Management of Thoracic Outlet Syndrome by Physical Therapy: An Outcome Study

Jouni Zidbeck
University of North Dakota

Follow this and additional works at: https://commons.und.edu/pt-grad

Part of the Physical Therapy Commons

Recommended Citation
https://commons.und.edu/pt-grad/491

This Scholarly Project is brought to you for free and open access by the Department of Physical Therapy at UND Scholarly Commons. It has been accepted for inclusion in Physical Therapy Scholarly Projects by an authorized administrator of UND Scholarly Commons. For more information, please contact zeinelbyousif@library.und.edu.
MANAGEMENT OF THORACIC OUTLET SYNDROME

BY PHYSICAL THERAPY:

AN OUTCOME STUDY

by

Jouni Zidbeck
Bachelor of Science in Physical Therapy
University of North Dakota, 1996

An Independent Study
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Master of Physical Therapy

Grand Forks, North Dakota
May
1997
This Independent Study, submitted by Jouni H. Zidbeck in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

[Signatures]

Renee Madry
Faculty Preceptor

Beverly Johnson
Graduate School Advisor

[Signatures]

Chairperson, Physical Therapy
### PERMISSION

<table>
<thead>
<tr>
<th>Title</th>
<th>Management of Thoracic Outlet Syndrome by Physical Therapy: An Outcome Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department</td>
<td>Physical Therapy</td>
</tr>
<tr>
<td>Degree</td>
<td>Master of Physical Therapy</td>
</tr>
</tbody>
</table>

In presenting this Independent Study Report in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the Department of Physical Therapy shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my work or, in her absence, by the Chairperson of the department. It is understood that any copying or publication or other use of this independent study or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and the University of North Dakota in any scholarly use which may be made of any material in my Independent Study Report.

Signature  

Date \( \text{Jan. 6, 1997} \)
TABLE OF CONTENTS

LIST OF FIGURES .......................................................... vi
LIST OF TABLES .............................................................. vii
ACKNOWLEDGEMENTS ......................................................... viii
DEDICATION ........................................................................ ix
ABSTRACT ........................................................................ x

CHAPTER

I INTRODUCTION ...................................................................... 1
  Background ........................................................................ 1
  Overview of Paper ............................................................. 4

II LITERATURE REVIEW ......................................................... 6
  Anatomy ............................................................................ 6
  Etiology ............................................................................ 13
  Diagnostic Process ............................................................ 17
  Treatment .......................................................................... 25

III METHODOLOGY ................................................................. 32
  Chart Review Process ........................................................ 32
  Data Analysis ..................................................................... 34

IV RESULTS ............................................................................. 36
  Overview of Results .......................................................... 36
  Demographics .................................................................... 37
  Trends .............................................................................. 37

iv
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Schematic drawing of brachial plexus as it exits the vertebra</td>
<td>7</td>
</tr>
<tr>
<td>2.</td>
<td>Schematic drawing of the upper, middle and lower trunk of the right brachial plexus as they pass between the anterior and medial scalene muscles</td>
<td>8</td>
</tr>
<tr>
<td>3.</td>
<td>Schematic drawing of the neurovascular structures as they pass over the first rib and continue laterally to pass under the pectoralis minor muscle near its insertion to the coracoid process</td>
<td>10</td>
</tr>
</tbody>
</table>
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Commonly Accepted Variations of Thoracic Outlet Syndrome</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Differential Diagnosis of Thoracic Outlet Syndrome</td>
<td>23</td>
</tr>
<tr>
<td>3.</td>
<td>Outcome of Treatment of Thoracic Outlet Syndrome by Physical Therapy</td>
<td>38</td>
</tr>
<tr>
<td>4.</td>
<td>Overall Distribution of Patients Receiving Specific Treatments Versus Outcome</td>
<td>40</td>
</tr>
<tr>
<td>5.</td>
<td>Number of Patients Receiving Specific Treatment Within Either Improved or Not Improved Outcome Category</td>
<td>41</td>
</tr>
</tbody>
</table>
ACKNOWLEDGMENTS

I wish to extend my sincere appreciation to Dr. Renee Mabey, my preceptor, for your guidance and invaluable input that you have offered me throughout the course of this project. I also wish to thank Sue Jeno, my instructor, for being so very helpful in getting me started on this project.

I wish to thank all the physical therapists and medical records personnel at PT/OT Associates (Fargo, ND), The Rehab (Grand Forks, ND) and Polinsky Medical Rehabilitation Center (Duluth, MN) who were involved in locating medical records for my data collection. Without your help this project would not have been complete.

Finally, I wish to thank Jamie Napier for your love, support, and patience that I have always felt during these last three hectic years of work and school. Mahalketa.
This research project is dedicated

to my dear parents

Aslak and Leila Zidbeck
Thoracic outlet syndrome (TOS) is a disorder caused by compression of the brachial nerve plexus or subclavian artery or vein as they pass through a potentially limited space in the anterolateral neck and proximal shoulder. An individual with a predisposition for TOS due to his or her anatomy may have an onset of symptoms due to many different etiologies including acute injury and prolonged postural abnormalities. Although conservative management by physical therapy cannot replace surgery in severe or complicated cases of TOS, it is, nevertheless, the recommended first treatment choice. The purpose of this study was to assess the success of conservative management of TOS by physical therapy and to identify relationships between treatment choices and treatment outcome. A review of 21 physical therapy charts showed improvement in 67% of patients (n=14) and no improvement in 33% of patients (n=7) after conservative treatment. Although the overall treatment outcome was not impressive, certain interesting trends were observed when studying the relationships of specific physical therapy treatment choices and their outcomes. The results of this study suggest that conservative treatment of TOS can be effective but only if approached with a well-planned and aggressive treatment regimen including active participation by the patient.
CHAPTER I

INTRODUCTION

Background

Thoracic outlet syndrome (TOS) refers to a group of disorders caused by compression of the brachial nerve plexus or subclavian artery or vein as they pass through the potentially limited space in the anterolateral neck and proximal shoulder. Compression is most commonly caused by impingement of these neurovascular structures as they pass around a cervical rib, between the scalene muscles, between the first rib and clavicle, or around the coracoid process of the scapula. An individual with an anatomical predisposition for TOS may have an onset of symptoms after acute injury or chronic trauma, for example, from prolonged postural abnormalities.

History

Since its first appearance in medical literature in 1743,¹ the condition of thoracic outlet syndrome has been a controversial topic. Specifically, questions have arisen about diagnosis and, by some, even of its existence altogether.²⁻⁵ Although many diagnostic tests are available for both physicians and manual therapists, a diagnosis is often difficult to prove since only a few clear-cut tests are available and accepted by all.² For this reason many authors believe that the diagnosis is overrated and overused.²⁻⁷
Presently, TOS is considered by some authors to be a very specific compressive condition affecting only the proximal brachial nerve plexus as it is compressed by a cervical rib. Meanwhile, other authors advocate grouping several related conditions under the heading of TOS.\textsuperscript{5,8} Table 1 presents a collection of disorders that are commonly accepted under the heading of thoracic outlet syndrome.

For the purposes of this paper, the term “thoracic outlet syndrome” includes pathological conditions in which the brachial nerve plexus as well as subclavian artery and/or vein are affected by compression by various anatomical structures in the region of the thoracic outlet.

**Treatment Choices**

Another topic of controversy has been the treatment of thoracic outlet syndrome. While some physicians still choose surgery as the primary treatment method, many authors agree that, although conservative management by physical therapy cannot replace surgery in severe or complicated cases of TOS, it is, nevertheless, the first treatment choice.\textsuperscript{2,9-15} Conservative treatment refers to a wide range of non-invasive techniques used primarily by osteopathic physicians (D.O.), occupational therapists (O.T.), and physical therapists (P.T.). Specific treatment choices may include soft tissue techniques such as stretching and myofascial release, specific muscle strengthening exercises, joint mobilization, postural education, therapeutic modalities such as superficial and deep heat, stress relief, and activity modification.
Table 1.—Commonly Accepted Variations of Thoracic Outlet Syndrome

1. Scalenus anticus syndrome
2. Hyperabduction syndrome
3. Costoclavicular syndrome
4. Cervical rib
5. Fractured clavicle
6. Cervicobrachial compression syndrome
7. Pneumatic hammer
8. Effort vein thrombosis
9. Subcoracoid pectoralis minor syndrome
10. First thoracic rib
Since TOS has many different etiologies, it is not practical to state which one treatment choice is the single most effective choice. Thoracic outlet syndrome may be an end result of several different factors including, for example, poor work habits and posture. In order for a conservative treatment approach to be effective, one must then consider all possible factors that may have contributed to the present condition. The most effective treatment approach will most likely be a combination of several different treatments, each targeting one specific contributing factor.

It appears that "in order for the so-called conservative treatment to be given a fair trial, it should be directed as specifically as possible to the involved structures." Instead of simply providing an individual with "generic" thoracic outlet syndrome exercises, the clinician must first perform differential diagnosis of the thoracic outlet area in order to discover which anatomical area is causing impingement. Only after the impinging structure has been identified should a clinician advance to planning a treatment approach which will concentrate on the involved anatomical area.

**Overview of Paper**

The purpose of this paper is to evaluate the overall success of a conservative treatment approach for management of TOS. Although success of individual treatments is not evaluated, this study identifies certain trends of treatment choices versus outcome, keeping in mind, of course, that a complete treatment approach is made on an individual basis and is based on a variety of contributing factors identified during initial evaluation.

Since awareness of the specific anatomy involved is so vital for successful management of TOS, this paper begins with a review of the involved anatomy of the
thoracic outlet region. After the review of anatomy, diagnostic tests of the thoracic outlet will be presented followed by discussion of available treatment choices.

The second part of this paper will present results of a study evaluating outcome of conservative management of TOS by traditional physical therapy techniques including postural corrections, exercises, soft-tissue techniques, joint mobilization, and modalities. The paper will conclude with a discussion of the results of this study.
CHAPTER II

LITERATURE REVIEW

Anatomy

Being aware of the exact anatomical structures involved when performing diagnostic tests for thoracic outlet syndrome (TOS) is crucial for making appropriate treatment decisions. In addition, one must understand the anatomy of the thoracic outlet in order to appreciate how, in some individuals, even minor changes in this area may result in problems after acute injury or chronic trauma from, for example, a lifetime of poor postural habits.

The thoracic outlet is the area in which the brachial nerve plexus, subclavian artery and subclavian vein are located as they travel from the area of the neck to the chest and proximal shoulder. Approximately 90% of the symptoms of thoracic outlet syndrome are neurological\(^6\)\(^{16}\) which implies that most complaints are caused by impingement of the brachial plexus. After the nerve roots of the brachial plexus (C\(_5\), C\(_6\), C\(_7\), C\(_8\), T\(_1\)) exit the intervertebral foramina, they unite to form the upper, middle, and lower nerve trunks (Figure 1) which pass through a potentially tight area between the anterior and middle scalene muscles (Figure 2). After passing between the scalene muscles, the nerve trunks loop between the first rib and clavicle and continue laterally to
Fig 1.—Schematic drawing of the brachial plexus as it exits the vertebra. (Reprinted with permission)
Fig 2.—Schematic drawing of the upper, middle and lower trunk of the right brachial plexus as they pass between anterior and middle scalene muscles.
pass under the pectoralis minor muscle near its insertion to the coracoid process of the scapula (Figure 3).

The remaining 10% of TOS cases are from compression of either the subclavian artery or vein. After the subclavian artery branches from the brachiocephalic artery (right side) or arch of the aorta (left side), it joins the nerve roots of the brachial plexus and passes through the narrow opening between the scalene muscles. The artery is then joined by the subclavian vein and together they follow the path of the brachial plexus as they pass between the first rib and clavicle and move laterally to pass under the pectoralis minor.

**Areas of Impingement**

Specific symptoms of TOS arise when these neurovascular structures are compressed at one of four locations along this area: (1) superior thoracic outlet, (2) scalene triangle, (3) costoclavicular interval, and (4) coracoid-pectoralis minor loop. Each one will be discussed separately.

**Superior Thoracic Outlet.**—Of the four anatomical areas of compression listed above, the most proximal area is the superior thoracic outlet which is bordered posteriorly by the vertebra, anteriorly by the sternum (manubrium), and laterally by the first thoracic rib. Within this area, the most common bony abnormality causing symptoms of TOS is a cervical rib which presents in less than 1% of the population. Of individuals with a cervical rib only 10% or less have associated symptoms of TOS.

In some individuals, fibrous bands originating from a prominent C7 transverse process or a cervical rib may cause symptoms if the brachial plexus and/or subclavian
Fig 3.—Schematic drawing of the neurovascular structures as they pass over the first rib and continue laterally to pass under the pectoralis minor muscle near its insertion to the coracoid process.
artery are stretched across the structure. Individuals whose symptoms are severe and truly secondary to a cervical rib or fibrous bands will most likely undergo surgery to correct the abnormalities if the symptoms are nonresponsive to conservative measures. Although radiographic studies do not show fibrous bands, they do show the presence of cervical ribs or elongated C7 transverse processes which may aid the diagnostic process.

**Scalene Triangle.**—The second anatomical area causing compression may be the scalene triangle. The sides of the triangle are formed by the anterior and middle scalene muscles while the first rib forms the floor. Problems occurring here include developmental variations, muscle tightness, and hypertrophy.

An individual may have abnormal scalene muscle development with anomalous fibromuscular bands entrapping the upper trunk (C5, C6) of the brachial plexus. If an individual already has a predisposition for TOS due to a congenitally narrow passage between the anterior and middle scalene muscles, even a slight increase in muscle tightness or hypertrophy may result in direct irritation to the brachial nerve plexus or constriction of the subclavian artery.

**Costoclavicular Interval.**—The third potential anatomical area causing impingement of the nervous and vascular structures is the bony costoclavicular interval. Since both of the bones are somewhat mobile, there exists a “vise-like relationship” between the clavicle and first rib. The medial end of the clavicle at the sternoclavicular joint acts as a fulcrum while the lateral end is quite free to elevate or depress with
shoulder motion. Shoulder depression combined with retraction especially results in reduced size of the costoclavicular interval.

As with depression of the clavicle, problems may arise if the lower border (first rib) of this interval is elevated. Since the scalene muscles insert onto the first rib, severe muscle tightness may result in elevation of the rib which, in turn, would result in approximation of the clavicle and first rib. Other related problems may arise from abnormality of bony exostosis or from excessive calus formation following a fracture of either the clavicle or first rib. In some cases, a healed but poorly aligned bone may cause problems.

Any changes from normal bone structure may cause narrowing of the costoclavicular space resulting in impingement to either the brachial nerve plexus or subclavian artery/vein. Due to the anatomical relationship between the costoclavicular space and the lower trunk of the brachial plexus, the symptoms most commonly associated with compression at this site occur along C₈ and T₁ dermatomes.

Coracoid-Pectoralis Minor Loop.—The last anatomical area causing compression is the coracoid-pectoralis loop. As the subclavian artery and vein enter the axillary area, their names change appropriately to axillary artery and vein. At the coracoid-pectoralis junction where the neurovascular structures pass under the tendon of the pectoralis minor and its insertion to the coracoid process of the scapula, they are “bound tightly together by the fascial axillary sheath.” When in a relaxed position with arm at one’s side, as in the anatomical position, the neurovascular structures are free to move having minimal contact with the pectoralis minor tendon or its insertion. However, if the individual raises
the arm overhead (shoulder abduction, external rotation), the neurovascular structures are pulled tight against the coracoid process while the tendon prevents them from slipping over. Direct compression to the neurovascular bundle at this point may cause an easily palpated decrease in radial pulse strength accompanied by complaints of “coldness” in the arm.

In his discussion of the coracoid-pectoralis minor loop, Pratt points out that instead of the expected symptoms of C₃ through T₁ nerve involvement from compression of the entire brachial plexus, most commonly TOS symptoms are isolated to the lower trunk (C₈, T₁) which suggests compression at a more proximal location: costoclavicular interval. He, therefore, questions “whether the coracoid-pectoralis minor loop is a true entrapment location.”

Etiology

Once the involved anatomy has been identified, the clinician must evaluate further to isolate specific factors that cause or promote the problem. These may be related to one’s lifestyle, daily activities during recreation and work, or even a minor trauma.

Posture

As with many other neuromusculoskeletal stresses and pathologies, posture is often a contributing factor in TOS. In fact, Sucher and Heath use the term “thoracic outlet posture” to describe an individual with increased thoracic kyphosis and protracted shoulders. Poor posture may cause aggravation of symptoms at any one of the following areas: scalene triangle, costoclavicular interval, or coracoid-pectoralis minor loop.
When considering posture, the clinician must analyze all aspects of the individual’s daily occupational and recreational activities. Certain occupations require prolonged work in a specific body position that can aggravate symptoms. Prolonged sitting, for example, can promote rounded shoulders, while carrying heavy objects can cause approximation of the costoclavicular interval. Recreational activities may also result in chronically poor posture. Consider, for example, the individual who slouches in a soft couch while watching several hours of television nightly.

Sleeping posture must also be analyzed since individuals often “assume a compressive posture while sleeping”19(p1047) or fall asleep with the shoulder abducted and externally rotated when it is positioned overhead. Sleeping posture should be suspected especially if symptoms are present or worse upon waking.

Harmful Activities

A clinician must be aware of and evaluate any other potentially problematic activities in which an individual may be participating. Any individual who spends an extended time performing overhead arm activities may be aggravating symptoms by chronic irritation to the plexus and vessels.

Consider, for example, a baseball pitcher who complains of symptoms during and after a game. During the pitch, the arm is brought into hyperabduction and external rotation causing possible occlusion of the axillary artery by the pectoralis minor and coracoid process. Other aggravating activities may be painting, window washing, blow-drying the hair, or any other work with the humerus flexed or abducted above the level of shoulder. One may even complain of symptoms when leaning forward from a seated
position to tie shoe laces. Although not as obvious, this activity does require flexion of both arms to approximately shoulder level.

**Muscle Development**

When searching for contributing factors, one must consider unusual muscle development as a possibility, especially in individuals who perform repetitive activities. For example, the weightlifter may have tight or hypertrophied scalenes (elevation of the first rib and narrowed costoclavicular space) or pectorals (depression of the shoulder and tightness at the coracoid-pectoralis loop).

Since the scalenes act bilaterally as neck flexors, long-term incorrect performance of abdominal crunches or sit-ups may place extra strain on the muscles resulting in tightness or hypertrophy. Shortness and/or hypertrophy of the scalene muscles may also occur in individuals with abnormal breathing patterns, such as a chronic emphysema patient who has for years depended on the use of accessory muscles for respiration. Since scalene muscles insert onto the first rib, tightness or hypertrophy may cause elevation of the first rib resulting in approximation at the costoclavicular interval.

**Depression of Shoulder**

A typical patient with symptoms of TOS is 20 to 40 years old.\(^{24}\) The higher incidence of TOS during this age range may be due to an increase in specific occupational and recreational activities performed. Although these factors may certainly play a significant role, it is thought that the increase is primarily due to depression of the shoulder girdle with age, reaching its maximum limit of depression at approximately age 40.
During discussion of the costoclavicular interval, it was mentioned that shoulder depression causes lowering of the clavicle. Lowered shoulders may also cause traction and irritation to the entire brachial plexus but may be most noticeable at the junction of the first rib as the plexus is being pulled tightly over the bone.

Depression of the shoulder girdle may be due to muscle atrophy or loss of strength of the parascapular musculature. Very hypertrophied muscles, on the other hand, may also cause depression of the shoulders, as can sometimes be seen in body builders. Women may tend to have a lower shoulder position than men, therefore, predisposing women to have a higher incidence of TOS. According to a study of 138 subjects, 60% of TOS patients seen were, in fact, women.

**Parascapular Muscle Weakness**

Weak parascapular musculature (especially scapular adductors) tend to promote shoulder protraction. The resulting scapular position places the adductors on stretch, therefore, causing a “less than ideal” and weakened muscle fiber length. The end result is forward shoulders, weak scapular muscles, and now, tight pectoral muscles leaving less room for the distal brachial plexus and axillary vessels at the coracoid-pectoralis minor loop. Once tight, the anterior shoulder muscle will literally pull the scapula anteriorly and inferiorly only to exacerbate the condition.

A possible triggering event for weak parascapular muscles may be an injury. A myofascial pain theory of Travell and Simons describes “primary dysfunction” being diagnosed and treated in one single muscle. The belief is that once acute injury occurs, for example, in scapular adductors, an active trigger point causes muscle spasms which
then retract the scapula (adduction). Use of scapular adductors are now relatively inhibited due to pain resulting in “relative disuse or functional weakness.”

This “functional weakness” will, in turn, allow the scapula to protract leading to TOS.

**Traumatic Injuries**

During a study of 138 TOS patients, 34% had an (unspecified) traumatic onset of symptoms. A soft tissue injury such as a torn muscle in the shoulder may cause abnormal shoulder mechanics and functional impairment followed eventually by neurovascular compression. "Any injury causing a ‘jerk’ of the shoulder or neck can precipitate the outlet syndrome including the so-called ‘whiplash’ auto injury." Another injury potentially causing symptoms of TOS is a clavicular or first rib fracture if it results in the previously mentioned callus formation with decreased space at the costoclavicular interval.

**Diagnostic Process**

**Symptoms**

By evaluating the severity of signs and symptoms, one can assess the degree of involvement. Mild symptoms of TOS may appear as paresthesias only without the presence of pain, atrophy, or muscle weakness. Regardless of the degree of involvement, all symptoms follow the same nerve root distributions. Symptoms may also appear as vascular or, in severe cases, include both neurogenic and vascular components.

*Neurogenic.*—Since 90% of compressions in the thoracic outlet are to the brachial plexus, neurogenic complaints are most common. Characteristic symptoms include sensory changes and/or weakness. Thoracic outlet syndrome most commonly involves
the lower trunk of the plexus and, therefore, most commonly associated symptoms are located along the medial arm where sensory changes follow the dermatomal patterns of C₈ and T₁ or the ulnar nerve distribution.²,¹⁹,²⁸ Impingement of the lower trunk most commonly occurs at the costoclavicular interval.

A patient with upper trunk involvement (C₅ and C₆) may complain of paresthesia and pain over the anterior and lateral neck, behind the sternocleidomastoid muscle, supraclavicular region, upper anterior chest, outer shoulder and arm.²⁰,³⁰-³² Unilateral headaches have also been reported with either upper or lower trunk involvement, but these are “difficult to explain on the basis of neuroanatomical pathways.”³⁰(p1246) Impingement of the upper trunk most commonly occurs in the scalene triangle.

A patient may present with either lower or upper trunk signs and symptoms or a mixture of both depending on the area(s) of involvement. In order to establish an accurate diagnosis, one must spend adequate time assessing these areas for local tenderness, muscle spasm, weakness, and numbness. One should perform dermatomal mapping in order to isolate the specific area of involvement.

Vascular.—Depending on the vessel involvement, vascular symptoms can be subdivided into arterial and venous. If compression of the subclavian artery occurs, the individual may complain of coldness, numbness, generalized pain, and exertional fatigue (claudication) throughout the entire involved arm.¹ Raynaud’s syndrome has also been reported in arterial compression.⁵,²⁰ Venous involvement results in edema, heaviness, cyanosis, and distension of superficial veins of the limb and shoulder.¹,⁵
Mixed.—If there is a compression of both nervous and vascular tissue, the patient may complain of a combination of neurogenic and vascular symptoms. An individual may present, for example, with neurological symptoms of numbness, tingling, and weakness accompanied by coldness, suggesting subclavian artery involvement. Again, it is vital to evaluate dermatomal and myotomal patterns to determine specific nerve root compression; it is probable that vascular compression is occurring at the same site as the neurological compression.

Signs

Observation.—Evaluation of a patient begins immediately on initial contact by observing areas such as gait, posture, body build, and arm swing. Since body build and posture were already covered earlier in the text, they will not be discussed here except to emphasize the importance of total body evaluation in order to rule out or identify contributing factors. For example, the “dynamic relationship between the shoulder and pelvic girdles cannot be overstated.” TOS may, in fact, be only a secondary problem caused by a pelvic dysfunction which, if not treated first, would prevent effective treatment of the TOS.

Special Tests.—There are four classic diagnostic tests available that a manual therapist may use. Each of the four attempts to mimic specific symptoms that occur during compression of neurovascular structures. Understanding the anatomical area involved during each test is pertinent to successful diagnosis and treatment.

Adson’s test is performed to evaluate for “scalenus anticus syndrome”—compression at the scalene triangle. The patient abducts the arm to 90 degrees and
inhalés deeply while extending and turning the head toward the side being tested. If the clinician palpates a diminished or absent radial pulse, the test is positive for TOS at the scalene triangle.¹

During the costoclavicular maneuver the patient extends one shoulder while depressing it downward as during a military brace. This may cause compression at the costoclavicular interval. As with Adson’s test, a positive test is based on diminished or absent radial pulse, suggesting “costoclavicular syndrome.”¹

The Allen test is an evaluation for impingement in the subcoracoid region under the pectoralis minor muscle. The patient is instructed to take a deep breath (elevating first rib), turn the head to opposite side being tested (scalene muscles tighten, elevating the first rib) while the arm is abducted and externally rotated. Again, a diminished radial pulse provides a positive diagnosis for “pectoralis minor syndrome.”¹

Finally, a test considered the most accurate is the three-minute elevated arm test (abduction and external rotation, or AER test) by Roos.²⁰ The patient closes and opens his hands while both arms are abducted and externally rotated to 90 degrees with elbows flexed at 90 degrees. A positive test for TOS is the presence of heaviness and exertional fatigue or an inability to maintain the overhead arm position.

The clinician must be observant during evaluation of these tests since each of them can result in false positive and negative findings.²⁰ In fact, up to 50% of asymptomatic individuals will have false positive tests based on obliteration of the radial pulse in the hyperabducted position.¹,²⁰,³⁰ Only if the maneuver reproduces the patient’s symptoms (observe for comparable signs) should a positive test be considered valid.¹
Since the three-minute test described by Roos is the only one of the four tests which actually produces observable signs other than the absence of the radial pulse, it is thought to be the most reliable of these tests.

One additional special test exists which can be performed by the manual therapist to assess for the presence of a subluxed first thoracic rib. The cervical rotation lateral flexion (CRLF) test\(^3\) can be performed by asking the patient to rotate the head and neck away from the side being tested followed by lateral neck flexion, bringing the ear towards the anterior chest. The test is performed on both sides. Any restricted motion may be an indication of a subluxed first thoracic rib. A first rib that has subluxed superiorly results in approximation at the costoclavicular interval which can cause compression of the neurovascular structures.

**Dermatomal mapping and manual muscle test.**—An evaluation of a suspected TOS patient should include identification of specific nerve root and trunk involvement by performing dermatomal mapping and manual muscle testing. Roos\(^{31(p327)}\) writes that “simply obtaining chief complaint of pain in the neck, shoulder, and arm with paresthesias, raising the arm to check the pulse . . . is a common practice to be condemned.” Without knowing the area of etiology, planning an efficient treatment approach would be difficult. Another benefit of including dermatomal mapping and manual muscle testing in the initial evaluation is that one can later use this information for comparison when assessing for improvement or regression of condition.

**Other Evaluation Tools.**—As with any other physical therapy evaluation, one must perform passive and active range of motion measurements, evaluation of peripheral
joint involvement, manual muscle tests, visual observation for hypertrophy or atrophy, and finally, palpation. A minimum requirement must be an assessment including (1) cervical and shoulder ROM, (2) strengths of scapular and shoulder stabilizers as well as shoulder elevators, (3) soft tissue lengths of the scalene and pectoralis minor muscles, (4) an evaluation of scapulohumeral rhythm, and (5) palpation for tightness, tenderness, and trigger points that may be inhibiting normal movement patterns. 34

Other diagnostic tests often performed prior to the physical therapy consult are electrodiagnostic tests, vascular Doppler tests, and neurological and radiographic tests. 1,2,16,31 These tests are beyond the scope of this paper, but if performed, the results may be available in patient medical records to be viewed by the therapist. For example, if suspecting cervical ribs, an X-ray report may be useful.

Differential Diagnosis

During evaluation, one must be very aware of diseases and other neuromusculoskeletal disorders with often very similar presenting signs and symptoms. This paper does not attempt to discuss this topic in detail, but rather, refers the reader to Table 2 1,5,6,19 that offers an overview of similarly presenting conditions. If at any time there is a questionable diagnosis with a possibility of a serious illness, the clinician should refer the patient to an appropriate medical professional. For example, an individual complaining of an onset of neck, shoulder, and arm pain after working in an overhead position for an extended period of time may be having symptoms of TOS. However, if after further evaluation the clinician discovers that the onset of pain is accompanied by diaphoresis and slight shortness of breath, the patient may be describing
Table 2.—Differential Diagnosis of Thoracic Outlet Syndrome\textsuperscript{1,5,6,19}

1. Acute brachial neuropathy
2. Carpal tunnel syndrome
3. Cubital tunnel syndrome
4. Peripheral nerve injuries of the shoulder involving suprascapular nerve, axillary nerve, long thoracic nerve, musculocutaneous nerve, spinal accessory nerve, or dorsal scapular nerves
5. Herniated intervertebral disc
6. Cervical spondylosis with radiculopathy
7. Bursitis
8. Capsulitis
9. Infectious diseases
10. Tendinitis
11. Myositis
12. Circulatory disorders
13. Angina pectoralis
14. Psychological disorders
15. Multiple sclerosis
16. Carcinoma/metastatic malignancies
17. Shoulder-hand syndrome
18. Space-occupying spinal cord lesions
19. Spinal stenosis
Table 2.—Differential Diagnosis of Thoracic Outlet Syndrome\textsuperscript{1,5,6,19} (Cont.)

20. Degenerative disease (shoulder/wrist arthritis)

21. Ulnar nerve compression at the elbow

22. Traction injury of the brachial plexus
symptoms of cardiac origin requiring immediate referral to an emergency medical setting.

**Treatment**

**Conservative Treatment**

Once the involved compressing anatomy has been identified, the manual therapist has several treatment options from which to choose. No single treatment choice is likely to succeed, however, unless combined with others to create a total treatment regimen. Regardless of what treatment choices will be included in the total treatment approach, a clinician must always accompany these with patient education. Huffman describes three other important aspects of TOS management including postural correction, manual therapy and a home exercise program.

*Patient Education.*—Since there are so many predisposing factors to TOS, the patient should first be educated on the specific area of compression to include avoidance of aggravating activities and postural awareness. A patient who understands the reasoning behind the "do's and don'ts" is more likely to be motivated to follow the prescribed treatment program. For example, if a college student understands that a full book bag weighing heavily on one shoulder and clavicle is a precipitating factor, he or she may be more motivated to consider use of a backpack style of book bag to disperse the weight over both shoulders. Meanwhile, a young weight trainer posing in front of a mirror must understand the importance of a well-balanced musculature as well as the importance of regular stretching to prevent possible neuromuscular problems including impingement in later years.
Postural Awareness and Associated Exercises.—Poor posture is a common predisposing factor of TOS; therefore, postural awareness and modification is a necessary first step in a conservative treatment approach. This may include changes in one’s sleeping posture. A side-lying sleeping posture, similar to the “fetal position,” can result in a “compressive sleeping posture” due to protraction of shoulders and must be discouraged. Instead, a supine or semi-sidelying position with a pillow to support the thoracic spine may be tried to facilitate opening of the thoracic outlet area.1

Although postural awareness is critical for a successful outcome of treatment, it is pointless unless exercises are provided to assist in maintenance of that ideal posture. Although the most visible postural problems may be at the thoracic and shoulder areas, TOS may be only a secondary problem caused by postural changes in the sagittal plane at the lumbopelvic region.23 Controlling posture in this region must be addressed first and appropriate exercises prescribed to allow stabilization and prevention of exacerbating consequences. Participation in an organized pelvic stabilization program may be helpful since it concentrates on the use of abdominal muscles, lower extremity strengthening, and awareness of proper pelvic tilt in the maintenance of ideal posture.

After posture at the lumbopelvic region has been addressed, the clinician must evaluate any remaining postural problems at the thoracic and scapular areas. In order to achieve and maintain proper shoulder posture, strengthening and endurance exercises of the scapular stabilizing muscles must be initiated.23 Initial focus will be on endurance whereby a “high repetition and low resistance” exercise program is adopted. If a strengthening program is started before building endurance, the result would simply be
recurrence or reactivation of trigger points and pain" which, in turn, could advance to protraction of the scapula.

For endurance activities, one source recommends three to five sets of 10 repetitions two times a day. Sucher and Heath recommend use of elastic bands (TheraBand) for low resistance. They also encourage minimizing upper extremity abduction beyond 45 degrees to prevent possible reactivation of parascapular (rhomboid and middle trapezius) trigger points. They add that, during exercise, arm positioning should be varied to allow strengthening of all components of the parascapular muscles. Exercises may, for example, include 90 degree shoulder flexion exercises as well as exercises similar to proprioceptive neuromuscular facilitation (PNF) diagonal patterns, D1 and D2.

An individual with depressed shoulders should strengthen the upper trapezius and levator scapula to aid in elevation of the shoulder. Elevation would reduce traction on the brachial plexus as well as lift the clavicle which may be causing compression.

A point of caution regarding exercises: if strengthening exercises are performed at the expense of stretching and increasing ROM, the treatment may fail or even cause new pathologies. An individual participating in strengthening exercises must, therefore, be provided a gentle stretching program in order to maintain flexibility and normal movement patterns at the shoulder.

Stretching.—Stretching of tight and compressive muscles is an important component of conservative treatment methods of TOS. Self-stretch of tight muscles can easily be performed at home. Self-stretches performed at home can be accompanied by
manual stretching performed by the therapist. Self-stretching of the pectoralis minor, for example, may be difficult to perform alone and can be facilitated by a manual stretch by the therapist. The contract-hold-relax method is a technique used by the manual therapist in stretching shortened muscles and can be used, for example, when stretching the scalene muscles.

*Myofascial Release.*—Although an effective means of treatment, stretching of the scalene or pectoralis muscles may at times be complicated. For example, the pectoralis minor self-stretch in the overhead position may be difficult to perform due to rotator cuff problems. An individual with scalene muscle tightness, on the other hand, may have an underlying degenerative joint disease (DJD) of the neck making manual stretching of the muscle quite uncomfortable or even dangerous. A solution may be to utilize myofascial release which is a soft tissue technique using a vigorous stretch with simultaneous direct pressure on the myofascial tissue. Since myofascial release uses very specific techniques for each muscle, the reader is referred to a discussion of the topic in a three-part series of related articles by Sucher and Heath.

*Joint Mobilization.*—Another treatment choice may be joint mobilization to increase mobility of the shoulder girdle as well as the first rib. An individual with restricted motion at the scapulothoracic joint may benefit from mobilization techniques. If one’s scapula is held in the protracted position, mobilization may be beneficial when directed towards retraction.

An individual with impingement at the costoclavicular interval may benefit from mobilization of the first rib. While the patient is lying supine, the therapist can apply
pressure directly on the first rib in a caudal direction in order to increase the space in the costoclavicular interval. 23

_Traction._—Traction has been mentioned as one method of lengthening tightened scalene muscles and surrounding fascia. 37 However, traction has been known to increase TOS symptoms. 16 Use of cervical traction for TOS has, therefore, been questioned for its often exacerbating consequences.

_Modalities._—Physical therapy modalities may offer at least temporary symptom relief and can be especially helpful with chronic and severe cases. 36 By decreasing pain and allowing muscle relaxation, modalities may be a necessary first step in breaking a pain-muscle spasm-pain cycle, therefore providing a more ideal setting in which to treat the actual compressive forces causing symptoms. Modalities may include superficial heat, ultrasound (US), and transcutaneous electrical stimulation (TENS). Prior to a myofascial release, US may be used to make the myofascia more elastic and stretchable. 23

_Stress Reduction._—One may need to include stress reduction techniques in the treatment plan since the often accompanying tension in the shoulder musculature may result in TOS. 19 For example, biofeedback may be of use to increase patient awareness of tight and elevated shoulders. 20 If external stressors are an obvious predisposing factor of one’s TOS symptoms, a clinician may consider referral to a counselor or another appropriate specialist.

_Surgical Intervention._—If a thorough conservative treatment approach has not been successful or if there is initially a “significant vascular compromise or motor loss” 22(p703) then surgical intervention may be necessary. Severe cases treated
unsuccessfully by conservative means may include impinging cervical ribs, tight fibromuscular bands, congenital abnormalities, or conditions associated with trauma (i.e., clavicle fracture with callus). Surgical intervention may involve excision of a cervical rib, first thoracic rib resection, scalenectomy of the anterior scalene muscle, or release of fibromuscular bands.\textsuperscript{1,20}

According to one source, 80% of patients examined for TOS will never need surgery, but the remaining 20% with severe symptoms will need surgery and results are usually good.\textsuperscript{30} In another study of 1200 patients seen for TOS, only 9.4% required surgical intervention.\textsuperscript{19} Of the 9.4% surgical patients, 80% recovered completely and 13% had improvement, while the remaining 7% had continued problems even after surgery.

However, “thoracic outlet syndrome surgery is dangerous”\textsuperscript{39(p67)} and should be done only by a surgeon who performs it frequently. Although not common, complications of surgery may include wound infection, brachial plexus injury, laceration of subclavian vessels, and pneumothorax.\textsuperscript{8,40}

Understanding the risks that a patient may face in surgery will hopefully add to the motivation of both the therapist and patient as they begin an aggressive and persistent treatment program “directed as specifically as possible to the involved structures.”\textsuperscript{2(p703)} Being aware of the success rate of a conservative treatment approach will also add to the knowledge and motivation of a therapist when treating individuals with TOS.

This paper will next present results of a study evaluating outcome of the conservative treatment approach for management of TOS by traditional physical therapy.
techniques including postural correction, exercises, soft-tissue techniques, joint
mobilization, and modalities. In order to explain how the data for the outcome were
collected, the presentation of the results will begin with a description of the chart review.
CHAPTER III
METHODOLOGY

Chart Review Process

In order to determine effectiveness of a conservative treatment approach for management of thoracic outlet syndrome (TOS), a review of medical records was performed. Three physical therapy clinics in northeastern North Dakota and northern Minnesota were contacted for permission to perform chart reviews of adult subjects (18 years or older) who had been treated for TOS.

Selection of Data

Selection of medical records to be reviewed included physical therapy charts dating back no later than 1986 that fell under diagnosis of TOS. Charts not included in this study were those with additional diagnosis that might have complicated the clinical presentation, such as rotator cuff injury, carpal tunnel syndrome, or prior surgery to the shoulder region. Specifically, when locating medical charts to supply data for this study, the ICD-9-CM code 353.0 was used. It includes the following four syndromes: (1) cervical rib syndrome, (2) costoclavicular syndrome, (3) scalenus anticus syndrome, and (4) thoracic outlet syndrome.
Approval and Consent Forms

Prior to contacting the individual physical therapy clinics and departments, a University of North Dakota (UND) Human Subjects Review Form (Appendix A) was completed and approved by the UND Institutional Review Board (IRB). Next, each physical therapy facility was contacted and provided with a written form (Appendix A) describing an overview of the study. The return of the same form with a signature acted as a consent form allowing the author to perform a chart review at the named facility. No data collection was initiated prior to signed approval from the participating facility.

Confidentiality

During the chart review, an emphasis was made to protect the identity of all subjects by coding both the subject and the facility providing the treatment. In addition, during evaluation of data, all collected data were viewed as one single sample and at no time was data matched with any one specific facility name.

Data Collection

A data collection tool (Appendix B) was used to gather demographic data and data related to initial medical examination, physical therapy management, and treatment outcome from each medical record. Only data pertinent to the purpose of this study were collected. Whenever documented, specific objective measurements were used to establish the outcome category of Excellent, Good, Fair, and Poor. Rating of outcome measures was done mostly on a subjective basis, however, since most of the medical records had an inadequate amount of objective documentation completed at the time of discharge. The outcome categories were defined as follows:
An “Excellent” outcome was based on direct patient or physical therapist quotes such as “complete recovery,” “symptom free,” “100% improvement,” “total relief of symptoms,” and “no longer having pain or previous symptoms.” When available, specific objective information, such as results of special tests or dermatomal mapping, was used to rate outcome.

A “Good” outcome was based, for example, on direct patient or physical therapist quotes such as “good recovery,” “almost complete recovery,” “90% improved,” “80% recovery,” “total relief of symptoms with exception of very mild persistence of numbness,” and “much improved.” When available, objective information, such as “80% normal arm elevation test,” was used to rate outcome.

“Fair” outcome was based on quotes suggesting “some improvement” but with continued minor problems such as “symptoms only during sleep.” Other quotes used when rating outcome were “doing somewhat better,” “symptoms slowly subsiding,” and “slightly decreased symptoms.”

“Poor” outcome was based on a dissatisfied patient. The individual may have chosen surgery as his or her next treatment of choice or have chosen to return to a physician for other treatment options. Direct quotes that were used were “no improvement” and “minimal improvement of symptoms.”

Data Analysis

After completion of data collection, the Statistical Package for Social Sciences (SPSS) version 6.1 software was used to provide descriptive and analytical statistics to demonstrate if there was a significant improvement of TOS with conservative physical
therapy management. However, due to an inadequate total number of charts, statistical results from the SPSS software\textsuperscript{42} were found to be invalid. Instead, evaluation of data focused on specific trends that were evident when comparing treatment choices and outcome. These trends provide manual therapists a list of specific treatments that have been most effective during management of TOS.
CHAPTER IV

RESULTS

Overview of Results

During the chart review process, a total of 152 medical charts were reviewed of which only a total of 21 charts were able to be used for this study. The 131 charts not included in this study were omitted due to various reasons.

Although a specific ICD-9 code (353.0) for thoracic outlet syndrome (TOS) was used to compile a list of physical therapy charts, many of the charts provided were only related problems of the brachial plexus, such as traumatic brachial plexus injury or brachial plexopathy, and did not fit the criteria for inclusion in this study. Although bearing a diagnosis of TOS, other charts not included had physical therapy treatments provided only after the subject had already undergone a surgical procedure of the thoracic outlet. Another group of charts was not chosen because they included additional diagnoses that might have affected the outcome of this study, such as rotator cuff impingement or carpal tunnel syndrome.

A group of charts had inconsistencies between physician diagnosis and physical therapist impression. Regardless of the physician’s diagnosis, a chart was included in this study only if the physical therapist impression was “thoracic outlet syndrome” simply because the focus of this study was specifically the outcome of physical therapy treatment
of TOS. Finally, several charts were omitted because they either had limited or incomplete documentation or had only one documented visit with no follow-up subjective or objective evaluation available.

**Demographics**

Of the remaining sample of 21 charts used in this study, eight (38%) represented males and 13 (62%) represented females. Subject ages ranged from 16 to 62. Mean age was 38.9 with a standard deviation of 12.3 years. Of the 21 patients, 52% (n=11) were 20 to 40 years of age. One patient was less than 20 years, while the remaining 43% (n=9) were over 40 years old.

Of the 21 medical charts, 20 patients had clearly described symptoms. Of these, 30% (n=6) presented with mild TOS symptoms, while 70% (n=14) presented with severe symptoms. “Mild” symptoms included paresthesia only, while “severe” symptoms included paresthesia accompanied by additional symptoms including pain, atrophy, muscle weakness, or heaviness. One patient with vascular symptoms was considered “severe.”

**Trends**

**Overall Outcome**

Data from the 21 charts revealed that conservative treatment by physical therapy resulted in 29% (n=6) Excellent, 38% (n=8) Good, 19% (n=4) Fair, and 14% (n=3) Poor outcomes (Table 3). For purposes of simplifying results and assigning values during use of the SPSS software in order to determine if there was significant overall improvement after physical therapy treatment, the following division into *Improved* and *Not Improved*
Table 3.—Outcome of Treatment of Thoracic Outlet Syndrome by Physical Therapy

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Improved</th>
<th>Not Improved</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Excellent</td>
<td>Good</td>
</tr>
<tr>
<td>Occurrence</td>
<td>29% (n=6)</td>
<td>38% (n=8)</td>
</tr>
<tr>
<td></td>
<td>67% (n=14)</td>
<td></td>
</tr>
</tbody>
</table>

Total patient population (N)=21.
categories was done: Excellent and Good outcomes were combined into a category titled *Improved*, while the Fair and Poor outcomes were combined into a category titled *Not Improved* (Table 3). Based on this method of division, 67% (n=14) of treatment outcomes showed improvement, while 33% (n=7) showed no improvement.

**Treatment Choices vs Outcome**

Although the overall improvement after conservative treatment by physical therapy (67%) was not impressive, certain interesting trends were observed when studying relationships of treatment choices and outcome. It appears that a more aggressive treatment approach with a more active patient involvement resulted in improved outcomes, while a treatment approach allowing less participation by the patient resulted in fewer improvements (Table 4).

Use of postural education was common in the *Improved* category. Fifteen patients (71%) received postural education, and of these patients, 87% (n=13) improved. Six patients (29%) did not receive postural education, and of these, only 17% (n=1) improved (Table 4). Of the 14 patients who improved, 93% (n=13) received postural education (Table 5).

Manual stretching turned out to be a relatively effective treatment choice. Of the 10 patients (48%) who received manual stretching, 80% (n=8) improved, while of the 11 patients (52%) who did not receive manual stretching, only 55% (n=6) improved (Table 4). Of the 14 patients who improved, 57% (n=8) received manual stretching (Table 5).
Table 4.—Overall Distribution of Patients Receiving Specific Treatments Versus Outcome

<table>
<thead>
<tr>
<th>Treatment Option</th>
<th>Not Included in Treatment</th>
<th>Included in Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Improved (n)</td>
<td>Not improved (n)</td>
</tr>
<tr>
<td>Posture training</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Manual stretch</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Self-stretch</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Myofascial release</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Strengthening exercises</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Massage</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>Superficial heat</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Electrical stimulation</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Joint mobilization</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Traction</td>
<td>14</td>
<td>6</td>
</tr>
</tbody>
</table>

Total patient population (N) = 21
<table>
<thead>
<tr>
<th>Treatments Provided</th>
<th>n</th>
<th>Improved</th>
<th>%</th>
<th>n</th>
<th>Not Improved</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posture training</td>
<td>13</td>
<td>93</td>
<td></td>
<td>2</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Manual stretch</td>
<td>8</td>
<td>57</td>
<td></td>
<td>2</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Self-stretch</td>
<td>12</td>
<td>86</td>
<td></td>
<td>5</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>Myofascial release</td>
<td>8</td>
<td>57</td>
<td></td>
<td>1</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Strengthening exercises</td>
<td>12</td>
<td>86</td>
<td></td>
<td>2</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Massage</td>
<td>1</td>
<td>9</td>
<td></td>
<td>3</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Modalities (E0=--stim, heat, US)</td>
<td>4</td>
<td>29</td>
<td></td>
<td>5</td>
<td>71</td>
<td></td>
</tr>
</tbody>
</table>

Total patient population (N)=21.
Performance of self-stretches were also found to be relatively effective. Of the 17 patients (81%) who were instructed to perform self-stretches, 71% (n=12) improved. Of the four patients (19%) who did not perform self-stretches, only 25% (n=1) improved (Table 4). Of the 13 patients who improved, 86% (n=12) were prescribed self-stretches (Table 5).

Of the nine patients (43%) who were treated with myofascial release techniques, 89% (n=8) improved while of the remaining 12 patients (57%) who did not receive myofascial techniques, 50% (n=6) improved (Table 4). Of the 14 total patients who improved, 57% (n=8) received myofascial release (Table 5).

Strengthening exercises were found to be an effective treatment choice. Of the 14 patients (67%) who received strengthening exercises, 86% (n=12) improved. Of the seven patients (33%) who did not receive exercises, only 29% (n=2) improved (Table 4). Of the 14 patients who improved, 86% (n=12) were prescribed an exercise program (Table 5).

Other Trends

There was some difference in treatment success between patients with severe and mild symptoms. Of the 14 patients with severe symptoms, 64% (n=9) improved. Of the six patients with only mild symptoms, 83% (n=5) improved.

Nine of the 21 patients (43%) reported injury as the original triggering cause of TOS symptoms, and of these injured individuals, 44% (n=4) improved after treatment. Of the 12 patients without injuries, 83% (n=10) improved.
Of the 16 patients whose total number of treatments were documented, 50% (n=8) were seen 6 to 10 times, and of these, 75% (n=6) improved. Of the six patients (38%) who were seen five times or less, 67% (n=4) improved. Of the remaining two patients (13%) who were treated over 10 times, one patient improved while the other did not.

Of the seven charts in the Not Improved category, two individuals chose to follow-up with surgery. Of these individuals, one had a Poor outcome with conservative treatment and chose to follow up with surgery only after one week (3 treatments) of postural awareness, massage, manual stretches, and cervical traction. The other individual had a Fair outcome after 23 treatments during an aggressive 10 weeks of treatment including manual stretch, myofascial release, first rib mobilization, and self-stretches. There was no further documentation available from these charts to allow a follow-up on surgery and final outcome.
CHAPTER V
DISCUSSION

General Summary

The results of this study suggest that conservative treatment of thoracic outlet syndrome (TOS) can be effective but only if approached with a well-designed and aggressive treatment plan including active participation by the patient. After completing differential diagnosis of the thoracic outlet area and learning which specific anatomical area is causing impingement, the clinician must investigate further in order to discover the possible etiology that might have triggered the occurrence of compressive forces acting on the neurovascular structures.

After identifying these facts, the clinician must proceed to design a total treatment regimen that addresses each of the precipitating factors. There is no one correct treatment protocol and no ideal treatment combination since each individual with TOS may have a unique set of precipitating factors. However, as is evident from results summarized in Tables 4 and 5 (Chapter IV), there appears to be a direct relationship between type of treatment chosen and quality of treatment outcome.

It was found that, although they certainly have their place in physical therapy if appropriately used, palliative treatments alone, such as modalities and massage, do not appear to be as effective as treatment that requires more active patient participation.
Furthermore, it appears that soft tissue stretch and/or release techniques (namely, self-stretch, manual stretch performed by the therapist, or myofascial release) result in positive outcomes.

**Results Compared with Literature**

This study shows results similar to those of other studies. Specifically, in a study by Roos and Cuthbert, the number of symptoms with a traumatic onset had been found to be 34%, while the present study of 21 charts shows an overall history of injuries at 43% (n=9). According to literature, poor shoulder posture is a common etiology of TOS; in this study, poor shoulder posture was present in 57% (n=12) of individuals. Dominance of neurological symptoms in thoracic outlet syndrome patients was found to be true in this study, as 95% (n=20) of symptoms were neurological. Only one patient had symptoms described as vascular (edema, heaviness). The ratio of men to women in this study was 38 to 62, respectively, while in literature, this is commonly found to be 40:60.

According to a study by Sällström and Celegin, treatment outcomes of 99 patients reevaluated 3 to 30 months (mean of 12.4 months) after initial examination were as follows: 28% Excellent, 28% Good, 6% Fair, and 38% Poor. If their Excellent and Good outcomes are collapsed into an *Improvement* category and their Fair and Poor outcomes into a *No Improvement* category, these outcomes demonstrate 56% *Improvement* and 44% *No Improvement*.

In another study by Novak, Collins, and MacKinnon, 42 patients participated in a telephone questionnaire that was conducted at least six months after the patient had
been discharged from therapy (mean follow-up time was one year). Overall, 25 patients reported improvement, 10 reported the same level of symptoms as during discharge, and 7 reported worse symptoms.

Overall treatment results in the present study of 21 charts were slightly better as 67% resulted in Improvement and 33% in No Improvement. The differences in treatment outcome between the present study and the two previous studies may be due to various reasons.

Neither of the two previous studies\textsuperscript{43,44} excluded from their study patients who had associated diagnoses that may have complicated the clinical picture. For example, in the study by Sällström and Celegin,\textsuperscript{43} other diagnoses seen in the patient population were myotendinitis of the shoulder girdle, cervical rhizopathy, tendinitis of the humeroscapular joint, and carpal tunnel syndrome. The study by Novak, Collins, and MacKinnon\textsuperscript{44} included patients with carpal tunnel syndrome (present in over 50% of patients).

Another factor causing varying outcomes may be the differences in length of time between initial examination of the patient and the reevaluation. In the two previous studies, the reevaluations were performed at a mean of approximately one year after discharge. In the present study, of the 16 patients with documented number of treatments, 14 patients were treated 10 times or less. Therefore, most of the data in this study were collected from discharge evaluations completed no later than approximately five weeks after initial examination (assuming 2 to 3 treatments per week).
CHAPTER VI

CONCLUSION

Limitations

There are obvious limitations to this study. Physical therapy charts often lack a complete discharge patient evaluation with objective tests because final contact with a patient is often made verbally over the telephone. Whenever available during the data collection phase, specific objective facts from documented discharge evaluations were used as the basis for rating the outcomes as Excellent, Good, Fair, or Poor according to criteria explained in Chapter III: Methodology. However, more often than not, outcomes were classified into outcome categories (Excellent through Poor) simply based on direct quotes or other subjective information from a limited discharge documentation. It is possible that I incorrectly interpreted the description of the actual patient condition. A therapist’s personal choice of wording, for example, “much improved” or “slightly decreased symptoms,” could be interpreted in more than one way.

When deciding whether an outcome is to be rated Good or Fair based solely on a subjective report, this limitation becomes an important consideration since the division between the two is the critical dividing point into the Improved and Not Improved categories (see Chapter III). Whenever there was a question about whether an outcome should be classified, for example, as Good or Fair, the “worse” of the two outcomes was
chosen for the simple reason that bias for a favorable outcome would be ruled out as a possible factor in the final results of this study.

The second limitation of this study is the limited number of charts available. For analytical and descriptive statistics to be accurate, a minimum of 25 to 30 randomly chosen charts should be used. Although 152 charts were reviewed, only a total of 21 were able to be included in this study due to reasons discussed earlier in Chapter IV: Results. Since the number of available charts was so relatively low, specific statistical results could not be obtained.

A third limiting factor of this study is the question of patient compliance factors. It is difficult to know how adherent each individual was in performing prescribed stretches and exercises at home between treatment sessions. Even if a treatment approach had been as aggressive as possible, a nonparticipating patient may have changed his or her outcome dramatically. In contrast, a therapist using minimal aggressiveness in his or her treatment approach may have unknowingly given permission for a passive or noncompliant attitude in the patient, further decreasing chances of a successful treatment outcome.

A fourth limiting factor of this study is its lack of distinction between specific anatomical areas of involvement. All patients were considered as having TOS, even though earlier in this paper I emphasized the importance of distinguishing specific anatomical areas of impingement for purposes of planning and implementing the ideal treatment approach. If one had the luxury of a large number of suitable patient charts,
one could ideally examine trends of treatment choice versus outcome for each of the specific anatomical areas of impingement.

Possible Future Studies

The original design of this study included two parts. The first part was to be a chart review focusing on the quality of treatment outcome at time of discharge (present study design), while the second part was to be a follow-up study using a telephone interview to gather data from each patient in order to evaluate long-term outcome. While a patient may have a steadily improving condition throughout treatment with minimal symptoms at discharge, the true test of overall treatment effectiveness would be to evaluate the long-term outcome. Unfortunately, a telephone follow-up was not possible due to regulations at certain physical therapy clinics and therefore the second part of the original study had to be canceled.

A possible future study might consider performing chart reviews at only those clinics allowing follow-up telephone interviews of all patients treated. Information from a follow-up interview would, for example, provide insight into whether a patient had received adequate patient education and motivation to continue postural awareness and exercises to insure maintenance of his or her improved health status.

Summary

Although the limited number of appropriate physical therapy charts did not allow statistical analysis of the data, certain interesting trends between treatment choices and outcome were discovered and have been discussed in this paper. Regardless of its limitations, this study has provided additional support for results found in previous
studies. Finally, this study has provided useful information for physical therapists when considering evaluation and treatment choices for thoracic outlet syndrome.
_X_ EXPEDITED REVIEW REQUESTED UNDER ITEM 8.9 (NUMBER[S]) OF HHS REGULATIONS
_ X_ EXEMPT REVIEW REQUESTED UNDER ITEM 2.4 (NUMBER[S]) OF HHS REGULATIONS

UNIVERSITY OF NORTH DAKOTA
HUMAN SUBJECTS REVIEW FORM
FOR NEW PROJECTS OR PROCEDURAL REVISIONS TO APPROVED PROJECTS INVOLVING HUMAN SUBJECTS

PRINCIPAL INVESTIGATOR: Jouni Zidbeck
TELEPHONE: 701 - 739 1688
DATE: July 18, 1996

ADDRESS TO WHICH NOTICE OF APPROVAL SHOULD BE SENT: Jouni Zidbeck, P.O. Box 8151, Univ. Station, G.F., ND 58202

SCHOOL/COLLEGE: Univ. of ND School of Medicine
DEPARTMENT: Physical Therapy
PROPOSED PROJECT DATES: 7/20/96-7/31/97

PROJECT TITLE: Management of Thoracic Output Syndrome by Physical Therapy: An Outcome Study

FUNDING AGENCIES (IF APPLICABLE): None

TYPE OF PROJECT:
_ X_ NEW PROJECT
_ _ CONTINUATION
_ _ RENEWAL
_ _ THESIS RESEARCH
_ _ STUDENT RESEARCH PROJECT
_ _ CHANGE IN PROCEDURE FOR A PREVIOUSLY APPROVED PROJECT

DISSERTATION/THESIS ADVISER, OR STUDENT ADVISER: Renee Mabey Ph.D., PT
Sue Jeno, MS, PT

PROPOSED PROJECT: _ INVOLVES NEW DRUGS (IND)
_ INVOLVES NON-APPROVED USE OF DRUG
_ INSTITUTION

IF ANY OF YOUR SUBJECTS FALL IN ANY OF THE FOLLOWING CLASSIFICATIONS, PLEASE INDICATE THE CLASSIFICATION(S):

_ MINORS (<18 YEARS)
_ PREGNANT WOMEN
_ MENTALLY DISABLED
_ FETUSES
_ MENTALLY RETARDED
_ PRISONERS
_ ABORTUSES
_ UND STUDENTS (>18 YEARS)

IF YOUR PROJECT INVOLVES ANY HUMAN TISSUE, BODY FLUIDS, PATHOLOGICAL SPECIMENS, DONATED ORGANS, FETAL MATERIAL, OR PLACENTAL MATERIALS, CHECK HERE

1. ABSTRACT: (LIMIT TO 200 WORDS OR LESS AND INCLUDE JUSTIFICATION OR NECESSITY FOR USING HUMAN SUBJECTS.

Thoracic outlet syndrome (TOS) is a disorder caused by compression of the brachial nerve plexus or subclavian artery as they pass through a potentially limited space in the anterolateral neck and proximal shoulder. Compression of these neurovascular structures is most often caused by impingement by scalene muscles, the first rib and clavicle or by pressure from the coracoid process of the scapula as the neurovascular structures pass inferior to it.

An individual with a predisposition for TOS due to his/her anatomy, may have an onset of symptoms after acute injury or chronic trauma, for example, from prolonged postural abnormalities. Although conservative management by physical therapy cannot replace surgery in severe or complicated cases of TOS, it is recommended as the first treatment choice. The purpose of this study is to assess the success of conservative treatment choices for the management of TOS.

Outcome assessment will be accomplished in a three (3) part process. The first part involves reviewing records of human patients who have been treated conservatively. The use of human subjects, via medical records, is necessary for this study. The second part involves a telephone questionnaire to previous TOS patients who have received physical therapy. The purpose of this part is to evaluate long-term effectiveness of physical therapy. In the third part, the information from the first two parts will be combined to assess overall effectiveness of physical therapy.
PLEASE NOTE: Only information pertinent to your request to utilize human subjects in your project or activity should be included on this form. Where appropriate attach sections from your proposal (if seeking outside funding).

2. PROTOCOL: (Describe procedures to which humans will be subjected. Use additional pages if necessary.)

   Methodology will entail reviewing medical records of adult subjects (18 years or older) who have been treated at various outpatient physical therapy clinics and physical therapy departments within acute care hospitals in northeastern North Dakota and northern Minnesota. The chart review will involve reviewing medical records dating back no earlier than 1986. Selection of medical records to be reviewed includes all charts that fall under diagnosis of thoracic outlet syndrome unless the client has additional diagnosis that may affect the outcome of this study. Selection of subjects who will be contacted by telephone includes all individuals whose medical records have been reviewed and who have an available phone number. Any individual contacted by phone will be informed of purpose of study and that participation is strictly voluntary.

   A data collection tool (enclosed) will be used to collect demographic data and data related to initial medical examination, physical therapy management and treatment outcome from each appropriate medical record as well as from telephone interviews. Only data pertinent to the purpose of this study will be collected. Data will be controlled by codified format to insure confidentiality.

   After gathering data, it will be analyzed with descriptive and analytical statistics to demonstrate if there is a significant improvement of thoracic outlet syndrome with conservative physical therapy management.
3. **BENEFITS:** (Describe the benefits to the individual or society.)

The results of this study will help determine if thoracic outlet syndrome is being treated successfully by conservative physical therapy treatments and, if so, what are the specific treatment choices that are being utilized with positive results?

Knowledge of the chart review and interview results will add to the pool of information available for manual therapists when considering treatment choices for thoracic outlet syndrome. The study will benefit the clients by allowing them to anonymously share their experience and success of treatment. The study will benefit society as a whole by making certain that effective treatment choices are being made by manual therapists which, in turn, assures cost effectiveness of treatment.

4. **RISKS:** (Describe the risks to the subject and precautions that will be taken to minimize them. The concept of risk goes beyond physical risk and includes risks to the subject's dignity and self-respect, as well as psychological, emotional or behavioral risk. If data are collected which could prove harmful or embarrassing to the subject if associated with him or her, then describe the methods to be used to insure the confidentiality of data obtained, including plans for final disposition or destruction, debriefing procedures, etc.)

With a chart review process and telephone interview, there is a risk of an accidental breach of confidentiality. In this study, all data will be collected in codified form to insure confidentiality of each subject. In addition, all collected data will be viewed as one single sample and at no time will data be matched with any one specific facility name. All data from medical records will be collected within the medical records department or in an appropriate area for the purpose of this study, as designated by the facility. At no time will medical records be shared with unauthorized personnel or removed from the participating facility. No medical records will be photocopied or reproduced in any manner or form. Information collection will be limited to information printed on the data collection tool (enclosed).

Telephone contact with subjects will be attempted from within the facility at the time of review of their medical records. If no contact is made, another attempt will be made from the home of the Principal Investigator of this study at which time no other person will be physically present to witness the telephone conversation to insure anonymity of the subject. All telephone numbers will be codified. No telephone conversations will be recorded.

Used data collection tools will be shared only with the Student Advisers, if necessary. After all information from data collection tools has been analyzed, the original forms will be kept in the Principal Investigator's file for a period of two (2) years after which they will be destroyed.
5. **CONSENT FORM:** A copy of the **CONSENT FORM** to be signed by the subject (if applicable) and/or any statement to be read to the subject should be attached to this form. If no **CONSENT FORM** is to be used, document the procedures to be used to assure that infringement upon the subject's rights will not occur. Describe where signed consent forms will be kept and for what period of time.

Permission to perform a chart review will be requested individually from each participating facility. No collection of information from medical records will be initiated prior to written approval from the individual clinic administrative personnel in charge. For the chart review, no consent form will be used by the subject. Throughout the study, each subject will be identified only by a code number.

At the beginning of the telephone interview, the individual is informed of the purpose of the study and that participation is strictly voluntary. The individual will be assured that refusal of participation and/or withdrawal from participation at any time during the telephone interview would in no way affect the client’s relationship with his/her therapist and/or the facility. Only those individuals who have given verbal or implied consent over the telephone will be interviewed. Implied consent means answering questions and sharing information willingly after the individual is informed of the purpose of the study and voluntary nature of participation.

The procedure of coding subject and clinic names or other identifying information will be utilized during the telephone interview.

6. For **FULL IRB REVIEW** forward a signed original and thirteen (13) copies of this completed form, and where applicable, thirteen (13) copies of the proposed consent form, questionnaires, etc. and any supporting documentation to:

Office of Research & Program Development
University of North Dakota
Box 8138, University Station
Grand Forks, North Dakota 58202

On campus, mail to: Office of Research & Program Development, Box 134, or drop it off at Room 101 Twamley Hall.

For **EXEMPT** or **EXPEDITED REVIEW** forward a signed original and a copy of the consent form, questionnaires, etc. and any supporting documentation to one of the addresses above.

The policies and procedures on Use of Human Subjects of the University of North Dakota apply to all activities involving use of Human Subjects performed by personnel conducting such activities under the auspices of the University. No activities are to be initiated without prior review and approval as prescribed by the University's policies and procedures governing the use of human subjects.

**SIGNATURES:**

Jouni Zidbeck
Principal Investigator  
DATE: __________ __

Project Director or Student Adviser  
DATE: __________ __

Training or Center Grant Director  
DATE: __________ __
PROJECT TITLE: Management of Thoracic Output Syndrome by Physical Therapy: An Outcome Study

The above referenced project was reviewed by a designated member for the University's Institutional Review Board on 7-29-96 and the following action was taken:

☐ Project approved. EXPEDITED REVIEW NO. _______.
   Next scheduled review is on _____________________________.

☐ Project approved. EXEMPT CATEGORY NO. _____.
   No periodic review scheduled unless so stated in REMARKS SECTION.

☐ Project approved PENDING receipt of corrections/additions in ORPD and approval by the IRB.
   This study may NOT be started UNTIL IRB approval has been received. (See REMARKS SECTION for further information.)

☒ Project approval deferred. This study may not be started until IRB approval has been received. (See REMARKS SECTION for further information.)

☐ Project denied. (See REMARKS SECTION for further information.)

REMARKS: Any changes in protocol or adverse occurrences in the course of the research project must be reported immediately to the IRB Chairman or ORPD.

A written consent form is needed for subjects who will be contacted to participate. They will need to return this prior to inclusion in the study.

cc: R. Mabey; S. Jeno, Advisers

Signature of Chairperson or designated IRB Member

UND's Institutional Review Board

Date 7-28-96

If the proposed project (clinical medical) is to be part of a research activity funded by a Federal Agency, a special assurance statement or a completed 576 Form may be required. Contact ORPD to obtain the required documents.

(7/93)
August 15, 1996

University of North Dakota
Institutional Review Board
Attn: Dr. Kevin Fire
Grand Forks, ND 58202

Dr. Fire,

Thank you for reviewing my Human Subjects Review Form dated July 18, 1996. At this time, I am resubmitting my Human Subjects Review Form in an amended form.

The first part of my study still involves a chart review of medical records of individuals who have been treated for thoracic outlet syndrome (TOS) by physical therapy. However, I do not plan to complete the second part of the study which, in my original Human Subjects Review Form was described as telephone interviews. I have revised the enclosed form as well as the attached data collection tool accordingly.

Thank you,

Jouni Zidbeck, SPT
PO Box 8151
Grand Forks, ND 58202
(701) 739 1688

Enclosure
Thoracic outlet syndrome (TOS) is a disorder caused by compression of the brachial nerve plexus or subclavian artery as they pass through a potentially limited space in the anterolateral neck and proximal shoulder. Compression of these neurovascular structures is most often caused by impingement by scalene muscles, the first rib and clavicle or by pressure from the coracoid process of the scapula as the neurovascular structures pass inferior to it.

An individual with a predisposition for TOS due to his/her anatomy, may have an onset of symptoms after acute injury or chronic trauma, for example, from prolonged postural abnormalities. Although conservative management by physical therapy cannot replace surgery in severe or complicated cases of TOS, it is recommended as the first treatment choice. The purpose of this study is to assess the success of conservative treatment choices for the management of TOS.

Outcome assessment will be accomplished in a two (2) part process. The first part involves reviewing records of human patients who have been treated conservatively. The review of medical records of human subjects is necessary for this study. In the second part, the information from the first part will be used to assess overall effectiveness of physical therapy. Part two (2) as defined in the original form (7/18/96), telephone interview, will not be performed.
PLEASE NOTE: Only information pertinent to your request to utilize human subjects in your project or activity should be included on this form. Where appropriate, attach sections from your proposal (if seeking outside funding).

2. PROTOCOL: (Describe procedures to which humans will be subjected. Use additional pages if necessary.)

Methodology will entail reviewing medical records of adult subjects (18 years or older) who have been treated at various outpatient physical therapy clinics and physical therapy departments within acute care hospitals in northeastern North Dakota and northern Minnesota. The chart review will involve reviewing medical records dating back no earlier than 1986. Selection of medical records to be reviewed includes all charts that fall under diagnosis of thoracic outlet syndrome unless the client has additional diagnosis that may affect the outcome of this study.

A data collection tool (enclosed) will be used to collect demographic data and data related to initial medical examination, physical therapy management and treatment outcome from each appropriate medical record. Only data pertinent to the purpose of this study will be collected. Data will be controlled by codified format to insure confidentiality.

After gathering data, it will be analyzed with descriptive and analytical statistics to demonstrate if there is a significant improvement of thoracic outlet syndrome with conservative physical therapy management.

3. BENEFITS: (Describe the benefits to the individual or society.)

The results of this study will help determine if thoracic outlet syndrome is being treated successfully by conservative physical therapy treatments and, if so, what are the specific treatment choices that are being utilized with positive results?

Knowledge of data collected from the chart review will add to the pool of information available for manual therapists when considering treatment choices for thoracic outlet syndrome. The study will benefit society as a whole by making certain that effective treatment choices are being made by manual therapists which, in turn, assures cost effectiveness of treatment.

4. RISKS: (Describe the risks to the subject and precautions that will be taken to minimize them. The concept of risk goes beyond physical risk and includes risks to the subject's dignity and self-respect, as well as psychological, emotional or behavioral risk. If data are collected which could prove harmful or embarrassing to the subject if associated with him or her, then describe the methods to be used to insure the confidentiality of data obtained, including plans for final disposition or destruction, debriefing procedures, etc.)

With a chart review process, there is a risk of an accidental breach of confidentiality. In this study, all data will be collected in codified form to insure confidentiality of each subject. In addition, all collected data will be viewed as one single sample and at no time will data be matched with any one specific facility name. All data from medical records will be collected within the medical records department or in an appropriate area for the purpose of this study, as designated by the facility. At no time will medical records be shared with unauthorized personnel or removed from the participating facility. No medical records will be photocopied or reproduced in any manner or form. Information collection will be limited to information printed on the data collection tool (enclosed).

Used data collection tools will be shared only with the Student Advisers, if necessary. After all information from data collection tools has been analyzed, the original forms will be kept in the Principal Investigator's file for a period of three (3) years after which they will be destroyed.
5. **CONSENT FORM:** A copy of the **CONSENT FORM** to be signed by the subject (if applicable) and/or any statement to be read to the subject should be attached to this form. If no **CONSENT FORM** is to be used, document the procedures to be used to assure that infringement upon the subject's rights will not occur. Describe where signed consent forms will be kept and for what period of time.

Permission to perform a chart review will be requested individually from each participating facility. No collection of information from medical records will be initiated prior to written approval from the individual clinic administrative personnel in charge. For the chart review, no consent form will be used by the subject. Throughout the study, each subject and facility name will be identified only by a code number.

6. For **FULL IRB REVIEW** forward a signed original and thirteen (13) copies of this completed form, and where applicable, thirteen (13) copies of the proposed consent form, questionnaires, etc. and any supporting documentation to:

Office of Research & Program Development
University of North Dakota
Box 8138, University Station
Grand Forks, North Dakota 58202

On campus, mail to: Office of Research & Program Development, Box 134, or drop it off at Room 101 Twamley Hall.

For **EXEMPT** or **EXPEDITED REVIEW** forward a signed original and a copy of the consent form, questionnaires, etc. and any supporting documentation to one of the addresses above.

The policies and procedures on **Use of Human Subjects** of the University of North Dakota apply to all activities involving use of Human Subjects performed by personnel conducting such activities under the auspices of the University. No activities are to be initiated without prior review and approval as prescribed by the University’s policies and procedures governing the use of human subjects.

**SIGNATURES:**

_________________________ DATE: ____________
Jouni Zidbeck
Principal Investigator

_________________________ DATE: ____________
Project Director or Student Adviser

_________________________ DATE: ____________
Training or Center Grant Director

(Revised 8/1992)
UNIVERSITY OF NORTH DAKOTA'S
INSTITUTIONAL REVIEW BOARD

DATE: August 16, 1996 PROJECT NUMBER IRB-9608-019

NAME: Jouni Zidbeck DEPARTMENT/COLLEGE Physical Therapy

PROJECT TITLE: Management of Thoracic Output Syndrome by Physical Therapy: An Outcome Study

The above referenced project was reviewed by a designated member for the University's Institutional Review Board on August 16, 1996 and the following action was taken:

☐ Project approved. EXPEDITED REVIEW NO. ______.
Next scheduled review is on ____________________________.

☒ Project approved. EXEMPT CATEGORY NO. ___.
No periodic review scheduled unless so stated in REMARKS SECTION.

☐ Project approved PENDING receipt of corrections/additions in ORPD and approval by the IRB.
This study may NOT be started UNTIL IRB approval has been received. (See REMARKS SECTION for further information.)

☐ Project approval deferred. This study may not be started until IRB approval has been received. (See REMARKS SECTION for further information.)

☐ Project denied. (See REMARKS SECTION for further information.)

REMARKS: Any changes in protocol or adverse occurrences in the course of the research project must be reported immediately to the IRB Chairman or ORPD.

cc: R. Mabey, S. Jeno, Advisers Dean, Medical School

[Signature] 8-16-96
UND's Institutional Review Board

If the proposed project (clinical medical) is to be part of a research activity funded by a Federal Agency, a special assurance statement or a completed 596 Form may be required. Contact ORPD to obtain the required documents.
(7/93)
August 13, 1996

PT/OT Associates
Attn: Cheryl Askelson, PT
2301 S 25th St.
Suite B
Fargo, ND 58103

Dear Cheryl Askelson,

I am requesting permission to perform a chart review at your facility. For your information, the following is a brief description of my proposed Independent Study, titled "Management of Thoracic Outlet Syndrome by Physical Therapy: An Outcome Study."

Thoracic outlet syndrome (TOS) is a disorder caused by compression of the brachial plexus or subclavian artery as they pass through a potentially limited space in the anterolateral neck and proximal shoulder. Although conservative management by physical therapy cannot replace surgery in severe or complicated cases of TOS, it is recommended as the first treatment choice. The purpose of this study is to assess the success of conservative treatment choices for the management of TOS.

Methodology will entail reviewing medical records of adult subjects (18 years or older) who have been treated conservatively by physical therapy. Selection of medical records to be reviewed includes charts dating back no later than 1986 that fall under diagnosis of thoracic outlet syndrome (ICD-9 code 353.0) and that have no additional diagnosis that may affect the outcome of this study.

A data collection tool (enclosed) will be used to collect demographic data and data related to initial medical examination, physical therapy management and treatment outcome from each appropriate medical record. Only data pertinent to the purpose of this study will be collected.

All data will be collected by codified format to insure confidentiality of each subject and your facility. All data from medical records will be reviewed in an appropriate area as designated by the facility. At no time will medical records be shared with unauthorized personnel or removed from the designated area. Information collection will be limited to information printed on the data collection tool. No medical records will be photocopied or reproduced in any manner or form.

After gathering data, it will be analyzed with descriptive and analytical statistics to demonstrate if there is a significant improvement of thoracic outlet syndrome with conservative physical therapy management. Used data collection tools will be shared only with the Student Advisers, if necessary. After all information from data collection tools has been analyzed, the original forms will be kept in Jouni Zidbeck’s file for a period of three (3) years after which they will be destroyed.

The results of this study will help determine if thoracic outlet syndrome is being treated successfully by conservative physical therapy treatments and, if so, what specific treatment choices are being utilized with positive results? Knowledge of the results of this study will add to the pool of information available for manual therapists when considering treatment choices for thoracic outlet syndrome. The study will benefit society as a whole by making certain that effective treatment choices are being made by manual therapists which, in turn, assures cost-effectiveness of treatment.

Material from this study will be used in writing my Independent Study for requirement of my Master of Physical Therapy Degree at the University of North Dakota, Grand Forks, North Dakota. Results of this study will be shared with your facility. Thank you for your attention to this request.

Sincerely,

Jouni Zidbeck, NREMT-P, SPT
PO Box 8151
Grand Forks, ND 58202

Approval is given to Jouni Zidbeck, Physical Therapy Student at the University of North Dakota, to perform a chart review at PT/OT Associates, Fargo, North Dakota for educational purposes as outlined above.

Cheryl Askelson

Enclosure
August 13, 1996

The Rehab
Medical Records Dept.
1300 South Columbia Rd
Grand Forks, ND 58201

Dear Medical Records Personnel,

I am requesting permission to perform a chart review at your facility. For your information, the following is a brief description of my proposed Independent Study, titled "Management of Thoracic Outlet Syndrome by Physical Therapy: An Outcome Study."

Thoracic outlet syndrome (TOS) is a disorder caused by compression of the brachial plexus or subclavian artery as they pass through a potentially limited space in the anterolateral neck and proximal shoulder. Although conservative management by physical therapy cannot replace surgery in severe or complicated cases of TOS, it is recommended as the first treatment choice. The purpose of this study is to assess the success of conservative treatment choices for the management of TOS.

Methodology will entail reviewing medical records of adult subjects (18 years or older) who have been treated conservatively by physical therapy. Selection of medical records to be reviewed includes charts dating back no later than 1986 that fall under diagnosis of thoracic outlet syndrome (ICD-9 code 353.0) and that have no additional diagnosis that may affect the outcome of this study.

A data collection tool (enclosed) will be used to collect demographic data and data related to initial medical examination, physical therapy management and treatment outcome from each appropriate medical record. Only data pertinent to the purpose of this study will be collected.

All data will be collected by codified format to insure confidentiality of each subject and your facility. All data from medical records will be reviewed in an appropriate area as designated by the facility. At no time will medical records be shared with unauthorized personnel or removed from the designated area. Information collection will be limited to information printed on the data collection tool. No medical records will be photocopied or reproduced in any manner or form.

After gathering data, it will be analyzed with descriptive and analytical statistics to demonstrate if there is a significant improvement of thoracic outlet syndrome with conservative physical therapy management. Used data collection tools will be shared only with the Student Advisers, if necessary. After all information from data collection tools has been analyzed, the original forms will be kept in Jouni Zidbeck’s file for a period of three (3) years after which they will be destroyed.

The results of this study will help determine if thoracic outlet syndrome is being treated successfully by conservative physical therapy treatments and, if so, what specific treatment choices are being utilized with positive results? Knowledge of the results of this study will add to the pool of information available for manual therapists when considering treatment choices for thoracic outlet syndrome. The study will benefit society as a whole by making certain that effective treatment choices are being made by manual therapists which, in turn, assures cost-effectiveness of treatment.

Material from this study will be used in writing my Independent Study for requirement of my Master of Physical Therapy Degree at the University of North Dakota, Grand Forks, North Dakota. Results of this study will be shared with your facility. Thank you for your attention to this request.

Sincerely,

Jouni Zidbeck, NREMT-P, SPT
PO Box 8151
Grand Forks, ND 58202

Approval is given to Jouni Zidbeck, Physical Therapy Student at the University of North Dakota, to perform a chart review at The Rehab, Grand Forks, North Dakota for educational purposes as outlined above.

Tracey Bogema, ART

Enclosure

* Have approval form on file from UND IRB review board
August 13, 1996

Polinsky Medical Rehabilitation Center
Attn: Deb Skansberg, PT
530 E 2nd St.
Duluth, MN 55805

Dear Deb Skansberg,

I am requesting permission to perform a chart review at your facility. For your information, the following is a brief description of my proposed Independent Study, titled "Management of Thoracic Outlet Syndrome by Physical Therapy: An Outcome Study."

Thoracic outlet syndrome (TOS) is a disorder caused by compression of the brachial plexus or subclavian artery as they pass through a potentially limited space in the anterolateral neck and proximal shoulder. Although conservative management by physical therapy cannot replace surgery in severe or complicated cases of TOS, it is recommended as the first treatment choice. The purpose of this study is to assess the success of conservative treatment choices for the management of TOS.

Methodology will entail reviewing medical records of adult subjects (18 years or older) who have been treated conservatively by physical therapy. Selection of medical records to be reviewed includes all charts dating from January 1995 to present that fall under diagnosis of thoracic outlet syndrome (ICD-9 code 353.0) and that have no additional diagnosis that may affect the outcome of this study.

A data collection tool (enclosed) will be used to collect demographic data and data related to initial medical examination, physical therapy management and treatment outcome from each appropriate medical record. Only data pertinent to the purpose of this study will be collected.

All data will be collected by codified format to insure confidentiality of each subject and your facility. All data from medical records will be reviewed in an appropriate area as designated by the facility. At no time will medical records be shared with unauthorized personnel or removed from the designated area. Information collection will be limited to information printed on the data collection tool. No medical records will be photocopied or reproduced in any manner or form.

After gathering data, it will be analyzed with descriptive and analytical statistics to demonstrate if there is a significant improvement of thoracic outlet syndrome with conservative physical therapy management. Used data collection tools will be shared only with the Student Advisers, if necessary. After all information from data collection tools has been analyzed, the original forms will be kept in Jouni Zidbeck’s file for a period of three (3) years after which they will be destroyed.

The results of this study will help determine if thoracic outlet syndrome is being treated successfully by conservative physical therapy treatments and, if so, what specific treatment choices are being utilized with positive results? Knowledge of the results of this study will add to the pool of information available for manual therapists when considering treatment choices for thoracic outlet syndrome. The study will benefit society as a whole by making certain that effective treatment choices are being made by manual therapists which, in turn, assures cost-effectiveness of treatment.

Material from this study will be used in writing my Independent Study for requirement of my Master of Physical Therapy Degree at the University of North Dakota, Grand Forks, North Dakota. This project has been approved by University of North Dakota’s Institutional Review Board (IRB). Results of this study will be shared with your facility.

Thank you for your attention to this request.

Sincerely,

Jouni Zidbeck, NREMT-P, SPT
PO Box 8151
Grand Forks, ND 58202

Approval is given to Jouni Zidbeck, Physical Therapy Student at the University of North Dakota, to perform a chart review at Center Therapy, Duluth, Minnesota for educational purposes as outlined above.

Enclosure
December 13, 1996

Arnie Keck, Instructor
Department of Physical Therapy
School of Medicine
University of North Dakota
Grand Forks, ND

Dear Arnie,

This request is in response to our 12/12/96 conversation. I am requesting permission to photocopy page 107: Brachial Plexus from your textbook *Anatomy for Allied Health* (1994).

The figure will be used in my Independent Study for requirement of my Master of Physical Therapy degree at the University of North Dakota, Grand Forks, ND.

Seven copies will be made of my Independent Study for the following uses: Department of Physical Therapy (2 copies), all physical therapy clinics that contributed data to this study (3 copies) and for my personal library (2 copies).

Thank you for your attention to this request.

/Jouni Zidbeck/

Jouni Zidbeck, SPT

Approval is given to Jouni Zidbeck, physical therapy student at the University of North Dakota, for copying the above publication for educational purposes as outlined above.

/Arnold Keck/
APPENDIX B
Data Collection Tool
Management of Thoracic Outlet Syndrome by Physical Therapy: An Outcome Study

<table>
<thead>
<tr>
<th>ID Code</th>
<th>Age</th>
<th>Sex</th>
<th>M</th>
<th>F</th>
</tr>
</thead>
</table>

**HISTORY:**
- Duration
- Injury? Y N
- Other pertinent history

**SYMPTOMS:**
- Neurogenic: Upper trunk
  - Pain
  - Numb
  - Weak
  - Other
- Lower trunk
  - Pain
  - Numb
  - Weak
  - Other
- General
  - Pain
  - Numb
  - Weak
  - Other

- Vascular: Arterial
  - Cold
  - Pain
  - Fatigue
  - Other
- Venous
  - Cyanosis
  - Venous distention
  - Edema
  - Other

<table>
<thead>
<tr>
<th>Pain</th>
<th>0 1 2 3 4 5 6 7 8 9 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>-------------------------</td>
</tr>
</tbody>
</table>

**FUNCTIONAL:**
- ADL’s
- Work
- Sports
- Other

**SIGNS:**
- Observation:
  - Posture
  - Asymmetry
  - Other

- ROM
- Peripheral jts
- Dermatomes
- Myotomes
- X-ray CT MRI EMG thermography vascular studies

<table>
<thead>
<tr>
<th>Allen</th>
<th>Adson</th>
<th>Costoclavicular</th>
<th>AER</th>
</tr>
</thead>
</table>
| Palpation
| M.D. diagnosis
| P.T. impression

**TREATMENT:**
- Meds: Analgesics Muscle relaxants
- Modalities: Superficial heat US E-estim Other
- Stretch: Brachial plexus Levator scapulae Upper trap Pectoralis
- Scalenels Sternocleido Other
- Myofascial release: Scalene Pectoralis Traps Other
TREATMENT (cont'd):

Joint mobs: 1st rib □  Sternocleido □  Acromioclavicular □  Scapula □
Other □
Posture correction: Sleep □  Sit □  Stand □
Other □
Exercises: Periscapular □  Middle/lower trap □  Sternocleido □
Serratus ant □  lower rhomboids □  Other □
Other □
Activity modification □
Self stretch: Upper trap □  Serratus □  Sternocleido □  Br.plexus □
Levator scapulae □  Upper trap □  Pectoralis □  Scalene □  Other □
Aerobic conditioning: diaphragmatic breathing □  lateral costal breathing □
progressive walking/other aerobic cond. ex’s □
Other □

TX DURATION: □□□□□ weeks □□□□□ treatments/week □□□□□ total tx □

OUTCOME:
Observation: Posture □
Asymmetry □
Other □
ROM
Peripheral jts.
Dermatomes □
Myotomes □
X-ray □  CT □  MRI □  EMG □  thermography □  vascular studies □
Allen □  Adson □  Costoclavicular □  AER □  Other □
Palpation □
Pain 0 1 2 3 4 5 6 7 8 9 10
REFERENCES


