Clinical Case Report Competition

West Coast College of Massage Therapy, Victoria Campus

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Reduction of arm pain in 23 year old female mixed martial artist with suspected thoracid outlet syndrome using massage therapy

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Reduction of arm pain in 23 year old female mixed martial artist with suspected thoracic outlet syndrome using massage therapy: A case report

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Conflict of Interest and Consent Notification Page

To the author's knowledge, no conflict of interest exists.

Informed consent was received from the patient prior to treatment. No personal information was revealed in the production of this paper.

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Abstract

Objective- Is massage therapy effective in reducing pain and discomfort in the arm of a 23 year old female mixed martial artist with suspected thoracic outlet syndrome?

Clinical features- 23-year-old female professional mixed martial artist who experienced pain, numbness, tingling and a sensation of heaviness when retracting punches with her right arm presented for massage therapy treatment. Symptoms were experienced when the subject used the arm and increased with level of activity.

Methods- Subject was treated eight times over a period of three months. Techniques used included myofascial release techniques, trigger point release, stretching, and general Swedish massage[1,2,3,4]. Recommended homecare involved daily stretching of subscapularis, pectoralis major, pectoralis minor, sternocleidomastoid and scalene muscles bilaterally and cold hydrotherapy to the affected area after training.

Results- A decrease in the patient's primary symptoms of numbness and tingling in her right upper extremity was reported after each treatment from treatment four onwards. The subject's available glenohumeral joint and cervical spine range of motion increased in several directions. Pectoralis minor length was increased. An increase in fascial mobility was palpated.

Conclusion-Massage therapy appeared to be helpful in reducing the primary symptoms experienced by the subject in this case.

Key words: massage therapy, thoracic outlet syndrome, mixed martial arts

Introduction

Mixed martial arts (MMA) is a full-contact combat sport that allows participants to draw from multiple fighting disciplines, including kickboxing, wrestling, and Brazilian Jiu Jitsu to defeat their opponent. The sport can be broadly divided into "ground" and "stand up" activities. The rules applied to each individual fight are often varied depending upon local regulations, the organization promoting the event and the local athletic commission. Fights are commonly organized as a set of three, five minute long rounds and played out most commonly in fenced octagons known as cages. A fight can end in a number of ways. Fights are sometimes ended by knockout. This is either a "technical knockout" where the mixed martial artist or fighter can no longer continue, or when a fighter is knocked unconscious. Fights can also be ended by a submission (where a fighter submits verbally or by tapping three times), or by a referee or, doctor or by corner stoppage (an official or team member stopping the fight out of concern for their fighter's wellbeing). If the following do not occur, fights will end when a pre-determined time runs out [5].

The sport of mixed martial arts is reported to be one of the fastest growing sports in the world, with gyms specializing in the sport opening up worldwide[5].

The sport of MMA is extremely physically demanding, especially at a professional level. A competitive athlete in MMA needs to be extraordinarily fit to cope with the multi-faceted physical demands of fighting. Today most professional fights are scheduled as three, five minute rounds. To the inexperienced bystander, three, five minute rounds may not sound difficult; however, fifteen minutes of one-on-one combat often requires fighters to use every ounce of physical strength, mental fortitude, and cardiovascular endurance.

To be successful, a mixed martial artist needs to excel in many physical dimensions; speed, strength, power, anaerobic endurance, agility, and flexibility. A high level of mental strength is also required for the athlete to maintain composure and successfully use their skills, under the physical and mental stress of combat while being watched by potentially thousands or even millions of spectators.

Minimizing the effects of injury is exceptionally important to a mixed martial artist, not just in terms of their physical performance, but in terms of their psychological hardiness. Mixed martial artists will tell you that a strong, confident mindset is an essential part of any winning fight strategy. With any sport a solid mental state is important, especially if you are the only one on your team and your opponent's goal is to render you unconscious or submissive, as fast as possible.

Mixed martial arts fights are frequently subject to erratic scheduling changes; with fights being changed, delayed, or cancelled altogether. With the high frequency of injuries occurring in the sport, it is common for fighters to back out of an event on short notice. This also means that another fighter may have an opportunity to take an available fight on short notice. Pre-fight conditioning and training leading up to an event under ideal circumstances takes at least six to eight weeks. Due to the variable nature of the sport, fighters are required to stay "fight ready" for extensive lengths of time, which can be physically and mentally draining.

Of particular importance is that there is no designated off-season for the sport of MMA. Therefore training does not follow periodization similar to other sports and may result in an increased likelihood of injury.

MMA requires the subject to constantly perform repetitive actions that stress the shoulder girdle such as punching. The muscles of the cervical spine are also frequently and significantly stressed by the sport, for example when the athlete is impacted by a punch, slammed down onto the canvas floor of the cage, or choked out by a submission hold.

The posture most commonly assumed by fighters to allow for the most physical protection requires shoulder forward posture, capital flexion, as well as internally rotated shoulders and a stance with one foot predominantly ahead of the other, resulting in unequal stresses to each side of the body, both laterally and anterior to posterior.

Fighters experience many different sports-specific injuries due to the tremendous multi-faceted physical stresses of MMA. The upper extremity of fighters regardless of trauma, is at particular risk of compromise, due to its anatomical vulnerability of both vascular and neurological structures as they exit the trunk, as demonstrated in figure 1.

Figure 1. A Basic Choke-hold used in MMA, a "Rear Naked Choke" (Author's photo)

The costoclavicular space in particular may become narrowed during combined arm abduction, retraction of the scapula (as when retracting a punch) and elevation of the first rib with inspiration[4]. The subclavius muscle may play a role in compression at this location with its primary action being to depress the clavicle, potentially further compressing the available space [4]. This situation may bring on symptoms in the upper extremity commonly referred to as thoracic outlet syndrome.

Thoracic outlet syndrome (TOS) is a broad diagnosis indicating compression or irritation of the brachial plexus or subclavian vessels and associated lymph vessels at one or more of the four sections of the thoracic outlet [6]. Thoracic outlet syndrome has been reported to be due to primarily a vascular compression, or a neurological compression or a combination of both. The mixed etiology leads to a varied collection of signs and symptoms [4].

The brachial plexus forms as it emerges from the lateral neck. Along with the subclavian artery and vein, the brachial plexus passes through the anterior and middle scalene also known as the scalene triangle. It travels between the clavicle and first rib through the costoclavicular space and the sternocostovertebral space. It finally passes posterior to pectoralis minor through the coracopectoral space [6]. The brachial plexus and associated vascular structures may be compressed at any of these locations.

There are many different causes of thoracic outlet syndrome. Common causes of thoracic outlet syndrome include; hypertonicity of the anterior scalene, middle scalene or pectoralis minor muscles, the presence of a cervical rib, compression between the first rib and clavicle, and inflammation[4].

Thoracic outlet syndrome is more common in women [7]. Factors that increase an individual's likelihood of developing thoracic outlet syndrome include postural abnormalities, thickening of the clavicle, weight training with increased muscular bulk in the thoracic outlet area, and obesity [8,4]. Activities that continually stress the muscles of the neck, or involved repetitive overhead movements can also contribute to TOS [7].

TOS can lead to a debilitating loss of function of the upper extremity, resulting in the affected individual being unable to perform tasks related to daily activities, particularly if they involve overhead movement [7].

Symptoms and signs of thoracic outlet syndrome may be bilateral or unilateral, and presentation varies depending on which structures are being compressed[6]. Primary symptoms include pain and paresthesia throughout the upper limb, primarily in the shoulder, and into the forearm and hand, but may also be experienced in the neck, chest or head[4]. Trigger points are commonly present in the involved muscles and will be similar to the brachial plexus compression symptoms [4]. Weakness may be found in muscles of the hand. Symptoms of vascular compression include pain and pallor, potential cyanosis, a sense of coldness in the affected limb. If lymphatic compression is occurring, edema may be experienced in the hand, and the patient may notice puffiness upon waking [4].

The patient may exhibit head forward posture, hyperkyphosis, wasting of intrinsic hand muscles, difficulty gripping, pallor, edema, and coolness of the hand[4]. Fascial restrictions may be palpated on the anterolateral neck, shoulder and upper arm[4].

A diagnosis of thoracic outlet syndrome is commonly determined by clinical presentation[8]. A thorough review of the patient's health history and a careful physical examination are essential to diagnosing TOS[7]. Another important component of diagnosing TOS is ruling out other potential pathologies of the cervical spine and shoulder, such as; cervical nerve root pathologies, Raynaud's disease, carpal tunnel syndrome, pronator teres syndrome, ulnar nerve compression, lesions of the rotator cuff, or osteoarthritis [7,4]. Determining the correct source of the compression or irritation is crucial to an effective treatment of TOS.

Common medical treatment for TOS depends on the etiology, which is often difficult to determine[7]. Conservative forms of treatment include; stretching and strengthening involved muscles, skeletal manipulations, massage therapy (specifically myofascial release, muscle stripping, and trigger point release therapy), hydrotherapy, electrotherapy, activity modification, cervical collar, and acupuncture[8]. If conservative treatment fails to improve the patient's condition after several months, surgical interventions may be considered.

One common surgical intervention involves removing or dividing portions of the indicated anterior or middle scalene muscles, in a procedure known as a scalenectomy[9]. A scalenectomy is often performed in conjunction with another surgery known as a rib resection that involves removing a segment of one or more ribs, generally the first rib or a cervical rib[9, 10]. Results of surgical interventions for thoracic outlet syndrome are mixed, with about thirty percent of patients experiencing a reoccurrence of symptoms [9].

Surgical interventions for TOS may lead to devastating damage to the brachial plexus, therefore most sources recommend that conservative forms of treatment be used for approximately three to six months[7,8].

The objective of this paper is to outline the clinical presentation and massage therapy treatment of a female mixed martial artist with suspected thoracic outlet syndrome.

Clinical Presentation

A 23-year-old female professional mixed martial artist presented to a massage therapy college clinic complaining of a burning pain around the bicipital groove of her right arm that occurred when punching with that arm. Retracting the punch caused the subject the most pain, with the arm feeling "numb and heavy", with the sensation of numbness and burning radiating down into her hand if the activity was continued. The subject was right hand dominant.

If the subject continued punching with that arm, the burning pain continued to worsen, and a sensation of numbness and burning radiated down into her hand. The subject's also reported her arm feeling "lethargic and heavy" in a manner that doesn't seem to correlate to how tired her muscles should have felt. The pain worsened if she started to punch faster. She notes that certain movements "feel pinched" and she "loses strength in certain directions".

The pain started seven years ago, when the subject began training in mixed martial arts, and has become progressively worse. The pain increases with the time spent training. The pain was experienced daily with training.

The subject also reported swelling in her wrists upon waking some mornings.

Health History

The subject has not had any other significant previous injuries or surgeries.

Resting and cold applications help to relieve her shoulder pain. The patient did not take any medications for the complaint. She received a cortisone injection into her right glenohumeral joint over one year ago for the same complaint with no resulting improvement.

Concurrently the subject saw a physiotherapist approximately once per week for a groin strain, iliotibial band pain, and shoulder pain. Treatment at the physiotherapist consists of intramuscular stimulation, ultrasound and cupping to the affected areas.

Physical Examination

A postural examination revealed moderate bilateral shoulder forward and head forward posture.

Range of motion testing at the shoulder revealed decreased ranges of motion of both shoulders when compared to commonly accepted normal ranges. When compared to the left shoulder, the right shoulder had a decreased range of motion available in every range except extension (Table 1). Strength was minimally decreased in abduction in both shoulders and painful with the right shoulder. Strength was also minimally decreased in flexion and internal rotation in the right shoulder (Table 2).

Table 1 -Range of Motion at Initial Assessment – Glenohumeral joint (With Abnormal Highlighted)

Motion	Normal Value[11]	Active ROM		Passive ROM	
		Left	Right	Left	Right
Flexion	160-180°	150°	140°	150°	140°
Extension	50-60°	30°	30°	30°	30°
Abduction	170-180°	160°	130°	160°	145°
Adduction	50-75°	25°	15°	25°	15°
Internal rotation	60-100°	35°	60°	35°	60°
External rotation	80-90°	20°	30°	25°	35°
Horizontal adduction	130°	125°	130°	125°	130°

Table 2- Resisted Shoulder Joint Range of Motion Initial Assessment (With Abnormal Highlighted)

Motion	Left		Right	
	Grade	Pain	Grade	Pain
Flexion	5	0	4	3
Extension	5	0	4	0
Abduction	4	0	4	4
Adduction	5	0	5	0
Internal rotation	5	0	4	0
External rotation	5	0	5	0
Horizontal adduction	5	0	4	3

Table 3-Manual Muscle Testing Initial Assessment (With Abnormal Values Highlighted)

Strength (Grade 0-5) (see Appendix 1)	Left	Right

Latissimus Dorsi	5	5
Subscapularis	3	3
Supraspinatus	5	5
Infraspinatus/ Teres minor	5	5
Serratus Anterior	5	5
Biceps Brachii	5	5
Teres Major	4	5
Lower Trapezius	4	4
Middle Trapezius	5	5

Manual muscle testing revealed weakness bilaterally in the subscapularis muscle, the subject was able to keep her hand off her low back , but not able to resist pressure. The subject noted pain with muscle testing of the right supraspinatus muscle but no loss of strength was found on either shoulder. Biceps brachii, latissimus dorsi, infraspinatus, teres minor, serratus anterior, teres major, and middle trapezius muscles were all normal for muscular strength and no pain was reported.

Pectoralis minor Skyline Test involves measures of the distance between the patient's acromion process and the table top while lying supine [4]. This test revealed a distance of four inches on the left, and five inches on the right between the subject's acromion process and the table.

The subject's cervical spine active range of motion was also assessed, with flexion and extension within normal ranges. Side flexion and rotation were reduced compared to normal accepted values, but both sides were equally reduced compared to each other. Thoracic spine ranges of motion were all within normal ranges.

Palpation revealed hypertoned upper trapezius muscles bilaterally. Assessment of the subject's fascia revealed a great deal of fascial restriction throughout the entire shoulder girdle. A sensation of fascial "stickiness" was noted by the examiner.

The fascia demonstrated decreased mobility in all directions, over the patient's upper back, upper chest, anterior, lateral and posterior neck.

On the fourth visit, the subject was reassessed due to the suspicion of thoracic outlet syndrome. Adson's test, was performed by having the seated patient face

toward the side to be tested, slightly lift the chin, hold a deep breath for approximately fifteen seconds while the examiner extended and slightly externally rotated the patient's affected arm[4]. The examiner monitored the patient's radial pulse on the affected side at the wrist. This test intended to assess for compression of neurovascular structures by the anterior scalene muscle[4]. The patient experienced a recreation of symptoms in the form of numbness and tingling on the affected side. When the test was performed on the right side, the patient experienced numbness and tingling down her shoulder, into her forearm and third finger on the anterior surface of her hand.

Travell's variation on Adson's test was used to assess for compression by a hypertoned middle scalene muscle[4]. This test was performed in the same way as Adson's test described above, with the only difference being that the patient was asked to rotate her head away from the side to be tested[4]. When the test was performed the patient experienced a sensation of numbness down the anterior side of her right shoulder.

Wright's hyperabduction test to check for compression by the pectoralis minor muscle was unremarkable. The test was performed by asking the patient to abduct her arm on the side to be tested as far as possible[4]. The examiner monitored the radial pulse at the wrist as the arm was then brought into slight extension[4].

Costoclavicular test assessing for compression occurring between the clavicle and first rib, was performed by monitoring the subject's radial pulse as the shoulder on the affected side was passively depressed and retracted [4]. When the test was performed on the left, the subject reported numbness and tingling down the lateral forearm and into the third finger on the left side. When the test was performed on the right, the subject reported numbness and tingling into the anterior shoulder, lateral forearm and into the third finger on the right side.

The patient noted that any movements involving depression of the shoulder girdle or rotating her head to its end range increased neurological symptoms.

Since the primary complaint involves symptoms of vascular and nerve compression, scalene muscle and costoclavicular compression of the shoulder girdle structures was suspected. Palpation of the muscles of the anterior neck,

along with noticed head forward posture and internally rotated shoulders support this possibility.

Shoulder and head forward posture, fascial restrictions over the shoulder girdle, and a recreation of symptoms with Adson's, Travell's, and Costoclavicular

orthopaedic tests, are all findings consistent with presentation of thoracic outlet syndrome[4]. Swelling in the hands upon waking and the onset of symptoms also point towards thoracic outlet syndrome. More specifically, these signs and symptoms potentially point towards concurrent presentation of scalenes anticus syndrome, scalenus medius syndrome, and costoclavicular syndrome, all categories of thoracic outlet syndrome that indicate the source of the compression (anterior scalene, middle scalene or costoclavicular space)[4].

Differential Diagnosis

Initially a myotendinopathy of one or more muscles of the shoulder girdle was suspected due to the patient's description of a "burning pain" down the anterior shoulder on the right side, the patient's posture, the location of the pain, and the repetitive sport-specific movements. The suspected etiology was increased load on the musculotendinous unit.

The biceps brachii muscle was assessed bilaterally using manual muscle testing, Speed's test, and a Hyperextension test [11, 8]. Manual muscle testing showed normal strength and no pain on either side.

Speed's test was performed by having the patient resist the examiner's pressure while standing and flexing a straight arm, first with the forearm in pronation and then with the forearm in supination. When this test was performed, pain was elicited in the patient bilaterally at the bicipital groove with forearms pronated and flexed to approximately sixty degrees. As the patient only experienced a recreation of symptoms with the forearm pronated, the test was deemed inconclusive.

Having the examiner passively extend the patient's elbow from a position of arm extension and elbow flexion, therefore stretching the biceps brachii, was considered the hyperextension test. This test was unremarkable.

An assessment of the stability of the transverse humeral ligament stability by performing Yergason's test, was also negative bilaterally[11]. The test was performed by having the patient supinate and externally rotate against the examiner's pressure while stabilizing her elbow against her own thorax. The examiner palpated the tendon of the long head of the biceps brachii while test was being perfomed. The results of this assessment largely rule out any significant involvement of the biceps brachii muscle.

Supraspinatus was assessed bilaterally with manual muscle testing and by performing the Empty Can test as described by Magee[11]. Manual muscle testing revealed normal strength bilaterally. When the Empty Can test was performed on the right, the patient noted that the sensation of pain was similar to the pain she

usually experienced. Results of the Empty Can test on the patient's left side were unremarkable.

Subscapularis was assessed using manual muscle testing. This testing revealed weakness bilaterally with the subject unable to resist examiner's anterior pressure with her hand away from her low back. This manual muscle test was assigned a grade three.

Neer's Impingement test and the Hawkins-Kennedy Impingement test were performed bilaterally as described by Magee, and results were all unremarkable[11]. Shoulder impingement syndrome was deemed unlikely to be the source of the patient's primary complaint by unremarkable test results bilaterally for both Neer's Impingement test and Hawkins-Kennedy impingement test.

A myotendinopathy was less likely to be the main source of the subject's primary complaint due to the findings of the assessment, and also due to the delayed onset of the subject's symptoms.

In this case, there may be many muscles and other structures involved with the subject's primary complaint.

Many myofascial trigger points refer into all or part of the area of the subject's described pain pattern; anterior shoulder down into the hand. These muscles include; supraspinatus, infraspinatus, subclavius, pectoralis minor, pronator teres, scalenes and biceps brachii.

The subject's health history, combined with assessment and palpation suggested that an overuse myotendinopathy of the subject's right biceps brachii, subscapularis and supraspinatus muscles was present in combination with compression of nerves and vasculature due to hypertoned scalene and pectoralis minor of the right side.

A nerve root pathology of the cervical spine was ruled out based on the fact that the subject's pain and discomfort is not constant.

Spurling`s Test, was performed by having the seated patient slowly extend, side bend and rotate the head to the affected side[4]. The examiner then applied a downward pressure[4]. The subject reported feeling a local "achy" sensation in her neck on the side opposite the side being tested, bilaterally.

Treatment

The subject was treated eight times over a three month period. The primary goal for treatment was to decrease the subject's pain during sport specific activities,

specifically retracting a punch with the right arm. Each treatment was an hour and ten minutes in length.

Specific treatment goals involved decreasing fascial restrictions in the shoulder girdle, treating trigger points referring into the area of the subject's pain, decreasing hypertonicity in affected muscles, and increasing the length of shortened muscles.

Treatments one through three initially focused on decreasing the subject's pain through primarily decreasing hypertonicity and myofascial adhesions in the subscapularis, supraspinatus and biceps brachii muscles.

Core elements of treatments 1-3

Subject was primarily treated in the supine position. The following is a description of treatment to the specific muscles:

- Subscapularis

  Myofascial release work was performed over the subscapularis muscle bilaterally at the beginning of treatment. Therapist used a small amount of oil around the axilla to allow tissue glide. Therapist stood facing supine patient used thumbs aligned with the wrist, elbow, and shoulder joint, and applied sufficient pressure to reach the subscapularis muscle, between the scapula and the subject's ribs. When tissue resistance was palpated, the therapist waited to feel a release, then progressed to the next barrier.

  Muscle stripping of the subscapularis was also performed from this position to decrease adhesions[13]. Myofascial release and muscle stripping techniques were performed on the subscapularis muscle bilaterally.

- Supraspinatus

  Muscle stripping, attachment release and trigger point release techniques were all used on the supraspinatus muscle[13, 2,2].

- Biceps Brachii

  Petrissage, golgi tendon organ release (GTO release), cross-hands myofascial release over anterior shoulder, muscle rolling, myofascial release- fascial stripping over biceps long head tendon [13,4, 1].

In addition to the core treatment described above, additional structures were also treated and modalities employed.

Treatment 1- Anterior, posterior and abduction elevation glide joint mobilization techniques were performed bilaterally on the patient's glenohumeral joints

bilaterally to increase the patient's range of motion [14]. Grade 2 mobilizations were used, mobilization was held between 30 seconds to one minute. The pectoralis major and minor muscles were stretched bilaterally[3]. Muscle stripping was applied to the scalene muscle group and subclavius muscle bilaterally[13].

Treatment 2- Petrissage was used on the teres major, teres minor, and latissimus dorsi muscles[13]. Pectoralis major and minor muscles were stretched. Trigger points in the subclavius muscle were released[2].

Treatment 3- Myofascial release techniques (described later under treatments 4-7) were used on the teres major, teres minor and latissimus dorsi muscles. The myofascial release technique skin rolling was used over the patient's upper trapezius muscles [13]. Muscle stripping was performed on the patient's subclavius, pectoralis major, and pronator teres muscles[13]. The patient's pectoralis minor muscles were stretched by having the therapist cross arms, placing one palm on each shoulder of the supine patient and apply a lateral and downward pressure.

Treatment 4- At the fourth treatment, further assessment indicated likely compression of neurovascular structures at the costoclavicular space and scalene triangle.

Treatments four through seven shifted focus away from treating the biceps brachii, subscapularis and supraspinatus muscles as the primary cause of the subject's pain and discomfort. The focus of treatment became reducing hypertonicity in the subject's scalenes, reducing shoulder forward posture, and reducing fascial restriction throughout the shoulder girdle.

Core of treatment four through seven

Myofascial release was used throughout the entire shoulder girdle region. The subject was started prone. Therapist stood to the subject's side, facing cephalad, supporting the subject's closest arm. The therapist's other hand was used to "pin down" fascia, then move the subject's arm away from the pinned tissue, thereby stripping the fascia. This technique was performed very slowly and used over the subject's latissimus dorsi muscle up to the deltoid attachment on the humerus, bilaterally. This technique was also used while the subject was positioned supine, over the scalene muscle group bilaterally. The therapist would support the subject's head with one arm, pin down fascia over the anterior neck with the other

fingers and rotate the head away from the pinned tissue to facilitate a fascial release. This technique was also used over the patient's pectoralis major attachment onto the humerus while supine. The therapist stood facing the patient while supported the patient's arm with one hand and anchoring into the

attachment of pectoralis major on the humerus with the other hand. The patient's arm was moved slowly and passively while pressure was applied to facilitate a fascial release.

Muscle stripping also played a large role in treatments four through eight [13]. The chart below illustrates which muscles were treated with muscle stripping in each treatment.

Table. 4 Muscle stripping performed in treatments four through eight [13]

Muscle Treated	Tx 4	Tx 5	Tx 6	Tx 7	Tx 8
Supraspinatus	√		√	√	√
Infraspinatus	√		√	√	√
Rhomboids	√				
Upper trapezius	√		√		
Pectoralis Major	√		√	√	√
Scalenes	√	√	√	√	√
Subclavius		√	√	√	√
Sternocleidomastoid					√
Subscapularis				√	√
Pronator Teres		√			
Forearm flexors			√		
Deltoid (all fibers)				√	
Teres Major					√
Teres Minor					√

In addition to the core treatment of myofascial release and muscle stripping described above, various additional techniques and structures were treated. These are described below.

Treatment 4- General Swedish massage was used on the patient's entire back, arms, and forearms[4]. The therapist released the patient's posterior suboccipital muscles by placing fingers into the bellies of the muscles as the patient lay supine, and applying a direct anterior pressure until a release was palpated. A grade 2

joint distraction and a posterior glide joint mobilization were applied to the patient's right glenohumeral joint with the intention to decrease joint capsule restrictions[14].

Treatment 5-Kneading was used on the patient's upper trapezius muscles [13,4]. The therapist also passively moved the patient's right glenohumeral joint, elbow, and wrist through full range of motion. Effleurage was used to flush out the patient's entire shoulder girdle, right arm, forearm, and anterior neck[13].

Treatment 6- A grade 2 posterior glide joint mobilization technique was again used to decrease posterior glenohumeral joint capsule tightness on the patient's right side[14]. A cervical spine distraction technique was used. The patient was positioned supine with the therapist seated at the patient's head. The muscle tissue surrounding the area was warmed up first using petrissage techniques[13].The therapist then grasped the patient's occipital region with both hands and applies a gentle distraction for approximately one minute. Cervical spine translation was performed next, with the supine patient's head supported by the therapist's forearms. Gentle, alternating pressure was applied on the transverse processes of the patient's cervical spine causing a translation movement.

Treatment 7-Isolytic release of pectoralis major's clavicular fibres was performed on the patient in a supine position, bilaterally. This was performed with the therapist anchoring both hands into the fibres of pectoralis major and instructing the patient to slowly extend her abducted arm, causing the muscle fibres to be stripped. This was performed within the patient's pain tolerance. Grade two joint mobilizations were also used bilaterally on the patient's glenohumeral joints. Specific mobilizations performed were posterior, anterior, and abduction progressions. Contract-relax tissue stretching technique was performed bilaterally on the patient's pectoralis major muscle[3].

Treatment 8-Cervical spine distraction and translation techniques were used as described in treatment six in addition to the core treatment.

Homecare

Treatments 1-3

Treatment 1-Homecare recommended after this treatment was eccentric loading of the right biceps brachii to assist in rapid healing of a suspected tendinopathy and stretching of subscapularis bilaterally. The eccentric loading of biceps brachii

was to be performed daily, in a bent over row position, in three sets of ten repetitions, with weights lift enough so that the patient would only start to feel any sort of fatigue after twenty repetitions. The subscapularis stretch given was to be performed daily for one week, for one to two minutes at a time.

Treatment 2-A pectoralis minor muscle stretch was given bilaterally, by having the patient interlock her fingers behind her back and pull her shoulders back and down, for fifteen seconds to start, after having a shower to allow the moist heat to warm up the muscle. The patient was unable to perform this stretch due to restrictions by hypertrophied and hypertoned muscles. Homecare was then modified to having the patient stretch the tissue by trying to perform the stretch. The patient was also encouraged to ice her affected shoulder for fifteen to twenty minutes with a wrapped ice pack after training to reduce the inflammation of her anterior shoulder.

Treatment 3- Patient was encouraged to continue with the homecare given, including the eccentric loading of right biceps brachii.

Treatment 4-Reassessment at this treatment suggested a potential diagnosis of thoracic outlet syndrome. Homecare was modified, with the patient being encouraged to continue with subscapularis stretches, and to discontinue the eccentric loading of the right biceps brachii.

Treatment 5-Specific stretches were given for anterior and middle scalene, and sternocleidomastoid muscles. Patient was encouraged to keep trying to stretch out her pectoralis minor muscles bilaterally.

Treatment 6-Patient was encouraged to continue the scalene, sternocleidomastoid, and pectoralis minor and major muscle stretches (patient was already regularly stretching pectoralis major with the doorway stretch, as part of her fitness regime, prior to the case study).

Treatment 7-Patient was encouraged to continue the pectoralis major and minor stretches.

Treatment 8-Patient was encouraged to continue stretching pectoralis major and minor and subscapularis, bilaterally.

Megan Pamela Fredh…, 10-4-2 10:58 AM
Comment: I am intending to add photos of these stretches in an appendix

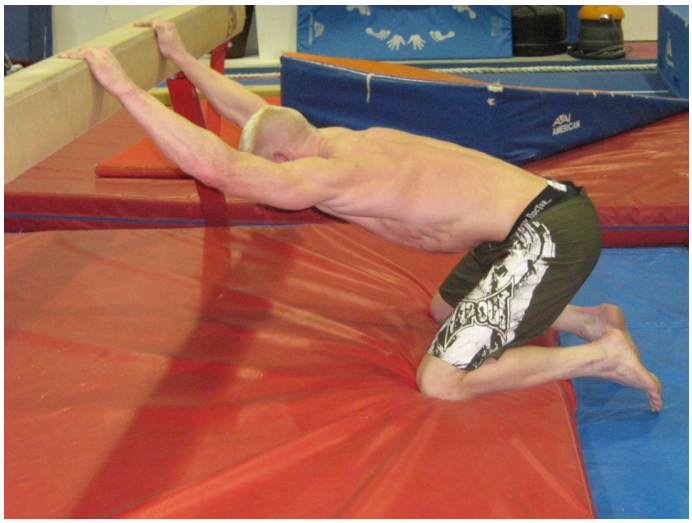

Figure 7. Subscapularis muscle stretch (Author's photo)

To stretch the subscapularis muscle bilaterally, the patient was instructed to abduct and externally rotate shoulders above their head against a chair or bench, and pull body inferiorly.

Figure 8. Pectoralis Minor Stretch (Author's photo)

To stretch the pectoralis minor, the patient was instructed to bring their shoulders back and down, with their hands clasped behind their back.

Assessment

The patient was also asked to record specific information onto a record in order to better track results over the course of treatment. The patient was asked to record daily training activities, the onset and intensity of pain during training, how long pain lasted after training, any medications taken, and any homecare performed (see Appendix 3). Specific special tests, Adson's, Travell's variation on Adson's and (less frequently) Costoclavicular test were used before and after each treatment from four to eight to measure changes in the subject's primary symptoms.

Results

Reassessment at eighth treatment

Table. 5 Glenohumeral Range of Motion Values, Final Assessment

Motion	**Normal Value**[11]	**Active ROM (value at first assessment in brackets)**		**Passive ROM**	
		Left	**Right**	**Left**	**Right**
Flexion	160-180°	150° (150°)	140° (140°)	155° (150°)	150° (140°)
Extension	50-60°	40° (30°)	40° (30)	45° (30°)	45° (30°)
Abduction	170-180°	160°(160°)	155°(130)	165° (160°)	160° (145°)
Adduction	50-75°	25° (25°)	25° (15)	25° (25°)	25° (15°)
Internal rotation	60-100°	70° (35°)	70° (60)	70° (35°)	70° (60°)
External rotation	80-90°	30° (20°)	30° (30)	30° (25°)	35° (35°)
Horizontal adduction	130°	125°(125°)	130° (130)	125° (125°)	130° (130°)

Note: Values shown in brackets indicate values of range of motion at initial assessment. Changes are highlighted.

A reassessment of the patient's glenohumeral joint range of motion revealed an increase in available active and passive movement for numerous motions. Notably, extension and internal rotation increased bilaterally. External rotation increased marginally on the left side only. The patient's available range for abduction and adduction on the right side showed a marked increase.

Table 6- Resisted glenohumeral joint range of motion

Motion	Left		Right	
	Grade	Pain	Grade	Pain
Flexion	5(5)	1-2(0)	5(4)	1-2(3)
Extension	5(5)	0(0)	5(4)	0(0)
Abduction	4+(4)	1-2(0)	5(4)	3(4)
Adduction	5(5)	0(0)	5(5)	1(0)
Internal rotation	5(5)	0(0)	5(4)	0(0)
External rotation	5(5)	1(0)	5(5)	1(0)
Horizontal adduction	5(5)	0(0)	5(4)	0(3)

Note: values in brackets indicate values of findings at initial assessment. Changes are highlighted.

A reassessment of the patient's strength and pain levels in specific ranges of motion at the glenohumeral joint revealed several changes. In particular, there was an increase in strength noted in all ranges of resisted motion that were previously rated as less than full strength. On the patient's left side, no pain had been reported at the initial assessment, and low levels of pain were noted with several resisted motions at final assessment. On the patient's right side, a decrease in pain was noted in all previously painful motions. The resisted motions of extension and adduction, on the right, elicited low levels of pain only at the final assessment.

Table 7-Manual Muscle Testing Final Assessment

Strength (Grade 0-5) (see Appendix 1)	**Left**	**Right**
Subscapularis	3(3)	4(3)
Teres Major	4+(4)	4+(5)
Lower Trapezius	4+(4)	5(4)

Note: Values in brackets are from the initial assessment. Changes are highlighted.

A reassessment of the strength of specific muscles of the subject's shoulder girdle revealed several changes. Increases in strength were noted in the subject's left teres major, right subscapularis, and bilateral lower trapezius muscles. A negligible decrease in strength was noted in the subject's right teres major muscle. Muscles that received a grade of five bilaterally at the initial assessment were not reassessed (see Appendix 1).

Pectoralis Minor Skyline Test revealed an improvement upon reassessment. On the left side, the measurement between the supine patient's acromion process and the table was initially four inches, and only three and a half inches upon reassessment. The right side showed an even greater improvement, with the measurement improving from five inches at the initial assessment to four inches at the final assessment.

Cervical spine active range of motion was also reassessed. The subject showed an increased range of cervical flexion, from fifty degrees at the initial assessment to fifty five degrees at the final assessment. Left rotation increased by less than five degrees from the initial assessment, and right rotation increased by five degrees. Left and right side flexion values were unchanged from the initial assessment.

Spurling's test was performed, with the patient describing a sensation of a muscle "stretch" on the side opposite the side being tested, bilaterally.

Thoracic spine range of motion values were all within normal values upon initial assessment, and not reassessed.

Adson's test was performed before and after each treatment, from treatments four through eight.

Table.8 - Progression of results shown with Adson's test (Changes Highlighted)[4]
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Treatment number		**Symptoms as described by patient**	
Side test performed on		**Left side**	**Right side**
Treatment 4	**Pre-treatment**	Test not performed	Numbness experienced right anterior shoulder down to lateral aspect of right hand
	Post-treatment	Test not performed	Still symptoms felt, "not as numb"
Treatment 5	**Pre-treatment**	Tingling sensation experienced on left side	Numbness and tingling felt down shoulder, medial forearm, into fingers
	Post-treatment	Tingling felt, but in a smaller area	No symptoms
Treatment 6	**Pre-treatment**	Test not performed	Numbness and tingling felt in area of right biceps brachii
	Post-treatment	Test not performed	Sensation "less than" previous
Treatment 7	**Pre-treatment**	Numbness, burning felt anterior lateral aspect of left shoulder to elbow	Numbness, burning felt in lower biceps, lateral half of hand
	Post-treatment	No symptoms	No symptoms
Treatment 8	**Pre-treatment**	Symptoms felt in distal, left biceps brachii, rated 2/10	Symptoms felt from right anterior shoulder down rated 3/10
	Post-treatment	Symptoms felt less, rated 1/10	Symptoms decreased in intensity, rated a 1/10 post treatment

Tables 8, 9 and 10, illustrate the changes in the patient's primary symptoms after each treatment, from treatment four through to eight, according to specific orthopaedic tests. The patient had presented with numbness and tingling down her arms and into her hands (a recreation of her primary complaint) when assessed using Adson's, Travell's, and Costoclavicular tests prior to treatment [4]. The same tests used prior to treatment were used for reassessment after each treatment. The patient consistently reported a decrease in symptoms experienced with Adson's and Travell's tests after each treatment[4]. The Costoclavicular test was performed less frequently for the sake of time, and results were less consistent.

Table.9. Progression of results shown with Travell's test (Changes Highlighted)[4]

Treatment number		**Symptoms as described by patient**	
Side test performed on		**Left side**	**Right side**
Treatment 4	**Pre-treatment**	Test not performed	Numbness experienced in right arm
	Post-treatment	Test not performed	"Improved, not as numb"
Treatment 5	**Pre-treatment**	Tingling experienced down anterior left shoulder	No symptoms reported
	Post-treatment	Symptoms experienced in a smaller area	No symptoms reported
Treatment 6	**Pre-treatment**	Test not performed	No symptoms reported
	Post-treatment	Test not performed	No symptoms reported
Treatment 7	**Pre-treatment**	No symptoms reported	No symptoms reported
	Post-treatment	No symptoms reported	No symptoms reported
Treatment 8	**Pre-treatment**	Symptoms felt from left shoulder down, rated 3/10 in intensity	Symptoms experienced anterior right shoulder down to medial aspect of palm, rated 3/10 in intensity
	Post-treatment	Symptoms rated 1-2/10 in intensity	Symptoms rated 1-2/10 in intensity

Table.10- Progression of results shown with Costoclavicular test[4] (Changes Highlighted)

Treatment number		**Symptoms as described by patient**	
Side test performed on		**Left side**	**Right side**
Treatment 4	**Pre-treatment**	Test not performed	Numbness experienced down into lateral aspect of right hand
	Post-treatment	Test not performed	Still symptoms felt, "not as numb"
Treatment 5	**Pre-treatment**	Tingling sensation experienced in patient's third finger and radial aspect of forearm of left side	Numbness and tingling felt down anterior shoulder down into third finger of right side
	Post-treatment	Tingling felt, but in a smaller area	Symptoms still present
Treatment 6	**Pre-treatment**	Test not performed	Numbness and tingling felt in area of right latissimus dorsi and elbow
	Post-treatment	Test not performed	Symptoms still present
Treatment 7	**Pre-treatment**	Test not performed	Test not performed
	Post-treatment	Test not performed	Test not performed
Treatment 8	**Pre-treatment**	Test not performed	Test not performed
	Post-treatment	Test not performed	Test not performed

At the final reassessment, the therapist noticed a greater degree of fascial mobility upon palpation. Another significant observation is the patient's ability to interlock her fingers behind her back in a stretch of her pectoralis minor muscle. This shows a substantial increase in the patient's mobility since the second treatment when the patient was significantly restricted and unable to perform this motion.

Speed's Test reassessment revealed a low level of pain at the bicipital groove with both forearm pronation and supination, bilaterally[11]. At the initial assessment, the subject reported feeling pain only with resistance in pronation, bilaterally.

The Empty Can test elicited a sensation of numbness and tingling in the first position (resistance applied to patient's arm while abducted to ninety degrees) on the affected side when performed bilaterally.

The patient's response to treatment was largely positive. Generally improvements were seen at the end of each treatment as evidenced by tables 8 and 9.

The day after treatment 6, the patient reported a significant increase in the intensity of symptoms. This corresponded with both a change in massage treatment (the introduction of cervical distraction and translation techniques in treatment six) and a change in weight training programs, beginning the day of treatment six. The patient said that it was normal for her to feel quite sore the day after beginning a new weight training program. The increase in intensity of symptoms was temporary, with discomfort returning to normal levels in the days following.

At the last treatment, the patient expressed that treatments had been helpful. The patient explained how her symptoms had been noticeably reduced in the days following a weekly massage treatment, and only started to return back to pre-massage levels when almost a week had passed.

Discussion

TOS is commonly caused by repeated movements of the upper extremity [15].The primary cause of the subject's symptoms in this case may have been a combination of overuse of the involved structures, muscle imbalances, hypertrophy of muscles of the cervical spine and shoulder girdle, referred myofascial trigger point pain, and sport-specific biomechanics.

Of the many factors having an impact on the results of this case study, perhaps the most important is the unique patient profile.

As a professional athlete, the subject adhered to a rigorous training schedule, six to seven days per week. She had been training full time in mixed martial arts for the past five years, and prior to that was a devoted dancer, training an average of twenty hours per week. Her current training schedule involves weightlifting three hours per week, cardiovascular training (including running, Airdyne biking, pushing, pulling and plyometric activities) three hours per week, Brazilian Jiu Jitsu three hours per week, Thai boxing four hours per week, and wrestling three hours per week. All these activities place a substantial stress on the muscles contributing to the subject's primary complaint (see Appendix 3).

The muscles supporting the patient's cervical spine were significantly hypertrophied and surrounded by a layer of fascia with limited mobility. These hypertrophied muscles and restricted fascia helped to create stability for an area of her body absorbing a great deal of impact on a regular basis, however, likely also contributed to her primary symptoms of neural compression. A challenge in

treatment was decreasing the hypertonicity of cervical muscles without decreasing stability.

The patient's posture serves her well in the cage. Carefully maintained, internally rotated, shoulder forward posture leading to an increased thoracic kyphotic curve, offers a measure of physical protection. Unfortunately, this posture is also a factor in the development of TOS[4].

The treatments were generally given once per week. Ideally, the patient would have been treated at least twice per week for the first two to three weeks, then once per week for the next four weeks. The frequency of treatments was limited by the therapist's limited clinic time and the patient's busy schedule.

The sheer volume of hours spent by the patient training on a weekly basis, presented a challenge in terms of making a positive difference on the patient's primary condition. As a competitive athlete, the subject had training commitments daily, a schedule requiring her to train after treatments. It is probable that some of the positive impact of the massage treatments was lessened by the training sessions that followed immediately after.

Promising results were seen in a relatively short period of time. In order for the patient to see longer lasting relief from symptoms, treatments should be continued more frequently.

The focus of individual treatments would vary depending on the patient's presentation.

As an athlete, this patient had a higher level of motivation to participate in resolving this nagging physical complaint than an average patient with perhaps less riding on their physical condition. An average patient may not be as motivated to follow homecare; however, an average patient will also not spend hours per day training in a sport that involves such regular physical trauma.

The same level of mental toughness and bravery required to get a fighter in the cage, conditions them not to tap or submit when their very air supply is being compromised or ligaments distorted to their physical limits, consequently can influence their definition of an injury or even pain.

In the several months before and during treatment, the subject was treated by other health care practitioners for additional concurrent injuries or conditions, which included a groin strain, iliotibial band dysfunction, and a possible meniscus injury. With the varied and significant stresses placed on an individual training for this sport, it seemed likely that this would be a common occurrence. When the subject was experiencing pain and dysfunction in a knee from possible iliotibial

band and meniscus conditions, it meant focusing on training activities for the upper body. Thus an increased physical stress load was placed on the upper body.

It is important to note that some of the benefit of treatments may be found in the fact that the patient's symptoms did not get markedly worse, despite an increased training stress on the upper body during the injuries to the lower body.

The subject in this case had two fights within the space of one month, and then was told by promoters that the next fight would be several months later. Several times in the months since, she was given a date for the fight, only to have it pushed back by months each time the given fight date was close. The result of this erratic scheduling is the subject has to stay in peak "fight condition" for extended periods of time, which can be physical and mentally gruelling.

As a competitive fighter, this patient needs the mental resilience to withstand punishing training regimens day after day and to stay sharply focused when being assaulted with blows that make even spectators wince in pain. The last thing this patient wants to be concerned with upon entering the cage is a pre-existing, nagging condition.

Conclusion

Massage therapy appeared to provide some benefit to the patient in regards to reduction of pain and discomfort in the arm. The patient's main symptoms, of a sensation of numbness, tingling, and burning sensation primarily down the right shoulder and into various regions of the hand, were reduced following treatment. Other positive results were seen as well, including increased active range of motion of the cervical spine and glenohumeral joints. Additionally, an increase in fascial mobility of the shoulder girdle was palpated. Overall the patient responded well to treatment, especially considering the intensity of the physical stresses placed on the subject on a daily basis.

The author recognises the study's limited ability to determine the treatment's true effectiveness and therefore future study is warranted to further explore the impact of massage therapy on sport's related compression syndromes in female mixed martial artists.

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Appendix 1

Oxford Muscle Strength Chart[8]

Grade 0 No muscular response

Grade 1 Perceptile contraction

Grade 2 Functions with gravity eliminated

Grade 3 Functions against gravity

Grade 4 Functions against some resistance

Grade 5 Normal strength, against resistance

* A grade of 4+ was used by the therapist in this case to indicate a level of muscular strength that was able to resist more than minimal resistance, without being normal strength.

Appendix 2

Pain Scale

The subjective pain scale used in this case report was described to the patient as a score of zero being "no pain" and a score of ten being "excruciating pain". The patient would assign then assign pain experienced a number according to the scale. This scale was also adapted to allow the patient to assign a number to the intensity of the sensation experienced, even if this sensation couldn't necessarily be described as pain.

O ----------5----------10

No pain Excruciating pain

Appendix 3

Summary of patient's assessment record information

Day (in relation to massage treatment)	Daily training activity	Onset of pain into training activity	Rated intensity of pain (see appendix 1)	How long pain lasted after training
Day before treatment 2	Thai boxing rounds (8 x 3 minute rounds)	Second round	4-5	10-15 minutes
Day of treatment 2	Sprinting and stand-up wrestling technique	"N/A didn't go super hard"	No info given	No info given
Day after treatment 2	Stair running, 3 x 5 minute thai boxing rounds, 5 minutes ground bag work 2 x 5 minute rounds sparring	Ground bag then sparring	2-3 while working bag 3-4 while sparring	20 minutes
Day before treatment 3	Weight training and conditioning	After weights, into conditioning	3	20 minutes
Day of treatment 3	Light run	"Not applicable"	No info given	No info given
Day after treatment 3	"not applicable"	No info given	No info given	No info given
Day before treatment 4	Thai boxing 2x 5 minute rounds pad work 3 x 5minute rounds sparring	First round of sparring	2.5	15 minutes
Day of treatment 4	Weights and conditioning	During conditioning	2-3	No info given
Day after treatment 4	Grappling	Approximately 10 minutes	6	20 minutes
Day before treatment 5	Running	"Not applicable"	No info given	No info given
Day of treatment 5	Weight training and conditioning	"A little during conditioning"	2-3	10 minutes
Day after treatment 5	"Not applicable"	No info given	No info given	No info given
Day before treatment 6	Thai boxing 3 rounds Shadowboxing	"sore after third round"	1-2	10 minutes
Day of treatment 6	Prior to treatment: weights and conditioning	Morning: during weights Evening: after third round	Morning: 4 Evening: 2	No info given

	Post-treatment: 6 rounds of boxing			
Day after treatment 6	Boxing sparring Grappling	“Right away”	6, “whole arm went numb”	20 minutes
Day before treatment 7	Sparring	“Sore at third round”	2-3	10 minutes
Day of treatment 7	Weights and conditioning	During conditioning	1-2	10 minutes
Day after treatment 7	Not applicable: Treatments 7 and 8 were performed on consecutive days			
Day of treatment 8	Wrestling	20 minutes in	1-2	5 minutes
Day after treatment 8	Brazilian Jiu Jitsu and wrestling	“not really sore just a little achy”	Not applicable	Not applicable