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First Rib Mobilization in the Treatment of Thoracic Outlet Syndrome

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FIRST RIB MOBILIZATION IN THE TREATMENT OF THORACIC OUTLET SYNDROME

By

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This scholarly project, submitted by Chad C Boehm in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

Shawnn Decker
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(Chairperson, Physical Therapy)

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Title First Rib Mobilization in the Treatment of Thoracic Outlet Syndrome

Department Physical Therapy

Degree Doctor of Physical Therapy

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Signature Chad C Boehm, SPT

Date 10/12/12

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ABSTRACT

Background and Purpose: Thoracic outlet syndrome (TOS) is one of the most controversial clinical entities in medicine. It encompasses three related syndromes: compression of the brachial plexus (neurogenic TOS), compression of the subclavian artery or vein (vascular TOS), and a non-specific or disputed type of TOS.[5] Neurovascular compression may be observed most commonly in the interscalene triangle, but has also been described in the costoclavicular space and subcoracoid space.[6] The purpose of this case study is to further explore the efficacy of manual therapy, specifically mobilization of the 1st rib, to relieve the symptoms of a 43 year-old female, suffering from TOS.

Case Description: The patient is a 43 year old female presenting with a tingling sensation around her left scapula and down her left arm after prolonged periods of relaxed sitting. Myotomes, dermatomes and reflexes were all negative, bilaterally. Adson's maneuver and Roos test were both negative.

Intervention: Moist hot pack and IFC were administered for 10 minutes for muscle relaxation. The patient was then asked to lay supine and her first ribs were palpated. A manual depression of the first rib was performed and repeated three times. This treatment was repeated six times over the course of two weeks, in addition to a home exercise program.

Outcomes: The patient was seen three times per week for two and a half weeks for a total of eight treatment sessions. During the course of treatment, the patient reported a significant decrease in the frequency and severity of her symptoms. Once the therapist felt the patient had met her clinical goals, she was discharged with instructions to follow-up if any symptoms reoccurred.

Discussion: This case study demonstrates manual depression of the 1st rib as an easy, effective option in the conservative management of thoracic outlet syndrome.

Chapter I
Background and Purpose

Thoracic outlet syndrome (TOS) is one of the most controversial clinical entities in medicine. The incidence of TOS is reported to be approximately 8% of the population[1] and affects females more than males (between 4:1 and 2:1 ratios).[1,2,3,4]

Thoracic outlet syndrome encompasses three related syndromes: compression of the brachial plexus (neurogenic TOS), compression of the subclavian artery or vein (vascular TOS), and a non-specific or disputed type of TOS.[5] Neurovascular compression may be observed most commonly in the interscalene triangle, but has also been described in the costoclavicular space and subcoracoid space.[6]

Clinical features may include pain in the shoulder and neck region, which radiates into the arm, paresis or paralysis of muscle innervated by branches of the brachial plexus, loss of sensation, reduction of arterial pulses in the affected extremity, ischemia, and/or edema[6].

Neurogenic TOS (NTOS) is the most common form of thoracic outlet syndrome, comprising well over 90% of all TOS patients[7] and according to Hooper *et al.*[8] a majority of patients with neurogenic TOS can be expected to improve with proper conservative treatment. However, Novak *et al.*[9] found that poor outcomes to conservative therapy were associated with obesity, worker's compensation, and double crush pathology involving the carpal or cubital tunnels.

In a recent review of 13 studies published between 1983 and 2001, Vanti *et al.*[10] found good or very good results were achieved using conservative treatment in 76 to 100% of disputed neurogenic TOS patients at short-term follow-up (within a month) and 59 to 88% after at least one year.

Conservative (non-operative) treatment of thoracic outlet syndrome has included the use of nonsteroidal anti-inflammatory drugs to reduce pain and inflammation.[11] Injection of botulinum toxin into the anterior and middle scalenes for temporary relief of pain and spasm resulting from neurovascular compression in the thoracic outlet has also been investigated.[12,13] Jordan *et al.*[12] found 64% of subjects had a minimum of 50% decrease in pain, numbness, and fatigue for at least one month following injection.

Since one of the areas of neurovascular entrapment is the costoclavicular space between the clavicle and first rib, it should logically follow that widening this space would be advantageous. One such conservative method to achieve this would be to use a mobilization to manually depress the first rib. However, research supporting the use of manual therapy in the treatment of TOS is scarce.

Walsh (1994) reported the use of soft-tissue mobilization techniques for the thoracic outlet along with a flexibility exercise program and posture modification activities in patients with TOS. Over the course of 2 to 14 sessions (mean 10.5 sessions), 68.5% of his patients were asymptomatic, 10.5% obtained moderate relief, 5.8% obtained no relief.[14]

Prost (1990) reported the use of active exercises to lower the first rib along with Peet's exercises, strengthening of the posterior muscles of the spine, elevation

of the shoulder girdle, isometric exercises for serratus anterior and pectoralis minor.[15] Over the course of 8 to 30 sessions (mean 14 sessions), 70% of patients obtained good results (negative clinical signs, negative Doppler exam), 10% of patients obtained moderate results (symptoms improved or disappeared, but had recurrences during work activities), and 20% of patients obtained poor results.[15]

The purpose of this case study is to further explore the efficacy of manual therapy, specifically mobilization of the 1st rib, to relieve the symptoms of a 43 year-old female, suffering from TOS.

Chapter 2
Case Description

The patient is a 43 year old female who presented with a tingling sensation around her left scapula and down her left arm after prolonged periods of relaxed sitting. At the time of the examination, the patient was employed at a local college and reported this tingling sensation had become a problem at work. She reported at times, her symptoms had gotten bad enough for her to temporarily lose sensation in her fingertips.

The patient had recently had an MRI, which was largely unremarkable, but indicated a minimal amount of stenosis of the C3, C4, C5 intervertebral foramina.

During observation, it was noted the patient had very good sitting posture but upper trapezius tightness was evident. This was exaggerated during the course of conversation when she began talking with her hands. At the time of examination, the patient had full active range of motion of both upper extremities and cervical spine. Symptoms were unable to be replicated with active or passive range of motion of the cervical spine.

Passive accessory intervertebral movements of the cervical spine were assessed with the patient in supine lying and the physical therapist cradling the patient's head under the occiput. The motion of each cervical vertebra was assessed for ease of motion as the patient's head was passively moved through rotation,

bilateral side-bending, flexion and extension. The motion of each cervical vertebra appeared normal.

Myotome testing, the assessment of the motor units innervated by a particular nerve root, was assessed with the patient sitting upright at the end of the assessment table. Resisted isometric contractions were performed as outlined in TABLE 1. Weakness in a resisted isometric contraction indicates a positive finding and thus, a compromised nerve root. All myotomes were negative, bilaterally.

Nerve Root	Motion resisted
C1	Head flexion
C2	Lateral side-bending
C3	Shoulder Elevation (Shrug)
C4	Shoulder Abduction
C5	Elbow Flexion
C6	Elbow Extension
C7	Thumb Extension
C8	Finger Adduction

TABLE 2-1. Isometric motion resisted and associated nerve root of myotome assessment.

Dermatome testing, the assessment of cutaneous innervation of a particular nerve root, was assessed with the patient sitting upright at the end of the assessment table. The patient was then asked to close her eyes as cutaneous stimulation was applied bilaterally to areas outlined in TABLE 2. As stimulation was provided, the patient was asked to indicate whether stimulation felt similar or different, comparing bilaterally. A perceived difference indicates a positive finding and thus, a compromised nerve root. All dermatomes were negative, bilaterally.

Nerve Root	Area stimulated (bilaterally)
C1	Crown of scalp
C2	Temple area above ears
C3	Lateral aspect of neck
C4	Superior aspect of shoulder
C5	Lateral aspect of deltoid
C6	Lateral aspect of thumb
C7	Posterior aspect of third digit
C8	Medial aspect of little finger
T1	Medial aspect of forearm
T2	Medial Aspect of upper arm

TABLE 2-2. Areas of bilateral stimulation with associated Cervical nerve root.

Reflex testing, the assessment of a peripheral nerve and associated reflex pathway, was performed for C6 and C7. Reflexive contraction of the biceps (C6) or triceps (C7) indicates a negative finding and thus, intact reflex pathway. Reflexes of C6 and C7 presented normal, bilaterally.

First thoracic nerve root stretch assesses dural irritation of the first thoracic nerve root (T1). This test was performed by having the patient abduct their arm to 90 degrees, flex their pronated forearm putting the hand behind the neck. This action stretches the ulnar nerve and T1 nerve root. Pain into the scapular area or arm indicates a positive test.[16] First thoracic nerve root testing was negative, bilaterally.

Two classic special tests for the presence of thoracic outlet syndrome are the Roos test and Adson maneuver. In 2001, Gillard, *et al*[17] assessed the clinical contribution of these (and other) special orthopedic tests in the diagnosis of thoracic outlet syndrome. Results relevant to this particular case study are outlined in TABLE 3. The special tests in question were found to be relatively poor at either

ruling in or ruling out the presence of thoracic outlet syndrome and were only slightly more effective when combined.

	Sensitivity	Specificity	(+) Likelihood Ratio	(-) Likelihood Ratio	Probability
Roos test	0.84	0.30	0.53	1.20	Useless
Adson Maneuver	0.79	0.76	0.28	3.29	Small
Adson + Roos	0.72	0.82	0.34	4.00	Small

TABLE 2-3. Reported sensitivity and specificity[17] with calculated positive and negative likelihood ratios for special tests performed during examination.

Roos test was performed with the patient sitting upright at the end of the assessment table. The patient was then asked to hold both shoulders in abduction to 90 degrees with both elbows bent to 90 degrees and repeatedly open and close her hands for three minutes. This position is thought to compress the neurovascular bundle under the pectoralis minor muscle. A positive finding is defined as a replication of symptoms or abolition of radial pulse. Patient reported no replication of symptoms while the physical therapist found no change in pulse quality.

Adson maneuver was performed by palpating the radial pulse at the left wrist. The patient's shoulder was laterally rotated and extended by the examiner as she was asked to rotate her head toward the test arm (to the left) and extend her head. Finally, the patient was asked to take a deep breath and hold it. This is thought to increase the tension of the anterior and middle scalene muscles, decreasing the interscalene space, thus compressing the neurovascular bundle. A positive finding is defined as the abolition of radial pulse. Patient suffered no loss of radial pulse.

Patient reported feeling her symptoms while sitting with her arms relaxed in her lap during the examination. While her symptoms were exacerbated, we had her lie on her back and performed manual traction of the cervical spine with a minimal

relief of symptoms. This led us to believe her cervical stenosis was a contributor, but not the primary cause of her symptoms.

The patient's description of her symptoms led us to believe thoracic outlet syndrome was still a possible cause. However, with the exception of upper trapezius tightness, the patient's posture was very good. This is contrary to a typical TOS presentation as the patient will generally have a forward head, rounded shoulders posture. In addition, our thoracic outlet special tests, ROM and neurological testing were all negative. This led us to also suspect a possible muscular entrapment of the suprascapular and/or dorsal scapular nerves in the upper trapezius muscle.

Plan of care would focus first on a relaxation of the upper and middle trapezius musculature and home exercise program to strengthen scapular stabilizers and promote scapular retraction with subsequent follow-up as to relief of symptoms. If this treatment was ineffective, we shift our focus to treating the suspected thoracic outlet syndrome utilizing the aforementioned exercise program and manual therapy to relieve symptoms again, with subsequent follow-up.

Chapter 3
Intervention

Since her sitting posture was adequate and thoracic outlet testing was negative, we began by treating the assumed muscular entrapment of the nerves coursing through her tight trapezius muscle. During the patient's initial visit, after examination and evaluation was complete, we administered Interferential Current (IFC) for musculoskeletal pain management and moist hot pack to the left upper and middle trapezius for muscle relaxation.

In 2010, Fuentes et al.[18] performed a systematic review of the literature to determine the effectiveness of IFC in the management of musculoskeletal pain. Fourteen studies were included in the analysis. These studies encompassed a wide array of diagnoses treated with IFC, summarized in TABLE 3-1.

Number of Studies Included	Diagnoses Treated
5	Low back pain
4	Knee Osteoarthritis
2	Fibromyalgia/myofascial pain
1	Jaw pain
1	Frozen shoulder pain
1	Bicipital tendinitis

TABLE 3-1. Adapted from Fuentes et al.[18]

The results of the meta-analysis indicated the use of IFC alone for musculoskeletal pain is not significantly better than placebo or other forms of therapy (i.e. manual therapy, traction, massage). However, the results of the meta-analysis also indicate the use of IFC as a co-intervention to be significantly better

than control and placebo for reducing chronic musculoskeletal pain at discharge and at 3 months post-treatment, respectively.

The patient was also given a home exercise program including an upper trapezius stretch, middle trapezius stretch and scapular retraction with depression exercises (FIGURES 3-1, 3-2 and 3-3).

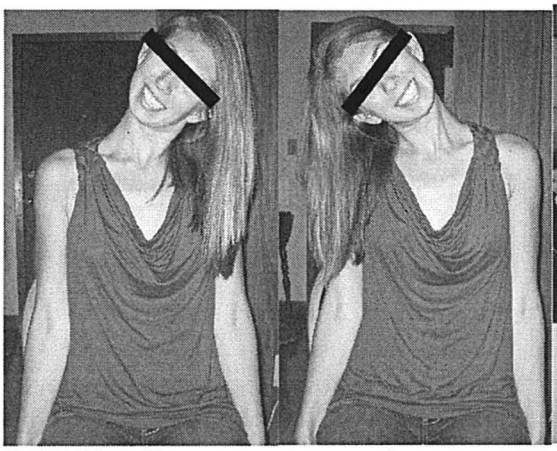


FIGURE 3-1. Upper trapezius stretch.

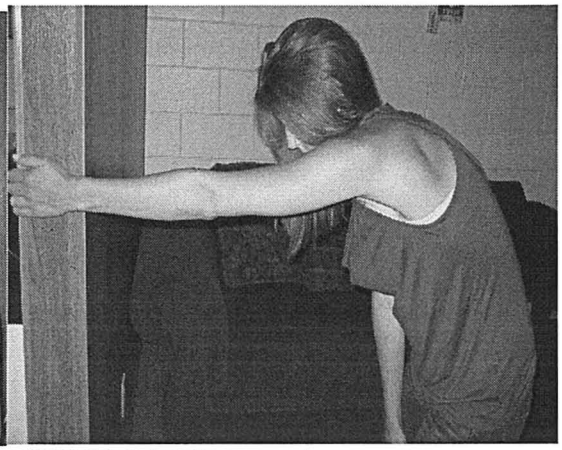


FIGURE 3-2. Middle trapezius stretch.

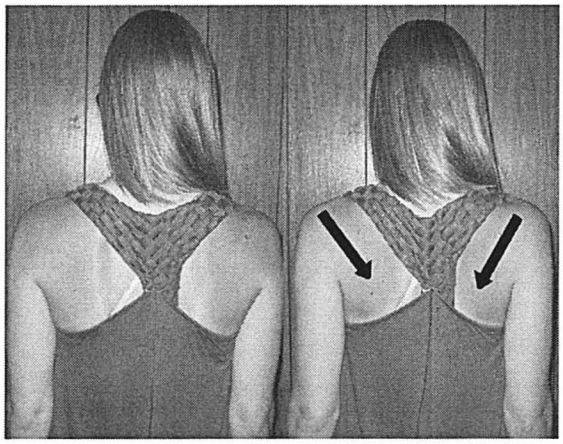


FIGURE 3-3. Scapular retraction with depression.

At her next scheduled visit, patient reported a minimal improvement in frequency and intensity of symptoms. This lead us to believe her stenosis may be a greater contributor than anticipated, so we began with IFC and moist hot pack to

upper and middle trapezius for 10 minutes for muscle relaxation. Static mechanical traction was then applied to the cervical spine at 12 pounds for 8 minutes, in a supine position.

In 2004, Taskaynatan et al.[19] performed a randomized prospective trial to investigate the effects of cervical traction in addition to exercise and hot pack therapy in 40 people with thoracic outlet syndrome of non-defined type. The participants were randomly divided into a control or treatment group. The control group received hot pack therapy and an exercise program; the experimental group received hot pack therapy, an exercise program, and cervical traction. Outcomes measured consisted of provocative maneuvers. These included the Adson, hyperabduction, hyperextension, Roos, costoclavicular, and Wright's maneuvers. These outcomes were assessed after three weeks of intervention. A significant difference in numbness scores was found between the groups, in favor of cervical traction (80% versus 20%, $P < 0.001$).[19]

The patient reported an immediate relief of symptoms only slightly greater than that of IFC and moist hot pack alone.

At her next visit, the patient again reported an overall minimal improvement in frequency and intensity of symptoms. Negative results of the Adson maneuver and Roos test ruled out neurovascular entrapment between the scalene muscles and pectoralis minor muscle, respectively. However, an area of entrapment the author failed to examine is a bony entrapment of the subclavian neurovascular bundle between the 1st rib and clavicle.

Moist hot pack and IFC were administered for 10 minutes for muscle relaxation. The patient was then asked to lay supine and her first ribs were palpated. It became evident her left first rib was elevated, when compared bilaterally. A mobilization was then performed to depress the first rib.

To perform the first rib mobilization, the patient remained lying supine with her head in the examiner's right hand. Examiner then palpated the left first rib and passively side-bended the patient's head to the left to relieve any muscular tension on the first rib. Patient was then asked to take a deep breath in and out. During exhalation, the examiner applied pressure to depress the first rib, holding it in place at the end of the exhalation. Then, holding the first rib in place, the patient was asked to inhale and exhale deeply again. The examiner continued applying pressure to hold the first rib in a position of relative depression during inhalation, and further depressed the first rib as able during exhalation. This process was repeated three times in two sets, for a total of six first rib depression mobilizations.

At her next treatment session, patient reported a significant improvement in frequency and intensity of her symptoms. Since the patient had the best results with moist hot pack and IFC followed by first rib depression mobilization, we continued with this intervention method while adding light strengthening and exercises of the scapular stabilizers.

Chapter 4
Outcomes

The patient was seen three times per week for two and a half weeks for a total of eight treatment sessions. During the final four treatment sessions, the patient had reported her symptoms arose very infrequently. Additionally, when her symptoms did arise, they were faint and short-lasting. This was reported consistently over a week's worth of treatment, the patient had met all the goals we had established after the initial examination and evaluation (TABLE 4-1), therefore we felt we had done as much as we could with conservative treatment. The patient was discharged with instructions to continue her home exercise program and follow up if she experienced any recurrence of symptoms.

Length of goal	
Long Term	Following three weeks of PT intervention, patient will report working a full week without exacerbation of symptoms.
Short Term	Following one week of PT intervention, patient will report three or fewer exacerbation of symptoms over the course of a workweek.
Short Term	Following one week of PT intervention, patient will demonstrate independence in HEP to decrease the frequency and intensity of her symptoms.

TABLE 4-1. Summary of long term and short terms goals which patient had met by discharge.

Cost

As previously stated, the patient was seen for a total of eight treatment sessions, which amounts to $661.50 of billable treatment time. Insurance was able

to pay 75% of this cost, which leaves $165.38 of out of pocket expense. A more detailed cost analysis is provided in TABLE 4-2.

Treatment	Reimbursement	Times performed	Total
Evaluation	$72.46	1	$72.46
Hot pack	$5.45	8	$43.60
Estim (manual)	$17.69	8	$141.52
Therex	$29.58	8	$236.64
Manual Therapy	$27.88	6	$167.28
		Grand Total	$661.50
		Out-of-Pocket	$165.38

TABLE 4-2. Cost analysis of treatment provided.

Additional costs typically associated with functional impairment were negligible. She lived quite close to the therapy facility so travel expenses were low. Additionally, the patient was able to continue contributing to the economy at large. That is to say, she did not miss any days of work and continued to be an active member of the community, going out to shop or buy gas, for example.

Chapter 5
Discussion

The primary purpose of this study was to evaluate the effectiveness of 1st rib mobilization in the treatment of thoracic outlet syndrome in a symptomatic 43-year-old female. At the conclusion of two and half weeks of an outpatient physical therapy program including interferential current (IFC), moist hot pack (MHP), manual therapy and therapeutic exercise, the patient reported a significant reduction in the frequency and intensity of her symptoms. This reduction made the patient's symptoms very manageable, allowing her to avoid the need for surgical intervention. While literature investigating manual therapy in the treatment of thoracic outlet syndrome is very limited, our results show a manual depression of the 1st rib to be an easy, effective option in conservative management of thoracic outlet symptoms.

A secondary purpose of this case study was to evaluate commonly used orthopedic provocative maneuvers in assessing the presence of thoracic outlet syndrome. As previously mentioned, Gillard, *et al*[17] found two common orthopedic tests, Roos test and Adson maneuver, to have very low sensitivity and specificity when used individually (TABLE 4-1). Furthermore, their study found performing Roos test and Adson's maneuver together actually decreased sensitivity and only slightly increased specificity, meaning these two tests are virtually useless in

determining the presence of thoracic outlet syndrome. The author was unaware of these findings at the time of the initial evaluation.

These findings are particularly relevant to this case study as both provocative maneuvers were performed and false negatives were attained. These false negatives affected the clinical decision-making process of the author, thus affecting the course of treatment. Subsequently, the patient was not provided the highest quality care as she received treatment for conditions that were not contributing to her symptoms. This means the patient, and the patient's insurance provider, had paid for two treatment sessions the patient did not fully benefit from. Had true positives been attained through provocative testing, quality care could have been provided earlier, reducing total visits to six and decreasing the financial burden to the patient and her health insurance provider.

As healthcare providers, our primary duty is to provide the highest quality care available. This begins with accurate diagnoses. With regards to thoracic outlet syndrome, current research and clinical experience both tell us the tests we currently utilize are not working. Therefore, the development and evaluation of new orthopedic maneuvers to assess the presence of thoracic outlet syndrome is an area in need of further research.

Some limitations of this case report include the absence of a functional assessment, the treatment of only one patient, and possible variations in the performance of the afore-mentioned special tests. Thus, the findings of this case report should be applied to the general public with caution.

Contributions to Success

While we obtained good clinical outcomes, it is important to note additional contributing factors, which led to those outcomes.

At her initial visit, she was visibly frustrated that her symptoms had gotten so bad. This made her very motivated to continue her lifestyle in a pain-free manner and thus, increased her compliance.

We were lucky in the fact our patient was very disclosing. She made a sincere effort to tell us anything and everything she felt relevant to her condition so we could make the best clinical decisions possible.

She was very inquisitive, asking about everything from the anatomy and cause of her symptoms to why were performing each treatment selected. This not only helped her understand what we were doing, it helped us become better teachers/clinicians.

Lastly, and I feel most importantly, she was open-minded. This made "selling" therapy services much easier, aiding in her willingness to participate in treatment sessions and perform her home exercise program.

Reflective Practice

When reflecting upon the course of treatment with this particular patient, two additions to the initial examination are identified as possible contributors to a more effective therapy experience: A functional assessment and the costoclavicular maneuver provocative test.

A commonly used functional assessment of the upper extremity is the Disability of the Arm, Shoulder and Hand (DASH) Questionnaire (Appendix A).

The DASH is a 30-item questionnaire, which assesses function of the upper extremity with respect to various activities of daily living (e.g. turning a key, making a bed or carrying heavy objects) with an optional section assessing upper extremity function during work and sports/performing arts. This questionnaire has proven to be a valid and reliable method of quantifying upper extremity function.[20,21] The DASH has a minimal detectible change of 10.5 points[21] and a minimal clinically important difference of 10.2 points.[21]

Where the Adson maneuver and Roos test assess neurovascular entrapment between the scalene muscles and pectoralis minor muscle, respectively, the costoclavicular maneuver assesses neurovascular entrapment between the clavicle and 1st rib.

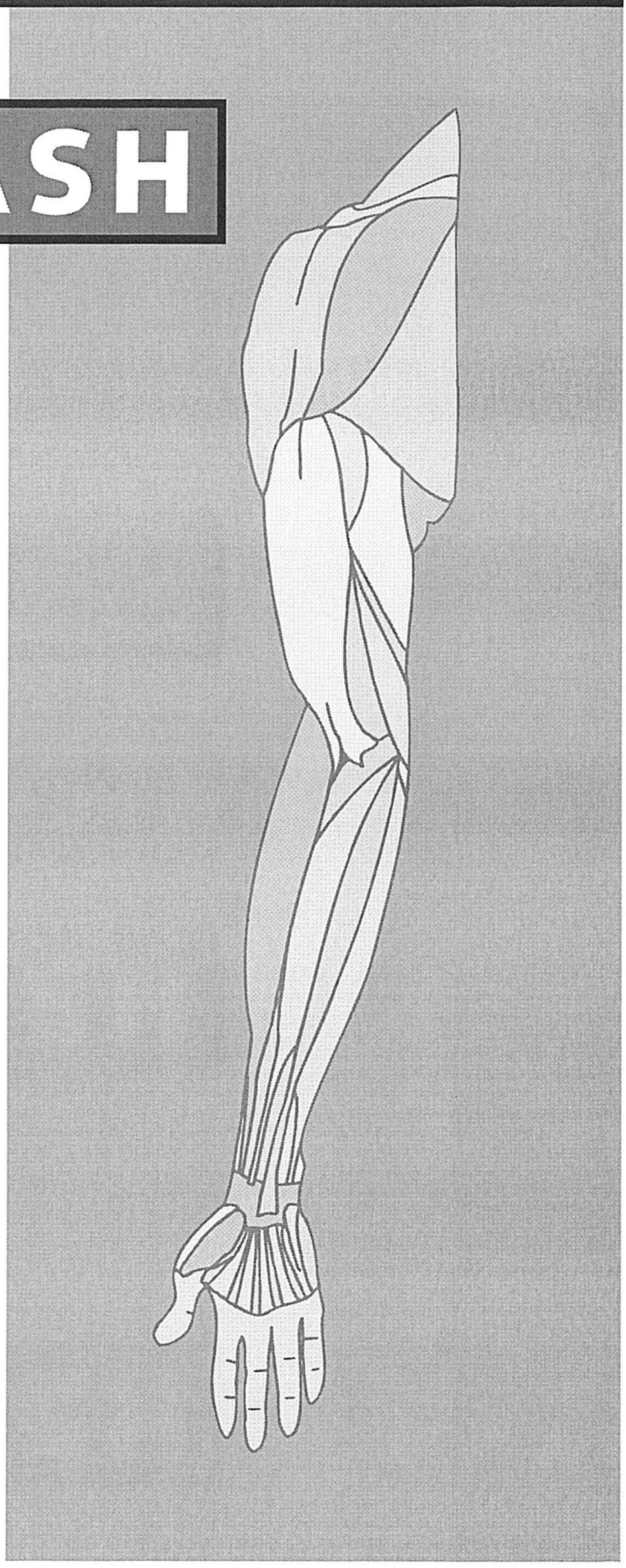
The costoclavicular maneuver is performed with the patient sitting upright at the end of the examination table. From behind, the examiner manually depresses and retracts the patient's shoulders, thus narrowing the costoclavicular space. Plewa and Delinger[22] found the costoclavicular maneuver to have a reasonable false-positive rate (only 7%) when using pain to indicate a positive result.

This simple maneuver may have helped the therapists identify the anatomical structures contributing to the patient's symptoms at the initial examination. As a result, the therapists may have created a more focused plan of care, returning the patient to optimal function in an abbreviated period of time.

APPENDIX A

DISABILITIES OF THE ARM, SHOULDER AND HAND

THE DASH



INSTRUCTIONS

This questionnaire asks about your symptoms as well as your ability to perform certain activities.

Please answer *every question*, based on your condition in the last week, by circling the appropriate number.

If you did not have the opportunity to perform an activity in the past week, please make your *best estimate* on which response would be the most accurate.

It doesn't matter which hand or arm you use to perform the activity; please answer based on your ability regardless of how you perform the task.

Disabilities of the Arm, Shoulder and Hand

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	1	2	3	4	5
2. Write.	1	2	3	4	5
3. Turn a key.	1	2	3	4	5
4. Prepare a meal.	1	2	3	4	5
5. Push open a heavy door.	1	2	3	4	5
6. Place an object on a shelf above your head.	1	2	3	4	5
7. Do heavy household chores (e.g., wash walls, wash floors).	1	2	3	4	5
8. Garden or do yard work.	1	2	3	4	5
. Make a bed.	1	2	3	4	5
10. Carry a shopping bag or briefcase.	1	2	3	4	5
11. Carry a heavy object (over 10 lbs).	1	2	3	4	5
12. Change a lightbulb overhead.	1	2	3	4	5
13. Wash or blow dry your hair.	1	2	3	4	5
14. Wash your back.	1	2	3	4	5
15. Put on a pullover sweater.	1	2	3	4	5
16. Use a knife to cut food.	1	2	3	4	5
17. Recreational activities which require little effort (e.g., cardplaying, knitting, etc.).	1	2	3	4	5
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5
19. Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.).	1	2	3	4	5
20. Manage transportation needs (getting from one place to another).	1	2	3	4	5
21. Sexual activities.	1	2	3	4	5

DISABILITIES OF THE ARM, SHOULDER AND HAND

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
22. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups? *(circle number)*	1	2	3	4	5

	NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
23. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem? *(circle number)*	1	2	3	4	5

Please rate the severity of the following symptoms in the last week. *(circle number)*

	NONE	MILD	MODERATE	SEVERE	EXTREME
24. Arm, shoulder or hand pain.	1	2	3	4	5
25. Arm, shoulder or hand pain when you performed any specific activity.	1	2	3	4	5
26. Tingling (pins and needles) in your arm, shoulder or hand.	1	2	3	4	5
27. Weakness in your arm, shoulder or hand.	1	2	3	4	5
28. Stiffness in your arm, shoulder or hand.	1	2	3	4	5

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SO MUCH DIFFICULTY THAT I CAN'T SLEEP
29. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? *(circle number)*	1	2	3	4	5

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
30. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem. *(circle number)*	1	2	3	4	5

DASH DISABILITY/SYMPTOM SCORE = $\left[\frac{\text{sum of n responses}}{n} - 1\right] \times 25$, where n is equal to the number of completed responses.

A DASH score may <u>not</u> be calculated if there are greater than 3 missing items.

DISABILITIES OF THE ARM, SHOULDER AND HAND

WORK MODULE (OPTIONAL)

The following questions ask about the impact of your arm, shoulder or hand problem on your ability to work (including home-making if that is your main work role).

Please indicate what your job/work is:_____

❒ I do not work. (You may skip this section.)

Please circle the number that best describes your physical ability in the past week. Did you have any difficulty:

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. using your usual technique for your work?	1	2	3	4	5
2. doing your usual work because of arm, shoulder or hand pain?	1	2	3	4	5
3. doing your work as well as you would like?	1	2	3	4	5
4. spending your usual amount of time doing your work?	1	2	3	4	5

SPORTS/PERFORMING ARTS MODULE (OPTIONAL)

The following questions relate to the impact of your arm, shoulder or hand problem on playing *your musical instrument or sport or both*. If you play more than one sport or instrument (or play both), please answer with respect to that activity which is most important to you.

Please indicate the sport or instrument which is most important to you:_____

❑ I do not play a sport or an instrument. (You may skip this section.)

Please circle the number that best describes your physical ability in the past week. Did you have any difficulty:

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. using your usual technique for playing your instrument or sport?	1	2	3	4	5
2. playing your musical instrument or sport because of arm, shoulder or hand pain?	1	2	3	4	5
3. playing your musical instrument or sport as well as you would like?	1	2	3	4	5
4. spending your usual amount of time practising or playing your instrument or sport?	1	2	3	4	5

SCORING THE OPTIONAL MODULES: Add up assigned values for each response; divide by 4 (number of items); subtract 1; multiply by 25.
An optional module score may <u>not</u> be calculated if there are any missing items.

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REFERENCES

1. Davidovic LB, Kostic DM, Jakovljevic NS, Kuzmanovic IL, Simic TM. Vascular thoracic outlet syndrome. *World J Surg.* 2003;27(5):545–550.

2. Gockel M, Vastamaki M, Alaranta H. Long-term results of primary scalenotomy in the treatment of thoracic outlet syndrome. *J Hand Surg [Br].* 1994;19(2):229–233.

3. Demondion X, Bacqueville E, Paul C, Duquesnoy B, Hachulla E, Cotten A. Thoracic outlet: Assessment with MR imaging in asymptomatic and symptomatic populations. *Radiology.* 2003;227(2):461–468.

4. Degeorges R, Reynaud C, Becquemin JP. Thoracic outlet syndrome surgery: Long-term functional results. *Ann Vasc Surg.* 2004;18(5):558–565.

5. Povlsen B, Belzberg A, Hansson T, Dorsi M. Treatment for thoracic outlet syndrome. *Cochrane Database Syst Rev.* 2010;1(1):1-19.

6. Huang JH, Zager EL. Thoracic outlet syndrome. *Neurosurgery.* 2004;55(4):897-2, discussion 902-903.

7. Sanders R, Hammond S, Rao N. Diagnosis of thoracic outlet syndrome. *J Vasc Surg.* 2007;6(3):601-604.

8. Hooper T, Denton J, McGalliard M, Brismee J, Sizer P. Thoracic outlet syndrome: A controversial clinical condition. part 2. *J Man Manip Ther.* 2010;18(3):132-138.

9. Novak CB, Collins ED, Mackinnon SE. Outcome following conservative management of thoracic outlet syndrome. *J Hand Surg Am.* 1995;20(4):542–548.

10. Vanti C, Natalini I, Romeo A, Tosarelli D, Pillastrini P. Conservative treatment of thoracic outlet syndrome: A review of the literature. *Eura Medicophys.* 2007;43(1):55-70.

11. Parziale JR, Akelman E, Weiss AP, Green A. Thoracic outlet syndrome. *Am J Orthop.* 2000;29(5):353–560.

12. Jordan SE, Ahn SS, Freischlag JA, Gelabert HA, Machleder HI. Selective botulinum chemodenervation of the scalene muscles for treatment of neurogenic thoracic outlet syndrome. *Ann Vasc Surg.* 2000;14(4):365–369.

13. Danielson K, Odderson IR. Botulinum toxin type a improves blood flow in vascular thoracic outlet syndrome. *Am J Phys Med Rehabil.* 2008;87(11):956–959.

14. Walsh, M. Therapist management of thoracic outlet syndrome. *J Hand Ther.* 1994;7(2):131-144.

15. Prost, A. Place de la kinesitherapie dans le traitement du syndrome de la transversee thoraco-brachiale. *Kinesitherapie Scientifique.* 1990;288:5-22.

16. Magee, D. *Orthopedic Physical Assessment. 5th ed.* St. Louis, MO: Saunders; 2008:497

17. Gillard J, Perez-Cousin M, Hachulla E, Remy J, Hurtevent J, Vinkier L, Thevenon A, Duquesnoy B. Diagnosing thoracic outlet syndrome: Contribution of provocative tests, ultrasonography, electrophysiology, and helical computed tomography in 48 patients. *Joint Bone Spine.* 2001;68(5):416-424.

18. Fuentes J, Olivo S, Magee D, Gross D. Effectiveness of interferential current therapy in the management of musculoskeletal pain: A systematic review and meta-analysis. *Phys Ther.* 2010;90(9):1219-1238.

19. Taskaynatan MA, Balaban B, Yasar E, Ozgul A, Kalyon TA. Cervical traction in conservative management of thoracic outlet syndrome. *J Musculoskelet Pain.* 2004;15(1):89–94.

20. Herup A, Merser S, Boeckstyns M. Validation of questionnaire for conditions of the upper extremity. *Ugeskr Laeger.* 2010;172(48):3333-3336.

21. Roy J, MacDermid J, Woodhouse L. Measuring shoulder function: A systematic review of four questionnaires. *Arthritis Rheum.* 2009;61(15):623-632.

22. Plewa MC, Delinger M. The false-positive rate of thoracic outlet syndrome shoulder maneuvers in healthy subjects. *Acad Emerg Med.* 1998;5:337-342.