



# Clinical Case Report Competition

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First Place Winner

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The effects of massage therapy on a professional opera singer with chronic pain and symptoms of thoracic outlet syndrome

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## Abstract

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**Objective:** The purpose of this study is to determine if massage therapy, with a focus on trigger point therapy can improve symptoms of thoracic outlet syndrome, chronic pain, and lung capacity.

**Background:** The subject is a 31 year-old Caucasian female who is a professional Opera and Jazz singer. She experiences constant and extreme pain on the left side of her body approximately eight months prior to the start of the study. The pain and symptoms she experiences are similar to that described in thoracic outlet syndrome.<sup>7</sup> Other health related conditions include Doctor diagnosed Temporomandibular Joint Disorder (TMJD) and occasional migraines also on the left side of her head. The subject reports she is unable to work full time for eight months prior to the start of the study due to pain.

**Methods:** The case study includes a total of 10 treatments, once per week, for ninety minutes each treatment. Techniques used include myofascial release and swedish massage to warm the tissue and trigger point therapy to specific muscles. Testing methods include the: McGill Pain Questionnaire<sup>17</sup>, Rib Excursion Test<sup>16</sup>, Maximum Phonation Time<sup>15</sup>, Adson Maneuver, Wright Hyperabduction, Military Brace,<sup>13</sup> and a subject-maintained pain journal.

**Results:** The results include an eight point reduction in the McGill Pain Score, a 5.8" total improvement in Rib Excursion over three areas measured, and a 0.3

second increase in Maximum Phonation Time. All tests for TOS, including Adson Maneuver, Halstead Maneuver, Wright Hyperabduction, and Military Brace, yield a negative result at the completion of the study.

**Conclusion:** The results of this case study indicate that the use of massage therapy, involving trigger point release, is effective in reducing symptoms of TOS. It is not an effective method in reducing chronic pain or increasing functional vocalizations.

**Key Words:** Trigger Point Therapy, Thoracic Outlet Syndrome, Chronic Pain, Lung Capacity

## Introduction

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Thoracic Outlet Syndrome (TOS) is a peripheral nerve disorder, in which the brachial plexus and subclavian vessels are compressed at one or more of the three common impingement sites as it travels from its spinal roots towards the upper extremity.<sup>6</sup> The interscalene triangle is composed of the anterior and middle scalene muscles and the first rib. To provoke symptoms of compression in this area, Adson and Halstead Maneuver will stretch the scalene muscles.<sup>13</sup> Palpation of the scalene muscles will also provoke symptoms.<sup>6, 13</sup> The costoclavicular space is composed of the clavicle and the first rib. Compression here is typically from faulty posture in a slouched position, a fractured clavicle or an elevated first rib.

An elevated first rib can be caused by either subluxation or upper thoracic breathing. To provoke symptoms in this area, the Military Brace test is used.<sup>6, 13</sup> The axillary interval is composed of the deltopectoral fascia, pectoralis minor muscle, and the coracoid process of the scapula. Symptoms can be provoked by palpation of the pectoralis minor muscle, or holding the arms in an elevated position.<sup>6</sup>

Signs and symptoms are usually neurological and vascular in nature and commonly include: pain, paresthesia, numbness, weakness, discolouration, swelling, and loss of the radial pulse.<sup>7</sup> Individuals with TOS also complain of headaches, which may be related to posture, tension, or vascular compromise through the neck.<sup>6</sup>

Thoracic Outlet Syndrome can be due to muscle hypertrophy of the scalenes or pectoralis minor muscle, the presence of a cervical rib or fracture of the clavicle, adaptive shortening of the surrounding fascia, or a space-occupying lesion. Faulty posture can also contribute to the onset of TOS. Respiratory patterns are also an important cause of TOS. One who uses primarily an upper thoracic respiratory pattern will have hypertrophy of the scalene muscles caused by the continual use of these and other accessory respiratory muscles to elevate the first and second ribs. The elevated upper ribs can lead to compression of the neural and vascular vessels under the clavicle.<sup>6</sup> There are three different types of TOS. Neurogenic

TOS (or True TOS) is usually caused by an anatomical abnormality like a cervical rib or elongated transverse process of C7.<sup>6</sup> The initial treatment for this is typically physical therapy, muscle relaxants, anti-inflammatory agents and adjustments in work ergonomics. If these methods are not successful, surgical interventions, such as a scalenectomy, brachial plexus neurolysis, or first rib resection, are typically deemed necessary.<sup>7</sup> Nonspecific "Symptomatic" Neurogenic TOS does not typically have any anatomical abnormalities rather postural findings that can lead to compression in some way.<sup>6</sup> Arterial Vascular Syndromes are quite rare, and are usually the result of structural abnormalities.<sup>6</sup> Venous Vascular Syndromes are not typical in TOS, either. This is sometimes believed to be from another cause, like a thrombosis.<sup>6</sup> Conservative treatment is anticoagulation therapy. Other early treatment includes early contrast venography, and a catheter-based thrombolytic therapy. If these treatments are ineffective, surgical thoracic outlet decompression is used, which may be accompanied by vascular angioplasty.<sup>7</sup> Differential diagnoses used to describe TOS include Cervical Rib, Scalenus Anticus Syndrome, Costoclavicular Syndrome, Subcoracoid-Pectoralis Minor Syndrome, and Hyperabduction Syndrome depending on the location of compression or structures involved in the compression.<sup>6</sup>

In a case study on a patient with symptoms of angina pectoris after five minutes of physical exertion, a chiropractor experiences a significant improvement after

three treatments for Thoracic Outlet Syndrome.<sup>9</sup> Treatments focus on Pectoralis Minor, Serratus Anterior and Latissimus Dorsi muscles, along with some joint manipulations for the left sternoclavicular joint and the cervical and thoracic spine. The patient is able to last for thirty minutes of physical exertion with no recreation of symptoms.<sup>9</sup>

A trigger point is defined as, “a focus of hyperirritability in a tissue that, when compressed, is locally tender and, if sufficiently hypersensitive, gives rise to referred pain and tenderness, and sometimes to referred autonomic phenomena and distortion of proprioception.”<sup>1(pg4,14)</sup> Many techniques are used to treat trigger points, such as trigger point pressure release, which is considered to be less vigorous than ischemic compressions, and is unlikely to produce any additional tissue ischemia.<sup>2</sup> Trigger points can be a very common source of musculoskeletal pain and dysfunction giving rise to characteristic referred pain, referred tenderness, motor dysfunction, and autonomic phenomena.<sup>2</sup> In order to properly determine if a trigger point is the cause of the patient’s specific pain complaint, a few diagnostic tools such as: spot tenderness or Jump Sign, recognized referred pain, a palpable taut band, and a twitch response are used.<sup>2</sup>

There is currently very limited research on the effects of massage therapy on professional singers, or if it can help with occupational muscular imbalances or pain specifically to singing and vocal production. In a meta-analysis of research

done for respiratory muscle training, it is suggested that while most of the studies are performed on elite athletes, the majority of cases show no difference in respiration during differing activities, i.e. running, swimming or rowing.<sup>10</sup>

Therefore, one could assume that practicing respiratory muscle training on any individual who is doing activities requiring increased respiratory capacity would be beneficial such as the increased respiratory work required in singing.<sup>11</sup>

The main muscles of inspiration include the diaphragm, which accounts for 75% of the effort in quiet breathing,<sup>11</sup> and the external intercostals, which account for the other 25% of quiet breathing.<sup>11</sup> During forced inhalation, other accessory muscles include the sternocleidomastoid and all three scalene muscles.<sup>11</sup> For the purpose of this study, any muscle also attaching to the ribs and having a reverse mover action of elevating the ribs are considered as accessory muscles of respiration. These muscles include: serratus anterior which can elevate ribs 1-9, pectoralis minor which elevates ribs 3-5, and subclavius which elevates the first rib.<sup>12</sup>

The purpose of this study is to examine if massage therapy, with a focus on trigger point therapy can have an effect on chronic pain, symptoms of Thoracic Outlet Syndrome and improve lung capacity of a professional Opera and Jazz singer.

## Case Study Subject

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The subject is a 31-year-old Caucasian female, a professional Opera and Jazz singer. At the time of the study, she is unable to work due to her complaints of pain through her shoulder, jaw, and ribs. She has been diagnosed with Temporomandibular Joint Disorder (TMJD), the onset of which occurs after her wisdom teeth are removed eight months prior to the start of the study. She describes the pain as stabbing, feeling like a shard of something is within the joint. She also experiences the occasional migraine on the left side of her head, reaching over her ears, into the temples and eyes.

The subject complains of constant pain on the left side of her body, specifically over her left scapula, neck and back. This pain is sometimes noted as excruciating and radiates from two or three specific points: through the neck into the head, around the shoulder, down into the arm, and into the ribs making deep breaths difficult and painful. She finds that she must breathe through her chest and neck, which also aggravates the pain. She notices that her left arm and hand sometimes becomes numb, tingly and weak. She notes that sitting or standing in one position for a length of time, driving, or cold weather makes the pain worse. The subject has felt this pain for years, but noticed an increase after her wisdom teeth removal eight months prior to the start of the study. The subject had been singing regularly for work before the onset of the pain, but has been off work for eight months

because of the pain. She can no longer sing Opera as the pain becomes unbearable in a very short amount of time, so she is limited to singing Jazz once per week.

The pain also disrupts her sleep at least three nights per week, as she finds it difficult to find a comfortable position to sleep. Any pressure on her jaw causes intense pain, and it is uncomfortable to keep her shoulder in one position too long.

The patient has tried other therapies for her pain such as a Sport and Spine Clinic, and an acupuncturist a few months prior to the start of the study for the pain in her jaw. She sees an Applied Kinesiology Chiropractic Doctor regularly. He has recommended massage therapy multiple times for this case, as he believes it would be highly beneficial.

## Methods

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Orthopedic tests for Thoracic Outlet Syndrome symptoms including Wright Test, Military Brace Test, Adson Maneuver and Halstead Maneuver<sup>13</sup> are performed on treatments 1, 4, and 10. Pain levels, and lung capacity are also tested at the same time. All tests are done in the same order, beginning at 12:30pm, when the treatment begins.

The Wright Test is used to provoke and test compression of the costoclavicular space and the axillary interval.<sup>13</sup> The Military Brace Test, also known as the Costoclavicular Syndrome Test is used to more accurately and specifically test the compression of the costoclavicular space.<sup>13</sup> Adson Maneuver and Halstead

Maneuver both test for the compression of the brachial plexus in the interscalene triangle.<sup>13</sup> Adson Maneuver places specificity on the anterior scalene muscle, while the Halstead Maneuver places tension on the middle scalene muscle.<sup>13</sup> A positive sign for these tests are either the disappearance of the radial pulse or the recreation of presenting symptoms.<sup>13</sup>

To test the subject's lung capacity, Maximum Phonation Time is utilized. This test is a measurement of respiratory and sound control, measuring the time an individual can sustain a sung note after having filled the lungs to maximum capacity.<sup>15</sup> The subject is asked to sustain a vowel sound produced on one deep breath at a comfortable pitch and loudness, while the therapist measures the length in time. The best of three attempts is used as the patient's Maximum Phonation Time.<sup>5</sup> A G one-and-a-half octaves above middle C is used for this subject as it is deemed to be in the middle of her vocal range, being the most comfortable. Another measurement of lung capacity used in this study is the Rib Excursion Measurement. The therapist uses a tape measure to assess the difference between a full exhalation and full inhalation. The measurements are taken at the axilla, the nipple line, and the tenth rib.<sup>13</sup>

To measure pain levels, the McGill Pain Questionnaire is used.<sup>17</sup> The subject selects descriptive words that describe the pain experienced, with a maximum score of 78. Each word in a section are assigned scores, and the scores are added

up into four major groups: sensory, affective, evaluative and miscellaneous.<sup>17</sup>

Following with the subject's schedule, treatments follow a weekly singing job so she is pre-warmed for any vocal or respiratory exercises and tests. Subjectively, the subject maintains a daily pain journal. She describes the kind of pain she experiences, as well as how long it lasts.

Treatments are conducted once weekly, and last a total of ninety minutes for a total of ten treatments. All treatments begin with myofascial release (MFR) and swedish massage. Approximately ten minutes per area treated are used for MFR and swedish to warm tissue and muscles. These techniques are followed by Trigger Point Therapy to specific muscles as presenting the day of the treatment. Treatments are prone, which is changed on Treatment three to side-lying due to the subject's other complaints. In this position, ten minutes are spent applying MFR and swedish to the rib cage and shoulder girdle. Following the warm-up of tissues, trigger point therapy is applied to affected muscles for twenty minutes. At thirty minutes, the patient is turned supine to treat the abdomen, chest, and neck. Twenty minutes are used for MFR and swedish, followed by forty minutes for trigger point therapy. Swedish clearing and stretching is applied after each trigger point has been released.

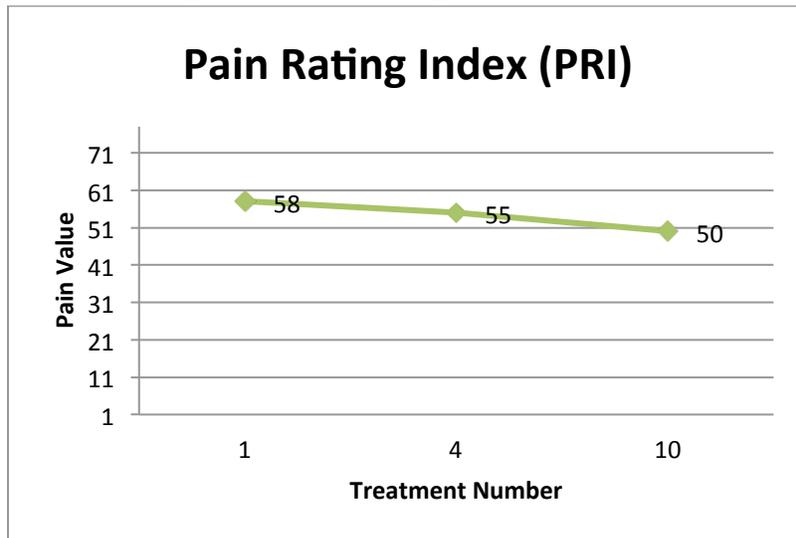
Muscles that are included in trigger point therapy vary slightly each treatment. Generally, muscles that are addressed in each treatment are muscles of respiration, lateral and posterior neck muscles, anterior chest muscles, and the

rotator cuff of the glenohumeral joint. During Treatment 1, the muscles addressed are: infraspinatus, rhomboid minor, pectoralis minor, subclavius, anterior and middle scalenes, and upper trapezius. Treatment 2 includes: infraspinatus, pectoralis minor, anterior, middle, and posterior scalenes. Treatment 3 includes: infraspinatus, subscapularis, serratus anterior, middle and posterior scalenes, and the suboccipital group. Treatment 4 includes: infraspinatus, serratus anterior, intercostals, diaphragm, middle scalenes, and upper trapezius. Treatment 5 includes: infraspinatus, serratus anterior, diaphragm, upper trapezius, middle and posterior scalenes, and levator scapula. Treatment 6 includes: infraspinatus, serratus anterior, pectoralis minor, middle and posterior scalenes, sternocleidomastoid, upper trapezius, diaphragm and subscapularis. Treatment 7 includes: infraspinatus, serratus anterior, intercostals, pectoralis minor, anterior and posterior scalenes, upper trapezius, and temporalis. Treatment 8 includes: infraspinatus, serratus anterior, intercostals, pectoralis minor, anterior, middle and posterior scalenes, and upper trapezius. Treatment 9 includes: infraspinatus, serratus anterior, intercostals, diaphragm, pectoralis minor, anterior, middle and posterior scalenes, upper trapezius, and temporalis. Treatment 10 includes: infraspinatus, serratus anterior, intercostals, subscapularis, pectoralis major and minor, anterior, middle and posterior scalenes, upper trapezius and temporalis.

## Results

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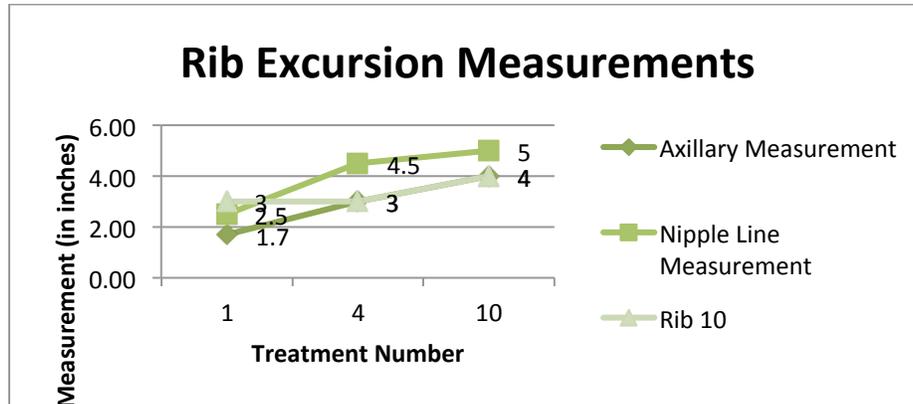
**Graph 1 - Change of Pain Rating Index Over 10 Treatments**



Graph 1 represents the change in pain symptoms based on the McGill Pain Questionnaire.

On the first treatment day, the subject scores a total of 58 out of a possible 78 on the McGill Pain Questionnaire. On the fourth treatment day, the subject scores a total of 55 out of a possible 78. On the tenth treatment day, the subject scores a total of 50 out of a possible 78. Over the course of the treatments, the subject's pain scores decrease by a total of 8 points on the McGill Pain Questionnaire.

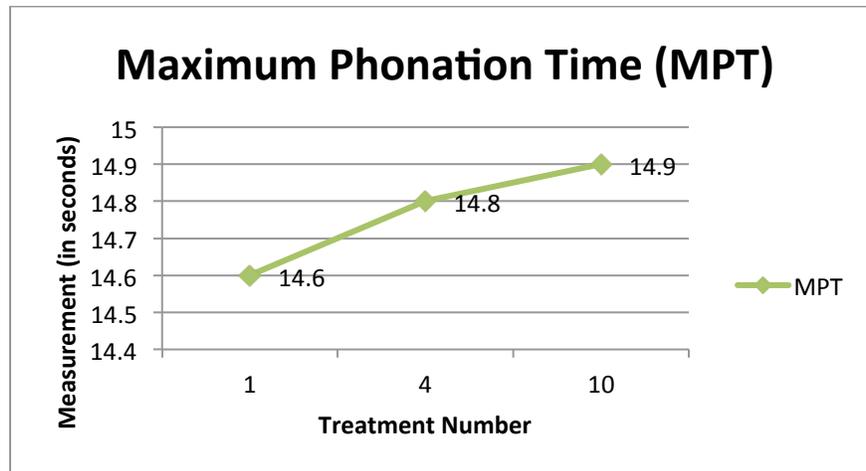
**Graph 2 – Change of Rib Excursion Measurements Over 10 Treatments**



Graph 2 represents the change in Rib Excursion Measurements. The values are representations of the difference between exhalation and inhalation.

The subject's initial Rib Excursion Measurements are taken on the day of the first treatment. At the axilla, the measurement is a total of 1.7" of rib excursion, the nipple line is a total of 2.5" rib excursion, and the tenth rib is a total of 3" rib excursion. The next Rib Excursion Measurements are taken on the day of the fourth treatment. At the axilla, the measurement is a total of 3" of rib excursion, the nipple line is a total of 4.5" rib excursion, and the tenth rib is a total of 3" rib excursion. The final Rib Excursion Measurements are taken on the tenth treatment. At the axilla, the measurement is a total of 4" rib excursion, the nipple line is a total of 5" rib excursion, and the tenth rib is a total of 4" difference. Total increases in Rib Excursion Measurements are 2.3" at the axilla, 2.5" at the nipple line, and 1" at the tenth rib.

**Graph 3 – Change of Maximum Phonation Time Over 10 Treatments**



Graph 3 is a representation of the Maximum Phonation Time as measured on Treatments 1, 4, and 10.

Maximum Phonation time is measured on treatments 1, 4, and 10, after the subject is pre-warmed from a prior singing job. Three measurements are taken each time the test is performed and the largest number is considered the Maximum Phonation Time. On the day of treatment 1, the subject achieves a Maximum Phonation Time of 14.6 seconds. On the day of the fourth treatment, the subject achieves a total of 14.8 seconds. This is a total increase of 0.2 seconds from the first measurement. On treatment 10, her Maximum Phonation Time is a total of 14.9 seconds. This is a total increase of 0.3 seconds from the first measurement. On the day of Treatment 1, the patient is tested for Thoracic Outlet Syndrome. Adson and Halstead Maneuver, Wright Hyperabduction, and Military Brace are

used as testing methods. On testing, the subject is positive for reduction of the radial pulse with all tests; however, the subject only notes an increase in neurological symptoms and pain with Wright's Hyperabduction. On the tenth treatment, the subject is negative for reduction of the radial pulse and any neurological symptoms with all tests.

Subjectively, the subject reports through her pain journal. By treatment 5, the subject notes that she is experiencing two pain-free days in the middle of the two previous weeks. This trend continues until the completion of the study. She also reports after the fifth treatment, there is an absence of the stabbing pain in her jaw. This pain is absent for most of the remainder of the day. This pattern also continues until the completion of the study.

## Discussion

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The results for the treatment of Thoracic Outlet Syndrome (TOS) in this study are conclusive because all tests are negative for pulse and nerve by the end of the course of treatment. It is possible that the scalene muscles have decreased in hypertonicity and tension due to trigger point therapy leading to a lesser pull on the first rib, allowing it to depress with exhalation and relaxation of the scalene muscles.<sup>6</sup> It is also possible that the decreased tension of the anterior and middle scalenes can also decrease compression on this plexus. It is also possible that the

pectoralis minor muscle has lengthened and decreased in hypertonicity and tension due to the same therapy. This can also increase the space between the ribs, coracoid process and pectoralis minor.<sup>6</sup>

In the initial assessment, Maximum Phonation Time is minimal, and not to the time deemed appropriate for a healthy female.<sup>15</sup> Results for adult males without any pathologies are typically between 25 and 35 seconds, where healthy adult females can sustain between 15 and 25 seconds.<sup>15</sup> Over the course of the treatments, this time is measured three times. The total improvement is very minimal, with no significant improvement. More studies need to be done into what treatment methods can help to improve this functional measurement. The patient notes that upon performance of this test, she has to stop vocalizations due to pain in the jaw. Therefore, treatment of the body as a whole with all presenting signs and symptoms can be considered important to changing and improving functionality. Trigger point therapy is not an effective method of treatment to improve functional vocalizations.

Total increases in Rib Excursion Measurements are 2.3” at the axilla, 2.5” at the nipple line, and 1” at the tenth rib. The first measurement of Rib Excursion is minimal, suggesting some sort of structural or functional issue in rib motion. By the completion of the study, the rib motion is within a normal, healthy range.<sup>16</sup> Ribs moving and expanding should lead to the lungs receiving a larger intake of

air.<sup>11</sup> Ideally, this should lead to increased lung capacity and vocal capacity.

Future studies should be done including a treatment plan with more variety, such as rib mobilizations to increase rib mobility and encourage both muscular and joint health.

It is unclear why there is such a significant difference in results between the Maximum Phonation Time and the Rib Excursion Test. Since there is such an improvement in rib motion, one could assume that the ability to hold a vocalization for an extended time should also improve. In this study, however, this is not the case. Reasons for this difference in results could be that there is an underlying vocal pathology, but the more likely reason is the pain reported by the subject in her jaw upon vocalizations. This points to the necessity of treating the body as a whole rather than a focus on one specific complaint, as other issues may impede recovery and perception of pain.

Over the course of the treatments, the subject's pain scores decrease by a total of eight points on the McGill Pain Questionnaire. While there is a decrease in the McGill Pain Question scores, it is not enough to be considered a significant improvement. This treatment plan lacked variety in differing methods and areas of the body treated. Perhaps, if the body is treated as a whole, then other areas left contributing to overall pain would not be contributing to the perception of pain in the rest of the body. It is quite possible, in this case, that all pain is related to other

pain. On palpation of the trigger point in the upper trapezius muscle, the referral pattern recreates the pattern of the patient's reported migraines. Also, on palpation of the infraspinatus muscle and diaphragm trigger points, the referral patterns cover all of the patient's complaints. An inactivation or decrease in these trigger points should lead to a decrease in perceived pain. In this case, the pain measurement did not decrease enough to be considered a satisfactory result.

When dealing with chronic pain, one must also understand that there is a psychological aspect that also can contribute to the pain. One may see more significant results if the treatment is paired with therapy for the emotional and psychological issues that accompany chronic pain and disability.<sup>8</sup> More studies need to be done on combining therapies to treat both the physical and psychological aspects of chronic pain.

The subject reports no pain for the remainder of the day post treatment, as well as two days mid-week that are pain free, or significantly decreased pain. She also reports on the last two treatments, that she is able to sing longer phrases than previous weeks. Regarding the trend in pain, it can be suggested that shorter treatments at a greater frequency may be beneficial for this case. It is suggested to the subject that treatments are moved to be twice weekly to attempt to change the noticed pattern. Since this does not fit into the subject's personal schedule, treatments are kept at the same time and frequency.

Thoracic Outlet Syndrome is a fairly clearly defined pathology in the medical community. Surgeries, anticoagulation therapy and muscle relaxants are used with many side effects.<sup>7</sup> More studies need to be conducted on the effects of massage therapy, specifically trigger point therapy, using Nerve Conduction Velocity tests with more objective numerical information. Such information can be more readily accepted by a larger audience, as it has more reliability. If the use of Massage Therapy for TOS can be presented to the medical community as an effective method of treatment with limited and minor side effects, Massage Therapy has the potential to become the primary method of treatment for this pathology. This would have a direct effect on the medical system, lowering the need for surgeries with added costs of therapy for recovery. It would reduce the number patients on long term medications with side effects that also need to be treated, and it would limit the number of people disability and leave from work, putting strain on the economy.

## Conclusion

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The treatment of TOS using trigger point therapy to reduce hypertonicity and tension in key compressive and postural muscles is shown to be effective in this study. More studies on this topic, using more subjects and more objective and scientific data, would be beneficial to increasing the knowledge base of massage therapy in treating TOS.

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