that will be needed to guide the technique(s) and vigor of treatment. The initial evaluation is separated into subjective and objective components.

Subjective Evaluation

The subjective evaluation includes a numeric rating of present symptoms, functional assessment using a standardized questionnaire, and history from onset to present time.

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Numeric assessment of present symptoms: The patient is asked to rate the intensity of pain at least and at worst on a 0–10 numeric pain rating scale (NPRS). The NPRS has high content validity; it directly measures the intensity of pain and has been shown to have correlations as high as r = .80 [2].

Functional assessment using a standardized functional questionnaire: The Disability Arm Shoulder Hand (DASH) questionnaire measures upper extremity function, and is ideal in this role. There are 30 questions, each with five possible answers ranging from 1 = normal to 5 = unable to do. Normal function is indicated by a score of 30 and maximum abnormal function, 120. The test-retest reliability is ICC = 0.96, and retesting after intervention can demonstrate change [3]. A problem encountered by this author is the difficulty of this and other standardized tests to pick up the subtle changes to be found over time in the NTOS population. The main value of the DASH assessment may be the fact that it provides a numeric value (albeit qualitative) that can be used as a measure of the severity of functional impairment between patients. A better answer to assessing change may be found in the Patient Specific Functional test [4].

History: The onset of symptoms in patients with NTOS is typically gradual. Characteristic symptomatic patterns emerge as these problems progress from acute to chronic. Symptoms can begin in the neck and spread to the arm and hand and other arm, or begin in the hand and progress to the arm, neck and other extremity. Pain, numbness, swelling, discoloration of the hand and temperature asymmetry in the hand can be specific to a peripheral nerve emanating from the brachial plexus, a cervical root or both. Symptoms can also include headache and, occasionally, low back and leg pain. As they progress, symptoms can be intermittent or constant and can vary in degree of severity from mild to severe. Rest or positional change or modification in performance of task eases mild symptoms, but not severe symptoms.

Objective Evaluation

Objective tests are divided into those tests that are done at the initial evaluation only, those tests that differentiate NTOS from other problems [1], and those tests that are repeated at every treatment to assess progress.

Testing at the Initial Evaluation

- **Postural observation/assessment:**
  - **Test:** Typical posture can include a forward head, together with scapular elevation and scapular protraction. There may be visible swelling in the supraclavicular fossa.
    - **Goal:** Reduce forward head posture.
- **Active Movements:**
  - **Test:** All active movement tests must only be examined to the point of tension (the point at which the flexion withdrawal response, as defined below, is elicited) not to the point of pain or pain increase [5]. In the NTOS patient there are musculoskeletal dysfunctions as well as neurovascular dysfunctions. In examining the musculoskeletal consequences of the injury, movement is commonly evaluated to the point of pain or pain increase. If one evaluates the neurovascular consequences in the same way, there is a high probability that the examination itself will exacerbate the patient's condition. To avoid this increase in symptoms, movement tests should be examined to the point of tension only. If the examination is limited to this point of tension, then the possibility of a flare secondary to the evaluation will be minimized. In evaluating the nervous system to determine its sensitivity to movement one must instruct the patient to alert the examiner to the tension point in active range of motion. It is the relationship between the tension free range of motion (ROM) and the full ROM that measures the flexion withdrawal reflex that is initiated by the sensitized nervous system. The closer the tension point is to the end range of motion (EROM) the more likely that the restriction (tension) is musculoskeletal in origin. Typically in NTOS the tension point is found in the first 50 % of active ROM while the EROM may be close to normal.
- **Active movement and palpation tests: Measuring the sensitivity of the nervous system**

- **Test:** Active movements of the neck examined: neck flexion: neck extension, neck rotation right and neck rotation left. Note whether there is a pattern of cervical restriction vs. brachial plexus restriction. Cervical movements are commonly painful ipsilateral or sensitive in upper trapezius and intrascapular regions. NTOS is commonly sensitive in the contralateral neck movements more than the ipsilateral neck movements. i.e. Side bending of the neck towards the symptomatic arm eases the pain rather than increasing the pain with NTOS. Conversely, side bending the neck away from the symptomatic arm increases the pain, rather than eases the pain as in CR. (See Spurling's test).
  - **Goal:** Increasing tension free ROM with reduction in pain, should be sufficient to allow increased function of the neck.
- **Test:** Active movements of upper extremities: Shoulder flexion with elbow extended tests shoulder ROM with a median nerve bias. Shoulder ROM with elbow flexed tests shoulder ROM with an ulnar bias and hand behind back tests shoulder ROM with a radial bias.
  - **Goal**: Increasing tension free ROM with reduction in pain should be sufficient to allow increased function of the shoulder.
- **Test**: Tinel's tap test: at the carpal tunnel, Guyens canal, cubital tunnel and over the brachial plexus (Erb's point). The greater the number of positive Tinel's sites the greater the sensitivity of the nervous system.
  - **Goal:** Decrease sensitivity of the nervous system, resulting in a negative tap test.
- **Test**: Palpation to assess tenderness: anterior scalene, subclavius and pectoralis minor.
  - **Goal**: The more sites of tenderness, the more likely it is that the tender muscles are hyperactive. Therefore the goal is to reduce the hyperactivity of these dual functioning muscles. (Breathing, neck and shoulder girdle movements).
- **Test**: Sensation of numbness or paraesthesia more commonly C8/T1 in distribution.
  - **Goal**: Normal sensitivity in C8-T1.

Tests Used to Differentiate NTOS from Other Problems (Most Commonly, at This Phase, Cervical Radiculitis)

- **Spurling's test.** A positive sign (incriminating a cervical disc problem) is pain or tingling referred to the ipsilateral arm. Referral to the contralateral arm suggests NTOS.
- Positioning the arm overhead eases the symptoms caused by cervical disk disease, while it aggravates the symptoms in NTOS. The elevated arm stress test (EAST) is a variant of this.
- Manual distraction of cervical spine eases symptoms caused by cervical disk disease, but aggravates those caused by NTOS.

Testing to Assess Changes Over Time

- **Test**: Hand temperature (conveniently measured with an infrared wine thermometer). Normal is symmetry between index and fifth digit and in high 80s low 90s. The hands may be cold with asymmetry between the index and little finger with the little finger commonly colder than the index finger [6]. The measurement error with the wine thermometer is estimated to be ±2°.
  - **Goal**: Re-establish normal physiologic response to diaphragmatic breathing, walking, and repeated movements of the arms. The normal response is increasing hand temperature. In NTOS the response can be a decrease in temperature.
- **Test**: Patients with NTOS have a breathing pattern at rest that is upper chest, scalene, subclavius and pectoralis minor dominant rather than diaphragmatic.
  - **Goal**: Calm the neurological system with parasympathetically sustained diaphragmatic breathing. Measure by increased tension free range of motion of the brachial plexus. Able to inhale 50 % without activating the scalenes [7, 8].
- **Test**: Even in NTOS, neurodynamic testing of sciatic plexus using straight leg raise (SLR) can be positive for abnormally restricted mobility and increased sensitivity. The extreme example is reproduction of hand symptoms with SLR.

Fig. 9.1 Right ULTT: Starting position note that the nervous system in its resting position should be relaxed and asymptomatic

  - **Goal**: Symmetrical (SLR) with pull in hamstrings and ROM 65° or greater.
- **Test**: Neurodynamic testing of upper limb tension test (ULTT) [8, 9]. I consider using the ULTT to assess the brachial plexus is as important as using the SLR to examine the sciatic plexus in symptoms of the lower extremity (Figs. 9.1, 9.2, 9.3 and 9.4). The ULTT limitation is not specific for a particular anatomical site but rather incriminates the nervous system as a whole in the symptom production [8, 9].
  - **Goal**: Use ULTT to assess increase in tension-free ROM of the brachial plexus which provides an objective measure of a decrease in neural sensitivity.
- **Test:** Cardiovascular assessment using a treadmill**:** Evaluate ability to walk without an increase in symptoms, record speed and time to a maximum of 20 min. Modify the speed and time and swing arms or support arms to avoid pain increase.
  - **Goal**: Swing arms, while walking at a speed of 3 mph, for 20 min, four times a day, without increase in symptoms.
- **Test**: Strength testing of the cervical spine, scapula, low back and thumb. Muscle weakness, if present, is mild and involves most commonly the thenar, hypothenar and interossei muscles innervated by the ulnar nerve. The traditional grip and pinch tests are within normal limits. To assess the relationship of the cervical spine stability and weakness of the thumb, examine with Kabat test (see Chap. 23). This test evaluates weakness of the intrinsic core stabilizers of the neck. It is also a sensitive measure of the dysfunction of the dynamics of

Fig. 9.2 Ending position before treatment Arm movements to take up the slack in the Brachial Plexus to initial point of tension. Assess symptoms at position of increase in tension. Record example as follows: Right ULTT: Symptoms of tension right IV and V digits at 40° of glenohumeral abduction and 180° of elbow extension without scapular depression without wrist and finger extension (This is a typical example of initial finding with NTOS)

Fig. 9.3 End Range of Motion after a treatment technique such as diaphragmatic breathing. Sample of ULTT ending position demonstrating decrease in neural sensitivity. Assess symptoms at increase in tension position. Record as follows: Right ULTT, Symptoms of tension in IV and V digits at 90° of glenohumeral abduction and 180° of elbow extension without scapular depression and without wrist and finger extension. Typical example of NTOS as nervous system is decreasing in irritability. Commonly assessed by having the patient walk with a stride that does not increase pain and swinging the arms provided that also does not increase pain

Fig. 9.4 Further increasing range of motion typical example with NTOS as nervous system is decreasing in irritability and now cannot find tension with full abduction of the arm unless take up more slack in the nervous system by hyper-extending wrist and fingers. Record as follows: Right ULTT: Symptoms IV and V digits at 90° of glenohumeral abduction and 180° of elbow extension without scapular depression with wrist and finger extension

the neck and shoulder girdle stability. The physical therapist and the patient can use this test, plus the Thinker's Pose, to determine if an activity/exercise causes a unilateral weakness. These weaknesses and/or dysfunctions are associated with patient with a diagnosis of NTOS [10].

– **Goal**: To be strong in all postures and during all exercises when initially they were weak.

Herman Kabat, M.D., the originator of the physical therapy technique termed proprioceptive neuromuscular facilitation (PNF), recognized that in the evaluation of neuromotor control of the hand and its relationship to the cervical spine that following proprioceptive stimulation of the deep neck flexors the weakness in unilateral deep thumb flexor could be reversed with an immediate increase in strength of the weak thumb. The deep head of flexor pollicis brevis is tested isometrically in the shortened range of thumb adduction [11] (Fig. 9.5). For an accurate test care must be used to minimize activity from median innervated muscles such as opponens pollicis and the long flexor of the thumb and the fingers. If one thumb is weak, it is re-tested while the patient is doing the Thinker Pose (Fig. 9.6). The force is just enough to activate proprioceptors in the deep

Fig. 9.5 Assessing strength of the ulnar innervated thumb muscles of the hand using an instrument as shown, the strength can be measured

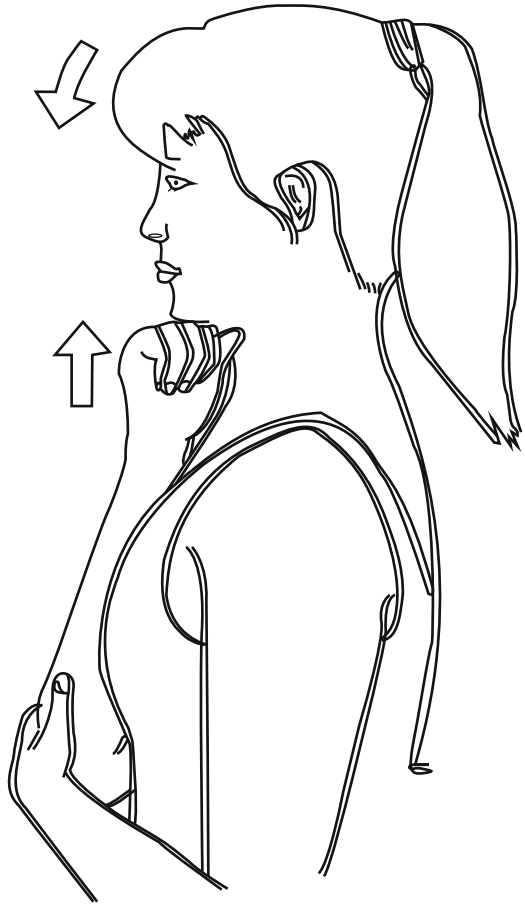

Fig. 9.6 "Thinker Pose"

neck flexors as the patient initiates movements of the trunk or upper extremities. The applied force should be thought of as a proprioceptive neuromuscular stimulus to the stabilizers of the neck rather than a strengthening stimulus, which could activate the scalenes as well as the deep neck flexors. If weakness is reversed, it is thought to be due to the isometric activation of the core stabilizers (deep neck flexors) with minimal or no activation of the scalenes, subclavius or pectoralis minor muscles. The hand weakness returns with stress to the neck in the form of minimal stress of gravity such as fully erect posture vs. relaxed forward head posture or flexed neck posture vs. relaxed resting posture. The patient who has a weak thumb that is strengthened by the "Thinker Pose" characteristically, has weakness in the stabilizers of the neck, lumbar spine and stabilizers of the scapula. Test the patient at each treatment to assess whether they are functionally stable in neutral, fully erect and flexed postures. This would be accomplished when the thumb tests strong without input from the thinkers pose.

Comments

As in any medical condition, the purpose of the initial evaluation is to identify and characterize the problem at hand. It is a non-trivial point that the physical therapist's evaluation must not cause increased sensitivity of the nervous system, because the nervous systems' response to NTOS involves the whole nervous system generating an abnormal response to minimal movement/activity to begin with! The care provided by the physical therapist must provide a model for the patient the care they need to use to manage their problem. The ability to do a thorough evaluation without exacerbating the patient's symptoms will establish a foundation of confidence in the practitioner's skill and experience. In treatment, a change you can make during a visit may not be sustained but even so can provide the patient with the understanding that it is possible to reverse some of the symptoms and signs almost immediately. It may take repetition of dysfunctional symptoms to correct the neuromotor dysfunction, and it is possible to retrain such a normal neuromotor response with repetition also.

The more sensitive the nervous system is, the slower will be the progression of treatment. The usual goals of strengthening and stretching have to be monitored carefully and can be maladaptive if they increase the sensitivity of the nervous system. In patients with NTOS, the nervous system has been injured and the chronicity of the problem has resulted in the centralization of the pain.

Conclusion

The goals of the initial physical therapy evaluation are to examine the neurovascular system in order to develop a treatment plan and use the objective findings to assess progress.

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