The Impact of Massage Therapy on Thoracic Outlet Syndrome.

Abstract

Thoracic Outlet Syndrome (TOS) is a unique and complex pathology that is difficult to diagnose. The participant, in this case study experienced pain and neurological symptoms for two years with no relief. The participant's main concerns are pain management and decreasing the neurological symptoms he is experiencing. Providing relief from these symptoms will allow the participant to return to his activities of daily living.

Significant findings in the initial assessment were: reported pain of 10/10, reduced range of motion (ROM) in the cervical spine and glenohumeral (GH) joint, absent deep tendon reflex (DTR) 7 bilaterally and positive special tests. Posterior-anterior (PA) glides were restricted throughout the cervical spine, and he presented with increased tone in muscles of the cervical spine and bilateral upper limbs. Assessments included ROM exams, peripheral joint scanning exams, and functional exams including functional outcome measures; visual analog scale (VAS) and Neck Disability Index (NDI). Due to neurological involvement, dermatomes, myotomes, DTRs, and special tests for TOS were also completed. Joint play of the cervical spine and palpation occurred prior to each treatment. Only positive special tests were reassessed post-treatment.

Using the Principles of Massage (Rattray & Ludwig, 2000, p.63-65), the participant was treated for ninety minutes each week for seven weeks using neuromuscular techniques, connective tissue techniques, static pressure techniques, proprioceptive neuromuscular facilitation (PNF) and passive stretching. The intent was to increase ROM, decrease pain and neurological symptoms, reduce muscle tone, and superior and inferior joint mobilizations to the clavicle bilaterally. The massage therapy students used assessments and palpation to arrive at a clinical impression that the participant's TOS was due to a decreased costoclavicular space.

At the end of seven weeks, the participant had increased ROM of the cervical spine, reduced pain, and restored DTRs. The participant reported improved sleep quality with no neurological symptoms when sleeping. At the final reassessment, three of four TOS tests were negative. These findings conclude that massage therapy may effectively treat symptoms of Thoracic Outlet Syndrome.

Objective: To determine if massage therapy is an effective modality to reduce thoracic outlet syndrome symptoms.

Methods: ROM, special tests, and neurological assessment were conducted on the participant. The visual analogue scale (VAS) and Neck Disability Index (NDI) outcome measures were used.

Results: DTR of the triceps (C7-C8) has returned to normal bilaterally (grade 2). Halstead, Modified Wright (Allen), and Adson special orthopedic tests are negative. There was an increase in cervical ROM and reduced neurological symptoms in the arm and hand were noted.

Conclusion: This study indicates that massage therapy may improve symptoms of thoracic outlet syndrome.

Keywords: Thoracic Outlet Syndrome, TOS, Massage Therapy, Scalenes, Costoclavicular.

Introduction

Thoracic Outlet Syndrome (TOS) is a unique condition in which specific structures compress the brachial plexus and subclavian artery producing symptoms in the neck, chest, arms and hand (Rattray & Ludwig, 2000, p. 825). The brachial plexus and subclavian artery travel between the anterior and middle scalenes, between the clavicle and 1st rib, posterior to pectoralis minor and into the axilla. These structures continue as the brachial plexus innervates the muscles of the upper limb. Due to their anatomical design, the brachial plexus and subclavian artery may be compressed between the anterior and middle scalenes, the clavicle and the first rib or pectoralis minor and the coracoid process of the scapula (Rattray & Ludwig, 2000. p. 825). Symptoms of TOS include paresthesia, pain, headaches, weakness, swelling, loss of pulse, and discolouration (Kisner and Colby, 2018, p. 404).

There are four types of thoracic outlet syndrome that individuals can suffer from: True Neurogenic, Disputed- symptomatic or nonspecific neurogenic, Vascular- Arterial, and Vascular Syndromes- Venous.

True Neurogenic TOS is rare and involves an anatomical deformity. Pain and paresthesia are experienced in the ulnar nerve pathway, accompanied by weakness and atrophy in the intrinsic hand muscles. A positive Electromyography (EMG) test confirms the diagnosis (Kisner and Colby, 2018, p. 402).

Disputed, symptomatic or nonspecific neurogenic TOS is the most common. It presents as True Neurogenic TOS; however, there is no evidence of anatomical abnormalities and no sign of muscle atrophy. EMG testing will be negative. Overhead activity, shoulder depression, or elevation of the shoulders aggravates symptoms. These symptoms are positionally aggravated and present while at rest or at night (Kisner and Colby, 2018, p 402).

Vascular - Arterial TOS is a rare condition caused by anatomical abnormalities. The axillary or subclavian artery is compressed (Kisner and Colby, 2018, p 402).

Vascular Syndromes - Venous TOS is caused by a different condition, such as thrombosis. This requires an immediate referral to a medical professional (Kisner and Colby, 2018, p.402).

Goodman and Fuller table 39.7(2021, p.1642) describes differences in Vascular TOS and Neural TOS Symptoms:

Vascular Symptoms	Neural Upper Plexus Symptoms	Neural Lower Plexus Symptoms
- Three-minute elevated test - Adson test - Swelling in the arm and hand - Discolouration of the hand - Costoclavicular and Hyperabduction test - Upper extremity claudication - Differences in blood pressure - Skin temperature changes - Cold intolerance	- Point tenderness of C5-C6 - Pressure over lateral neck elicits pain and/or numbness - Pain with head turned and/or tilted to the opposite side - Weak biceps, triceps, and wrist - Hypoesthesia in radial nerve distribution - Three-minute abduction stress test	- Pressure above clavicle elicits pain - Ulnar nerve tenderness when palpated under axilla or along the inner arm - Tinel sign for ulnar nerve in the axilla - Hypoesthesia in the ulnar nerve distribution - Serratus anterior and hand grip weakness

Due to the location of the musculature and structures involved in TOS, it is the objective of the massage therapy students to discover if massage therapy can reduce and improve the pain and neurological symptoms associated with thoracic outlet syndrome.

Methods

Patient Description:

The participant is a man in his forties who has worked labour-intensive jobs for almost two decades. His occupation, a gas technician, includes looking in a superior direction, with his neck in extension and his arms abducted above his head. He began experiencing pain and neurological symptoms from his neck into his chest, arms, and hands unilaterally two years ago. Soon after, this progressed into a bilateral issue. He experiences neurological symptoms in the radial, median, and ulnar nerve pathways bilaterally. The symptoms on his right side are more severe. Initially, he was diagnosed with TOS, but medical professionals changed their diagnosis. To determine the cause of his symptoms, he was thrown into the medical system for multiple tests and procedures. In 2021, he was misdiagnosed with fibromyalgia; however, after being referred to multiple health care providers, he connected with TOS specialists and was re-diagnosed with TOS.

The participant has received EMG testing for nerve conduction (the results were negative) and Magnetic resonance imaging (MRI) to detect possible structural abnormalities, such as an extra rib or an elongated transverse process (TVP); both were ruled out. One week prior to the first massage treatment, the participant received his second ultrasound-guided lidocaine injection in the scalenes and pectoralis minor, with no relief. The massage therapy students used special neurological tests such as the Adson maneuver, Halstead maneuver, Wright test and Modified Wright test (Allen) to form a hypothesis consistent with the TOS specialist's diagnosis of thoracic outlet syndrome. The location of the TOS compression is currently undiagnosed by a medical doctor; however, the participant reported that the doctor believes his TOS is a combination of Non-Specific Neurogenic and Vascular types. The massage therapy students' findings related to the participant's symptom picture coincide with the combination of Non-Specific Neurogenic and Vascular-Atrial TOS.

The participant is currently waiting for more testing and consultation for TOS surgery. After two years of disappointment and pain, he is currently also being treated for depression. His activity level has severely decreased, and he has been unable to work for eighteen months due to the pain and symptoms experienced during movement. He frequently experiences headaches and has difficulty sleeping due to the pain and neurological symptoms he experiences when lying down. His preferred position is seated, as it is the most comfortable. The participant reported all positions are painful and cause neurological symptoms bilaterally down his arms into his hands. The participant reported that he previously used acupuncture, physiotherapy, and chiropractic care as complementary therapies. Chiropractic and acupuncture were used for six months with little improvement in his symptoms. He participated in physiotherapy sessions for twelve months; however, the participant reported that physiotherapy aggravated his symptoms as time progressed.

Hypertension was noted during his first assessment, and he was referred to his doctor for further blood pressure testing. Modifications were made during treatment by the massage therapy students. He is not taking any medications for high blood pressure.

Upon initial examination, the massage therapy students observed an antalgic gait and guarded posture. Initial physical examination showed all cervical ranges of motion were reduced and painful. All TOS tests: Adson, Halstead, Wright, and Modified Wright; were positive, and DTR 7 / 8 were absent bilaterally (grade 0). The participant reported pain of 10/10 and frustration due to his experience with obtaining a diagnosis and surgery. During this study, he only received massage therapy at the student clinic once a week for two 60-minute appointments to manage his symptoms and completed the recommended homecare as tolerated.

Assessment Measures

The participant was evaluated using objective information such as: ROM, TOS special tests, neurological tests, functional outcome measures, and subjective information.

ROM:
Active Range of motion of his cervical spine was assessed in centimetres using a measuring tape. Measurements were taken before and after each treatment. The participant experiences pain and neurological symptoms with active and passive ROM. The participant has grade 5 resisted ROM in all ranges with pain in bilateral lateral flexion and rotation.
Passive ROM was assessed through PA glides, lateral challenges, and rotations before each treatment. Resisted ROM was assessed on a grading scale from zero to five before each treatment (Magee, 2014, p.39).

TOS Special Tests:
Special tests for thoracic outlet syndrome were used before and after each treatment. These included Adson, Wright, Modified Wright, and Halstead (Magee, 2014, p. 344-346).

Neurological Tests:
Dermatomes, upper limb myotomes, and DTRs of the biceps (C5), brachioradialis (C6), and triceps (C7, C8) were assessed at each appointment. Neurological tests yielding a positive result were reassessed after each appointment. No weakness was observed during testing; however, pain and neurological symptoms were reported by the participant in all ROM of each joint of the upper limb bilaterally.

Functional Outcome Measures:
The visual analog scale (Andrade, 2014, p.84) was used at the first, fourth and last appointment.
The Neck Disability Index (Magee, 2014. p.180) was used at his first and last appointment.

Practitioner Descriptors

The two massage therapy students involved in this study have no prior medical training. They are in their fifth semester at (removed) College, working under the supervision of a Registered Massage Therapist in the student clinic.

Therapeutic Intervention

During the initial appointment, an hour was given to go through a detailed and accurate health history. “In order to understand the full case, a therapist must include adequate time on intake in order to explore the issues that arise” (Andrade, 2014. p.31). Prior to the first treatment, the treatment plan and case study were discussed with the participant, and informed consent was obtained. The CMTO (2022) Standard 11 states the chest wall is a sensitive area, therefore special consent for treating pectoralis muscles was obtained for each treatment. The participant received two 60-minute appointments weekly, for a total of seven weeks, with 35 minutes during the first appointment dedicated to a thorough assessment. Due to limitations in scheduling, the participant was treated twice in one week and was not treated for one week. The plan of care consisted of nine weeks of appointments, but due to limitations was shortened to seven weeks. The goals of the treatment were to decrease pain, decrease neurological symptoms and increase cervical ROM.

The participant was treated in both side-lying and semi-reclined positions due to uncontrolled hypertension. Rhomboids, middle trapezius, levator scapulae, upper trapezius, and scalenes were treated in a side-lying position. The participant was then moved into a semi-reclined position to receive treatment on his scalenes, subclavius, pectoralis major and minor, biceps, triceps, forearm flexors, forearm extensors, and muscles of the hand. Connective tissue techniques, such as myofascial release and skin rolling, were used to decrease fascial adhesions in the cervical spine, chest wall and bilateral arms. In conditions such as TOS, myofascial release can assist in “improved alignment, balanced muscle function, enhanced quality and quantity of movement, and pain reduction through its direct treatment of the underlying dysfunction” (Andrade, 2014, p. 289). Neuromuscular techniques such as broad contact compression, effleurage, petrissage, and muscle stripping were used to decrease resting muscle tension (Andrade, 2014. p. 227). The massage therapy students identified multiple trigger points in the participant’s left middle scalenes each week and in the right middle scalenes in week five, with a classic referral pattern in his posterolateral arm and inferior to his first and second digit (Travell and Simons, 1983, p. 345). The trigger points were treated with specific compression and stretching techniques; hot hydrotherapy was avoided due to hypertension.

The massage therapy students used autogenic inhibition through proprioceptive neuromuscular facilitation (PNF) stretching to lengthen the bilateral scalenes. Latour et al. (2004. p.3) suggest that the muscle is lengthened slowly, to avoid the reflex contraction of the muscle spindle and promote new length and, therefore, improve range of motion. Bilateral passive stretching was used to assist in lengthening the shortened biceps brachii, pectoralis major and minor muscles. Stretching is indicated when “ROM is limited because soft tissues have lost their extensibility as the result of adhesions, contractures, and scar tissue formation, causing activity limitations or participation restrictions” (Kisner et al. 2018. p. 86). In week six, through assessments, palpations and subjective information, the massage therapy students hypothesized that the brachial plexus compression was in the costoclavicular region. The massage therapy students changed their approach by including superior and inferior costoclavicular joint mobilizations to create space in this region and complement the treatment. At this time, the joint mobilizations exacerbated the symptoms. In week seven, these joint mobilizations were performed again and were tolerated without exacerbating symptoms. In weeks six and seven, the therapists included specific compressions to the participant’s inferior scalene attachment at the first rib were used in conjunction with diaphragmatic breathing to create length and decrease tone in the anterior and middle scalenes.

Remedial exercise recommendations consisted of bilateral active-assisted stretching of pectoralis major and minor using a broom and active stretching of scalenes and biceps daily. Parameters for stretching were; a 30-second hold, three times a day, five days a week bilaterally. Walking or biking for 10 minutes each day was recommended to improve cardiovascular endurance. The participant had a negative experience with strengthening during physiotherapy, therefore, we avoided this component

during the plan of care. No referrals were made regarding his TOS during the plan of care as the participant is currently under the care of a specialist.

Results

The participant attended each appointment that was scheduled. This consistency possibly contributed to his gains throughout his plan of care. Rattray and Ludwig (2000, p.840) suggest that initially, appointments should be scheduled twice a week and then tapered off to once a week. Due to limitations in scheduling, this was not possible. Future studies should consider this initial increased frequency.

Initially, interventions were painful but tolerated by the participant and pain was monitored by the massage therapy student

s with a pain scale. After the first treatment, his residual pain did not decrease until four days post-treatment. Gradually, with each treatment, his residual pain was experienced for fewer days.

The participant was advised to stretch the scalenes, pectoralis, and biceps daily. In addition, 10-minute cardiovascular exercise was recommended daily. The participant could only tolerate 10 minutes of exercise before experiencing pain 10/10 and exasperating neurological symptoms. His cardiovascular activity was walking or biking on a stationary recumbent bike. He reported being able to complete homecare on some days and had difficulty on other days due to pain.

No TOS referrals were made; however, he was referred to his family doctor for hypertension. No adverse events occurred during this case study. The only unexpected event that occurred was a limitation in the schedule that shortened the plan of care from the scheduled nine weeks to seven weeks. More information is provided under limitations.

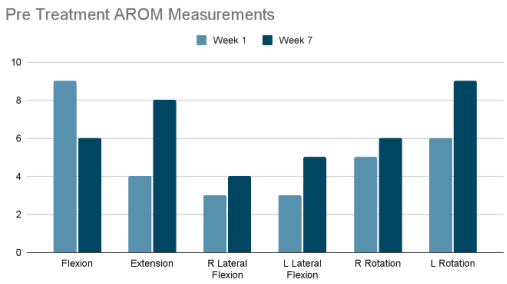
Major notable changes were an increase in cervical spine ROM noted post-treatment each week, abnormal/ absent deep tendon reflex (DTR) returning to normal, Adson, Halstead, and Modified Wright becoming negative throughout the treatment. Through observations, improvements were noted in the participant's posture and gait. He was able to fill out a form without needing to stop and bring it closer to his chest. The participant reported feeling less pain in the chest and arms and being able to sleep better because he no longer experiences neurological symptoms while lying down.

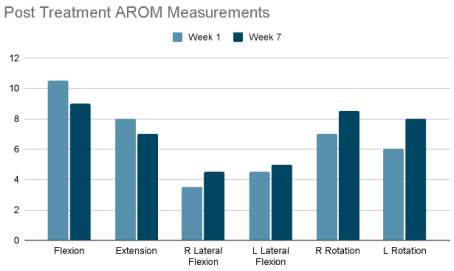
Range of Motion:

A notable increase in cervical spine ROM was observed.

AROM:

Active ROM	1st Appointment	4th Appointment	7th Appointment
Flexion	Pre - 9 cm with P Post- 10.5 cm	Pre - 6 cm Post- 9.5 cm	Pre - 6 cm Post- 9 cm
Extension	Pre - 4 cm with P Post- 8 cm	Pre - 8 cm Post- 12 cm	Pre - 8 cm Post- 7 cm
R Lateral Flexion	Pre - 3 cm with P Post- 3.5 cm	Pre - 4 cm Post- 5 cm	Pre - 4 cm with P Post- 4.5 cm
L Lateral Flexion	Pre - 3 cm with P Post- 4.5 cm	Pre - 4 cm Post- 6 cm	Pre - 5 cm Post- 5 cm
R Rotation	Pre - 5 cm with P Post- 7 cm	Pre - 9 cm with P Post- 10 cm	Pre - 6 cm P Post- 8.5 cm
L Rotation	Pre - 6 cm Post- 6 cm	Pre - 10 cm with P Post- 8 cm	Pre - 9 cm Post- 8 cm





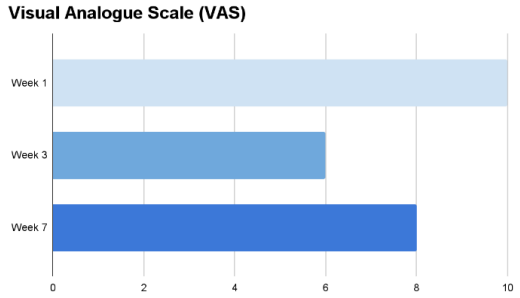
PROM:
Throughout the study, the massage therapy students observed a pattern developing during passive range of motion. PA glides initially caused pain and restriction in the superior cervical spine (C1-C2). In weeks four through seven, pain and restriction were noted in the inferior cervical spine (C5-C7). Initially, the massage therapy students noted a restriction during bilateral lateral challenges in the superior cervical spine (C1-5). In weeks four through seven, the therapists noted a restriction in the inferior cervical spine (C4-7). TVP rotation restriction and pain were inconsistent, with locations changing weekly.

RROM:
No weakness was observed during resisted ROM consistently throughout the study.

TOS Special Tests:
At the initial assessment, the participant had positive Adson, Halstead, Wright and Modified Wright (Allen) tests. After the initial treatment, Adson and Halstead tests were negative at reassessment and remained negative before and after the seven treatments.
During the reassessment in week seven, the participant had a negative Modified Wright test on the more affected side (right side) with a stable pulse observed by both massage therapy students. This was the first time the pulse had remained stable during right GH abduction of 90 degrees.

Neurological Testing:
At the initial examination, DTR's C7-C8 were absent bilaterally. Week seven was the final appointment where DTR's C5-C8 were assessed. C7-C8 demonstrated an improvement with a bilateral grade 2 result. Throughout the study, all myotomes have remained grade 5. The participant did not experience weakness during myotome testing.

Functional Outcome Measures:
Visual analogue scale (VAS): VAS was completed in weeks one, three, and seven. In week one, the participant presented with 10/10 pain on the outcome measure. In week three, the participant presented with 6/10. In week seven, the participant scored 8/10.



Neck Disability Index (NDI): The participant's score was unchanged during weeks one and seven using the NDI. Although the raw score remained the same, the numbers differed in certain sections. In week seven, pain intensity, personal care, and work score decreased.

Activities of Daily Living (ADL):
Due to pain and neurological symptoms, the participant is unable to perform various activities of daily living. The participant reported examples of affected ADLs as only being able to drive for half an hour without experiencing 10/10 pain, being unable to vacuum without needing to take a break after three minutes due to pain and neurological symptoms and having difficulty washing his hair. During the first appointment, the massage therapy students observed the participant reach forward to sign a consent form. He stopped and brought it towards him, due to the pain the arm flexion was causing him. During the sixth appointment, the participant signed another form; however, no positioning adjustments needed to be made. These observations were discussed with the participant. He reported feeling that he was able to complete this task without adjusting his position due to pain. During the week five assessment, the participant reported that his bilateral arms and chest felt better and that the pain was isolated to his scalene muscles. He also reported no longer experiencing neurological symptoms when lying down leading to better sleep.

Gait and Posture:
In week five, the massage therapy students noted a significant improvement in the participant's gait and posture.

Discussion

Comparison and Integration of Literature

The results from this study suggest that massage may be effective in the reduction and improvement of the pain and neurological symptoms of TOS. The participant's ROM increased following each treatment, improvements in DTRs and special tests were noted at the conclusion of this study. Functional outcome measures, VAS and NDI, indicate improvements in ADL's. The participant reported noticing an improvement in ROM and a reduction in symptoms. Muscolino states, "The therapy approaches for the types of TOS also follow directly from an understanding of the mechanism of the condition" (Musolinco, 2006, p.171). The participant had not been diagnosed with a specific type of TOS or compression location; therefore, the massage therapy students treated all areas of possible compression (retropectoralis minor space, scalene triangle, costoclavicular). In week six, the massage therapy students hypothesized that the location of compression was in the costoclavicular space. Factors influencing this hypothesis were; an improvement in pectoral pain, a diminished pulse only during GH abduction at 90 degrees or greater and subjective information during treatment. The massage therapy students adjusted techniques to focus on the costoclavicular area to improve the length and tone of the scalenes. Specifically in their inferior attachments at the first rib and to mobilize the clavicle to create space in this area.

Other notable findings were the presence of trigger points palpated weekly in the left middle scalene muscles and the right middle scalene muscles on weeks five through seven. The trigger points were assessed based on a nodule within a taut band, tenderness, and a referral pattern. The participant had previously received ultrasound-guided lidocaine injections in his scalene and pectoralis muscles. In 2018, Douglas published a case study involving a participant with TOS. Her focus was on trigger point therapy for the muscles that had been treated with lidocaine (Douglas, 2018). No relevant literature was found to correlate lidocaine injections as causation of trigger points. The only information found in the use of lidocaine injections was to decrease trigger points. The presence of trigger points in the participant's scalenes and the Douglas' participant calls for future investigation on the association between muscles treated with lidocaine injections and the presence of trigger points in these muscles.

After the participant's initial diagnosis with TOS, he saw a physiotherapist for twelve months. He was not receiving any relief and reported finding that exercise made his symptoms worse. Thevenon et al, (2020, p.546) discuss clients with TOS who had no success with private practice physiotherapy. In a study, they tried another approach that included: strengthening, stretching, diaphragmatic breathing, "postural correction, passive mobilization of the cervical spine and the scapula, and relaxation of the neck and shoulder muscles". In this study, GH joint flexors and neck muscles were strengthened using isometric contractions, followed by stretching to pectoralis major, biceps, scalenes, sternocleidomastoid (SCM), and subscapularis. In order to decrease tone, the neck and shoulder muscles were treated with massage. "The occupational therapy programme included postural training in symptom-triggering situations, adaptation of the work environment, and changes in activities of daily living" (Thevenon et al, 2020, p.546). Three months after the study concluded, 80% of the participants experienced a reduction in symptoms. 25% of the participants opted for TOS surgery after the rehabilitation program; the reason is unknown.

The authors of the case study believe that a systematic approach to incorporating massage therapy with physiotherapy can yield successful results by decreasing tone using massage techniques and incorporating stretching first to increase the space where compression is located. Once this space has been created, adding strengthening exercises to improve posture and gait should be included with remedial exercise. A referral to an occupational therapist may help improve biomechanics and workplace ergonomics to decrease the risk of increased brachial plexus compression. Further investigation as to a specific approach in treating TOS with combined therapies to reduce tone, lengthen muscles and create space for the nerves and vasculature would be favourable.

Rationale for Observed Outcomes

The improvement seen in the participant's posture and gait may have been due to decreasing tone on the pectoral muscles allowing for his bilateral GH joints to return to a neutral position. The treatment included techniques to reduce tone in the biceps, brachioradialis, and triceps; thus, possibly decompressing the radial nerve and allowing the deep tendon reflexes (7/8) to fire. No relevant literature was found to associate these findings. The massage therapy students primarily focused on the scalenes and pectoral muscles. Relieving the tone, lengthening the muscles and creating space for the underlying structures may have relieved the compression in the costoclavicular area. It is proposed that this increased costoclavicular space led to the negative Adson, Halstead, and Modified Wright tests.

Strengths

The study's strengths were the consistency of the treatments, detailed assessments, and the ability to adjust the treatment to achieve the best possible results. It is possible that these strengths led to increased cervical spine ROM, increased ability of daily tasks, and decreased pain and neurological symptoms.

Limitations

Limitations were based on scheduling conflicts. Ideally, the participant would have received weekly massages. He was treated twice in one week to avoid missing two weeks due to scheduling. In addition, due to unforeseen circumstances, the participant was unable to attend the clinic in the last weeks to complete his plan of care, limiting the treatment and, therefore, data.

Patient Perspective

The participant reported having a pleasant experience and commented on how professional and thorough the massage therapy students were. He was excited and relieved to see progress as this was his first time seeing any improvement in his neurological symptoms in two years. He reported being surprised in week seven when the Modified Wright test was negative post-treatment.

He communicated that he found it difficult to complete his daily home care due to the severity of pain it caused. ADLs were improved on a minor level, and he was pleased with better sleep quality, and temporary relief of pain and described his biggest improvement as neck mobility.

He discussed that the only negative aspect of his care was that his treatments were only once a week and that he may have benefitted from receiving two treatments each week.

When asked if he would recommend massage therapy to other TOS clients, he stated that he would. He has noticed an increase in his symptoms as he has not received treatment since the conclusion of this case study. He explained that although the massage therapy students had less education than the professionals that he had seen prior to the case study, he felt that the massage therapy students were more knowledgeable about his condition.

Since the conclusion of this case study, the participant has been under the care of a TOS specialist. Through imaging, the location of the compression was confirmed at the costoclavicular space compressing the brachial plexus, subclavian artery and the subclavian vein. He is currently waiting for a bilateral first rib resection. The participant plans to continue with massage therapy post-surgery.

Takeaway Lessons

The massage therapy students agreed that the VAS would have been a useful outcome measure to use pre and post-treatment. This would have provided additional information to be included in the study. Using the VAS would have tracked the participant's progress weekly.

Implications for Future Research

The results from this study indicate that massage therapy may be effective in improving ROM and managing symptoms of thoracic outlet syndrome. Each case of TOS is unique, and future studies should be conducted to validate these results.

Implications for Clinical or Massage Therapy Education

TOS is a condition that is typically difficult to diagnose. Currently, surgery is the treatment of choice for TOS within the medical community. Due to the long wait for specialists, medical screening and surgery, massage therapy could be used as an alternative to help reduce symptoms of thoracic outlet syndrome.

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