Massage Therapists' Association of British Columbia

Clinical Case Report Competition

Okanagan Valley College of Massage Therapy

Spring 2009

Second Place Winner

Karla A. Lane

Effect of comprehensive massage therapy and therapeutic exercise in the treatment of chronic myogenic neck pain

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MTABC 2009

Spring 2009 MTABC Clinical Case Report Award

Okanagan Valley College of Massage Therapy competition

2nd Place — Karla A. Lane

for

Effect of Comprehensive Massage Therapy and Therapeutic Exercise in the Treatment of Chronic Myogenic Neck Pain

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ABSTRACT

Objective: to assess the effectiveness of therapeutic exercise alone, and of comprehensive massage therapy in reducing pain and increasing cervical range of motion in a subject experiencing chronic myogenic neck pain.

Methods: Following a two week period in which baseline data was recorded, a baseline assessment of the subject was undertaken. A therapeutic exercise program was designed and implemented for a period of two and a half weeks to address muscle imbalances in the cervical and thoracic regions. A full midpoint assessment was performed, followed by commencement of six one-hour comprehensive massage treatments, delivered over a period of four weeks. The treatment plan focused on the cervical region, utilizing Swedish, Neuromuscular, and fascial techniques, trigger point therapy and continuing therapeutic exercise. Treatment progress was assessed by subjective pain ratings on a 10-point scale, and active range of motion of the cervical spine. The final assessment was performed one week after the sixth massage.

Results: The client's pain decreased from a daily average of 2.2/10 at baseline to 1.6/10 at the final assessment. Cervical range of motion in lateral flexion increased by 20˚ bilaterally. Range of motion increases with rotation were less remarkable. Pain experienced during active range of motion was markedly reduced in all ranges, from maximal values of 5/10 at baseline to 0/10 in all ranges at the final assessment. Stretching of the cervical musculature was found to provide instant reduction in neck pain experienced by the client. Massage treatments consistently decreased right suboccipital pain by 20%.

Conclusions: Both therapeutic exercise alone and comprehensive massage therapy were effective in providing symptomatic relief of chronic myogenic neck pain. Both interventions increased cervical range of motion, and comprehensive massage therapy decreased the average daily pain experienced by the subject. This study provides support for the effectiveness of massage therapy in treating cervical dysfunction, and further research is suggested to clarify the relative contributions of the various components of massage therapy in treatment of chronic myogenic neck pain.

INTRODUCTION

Neck pain is a common disorder, ranking second behind low back pain as the most commonly reported musculoskeletal complaint (Kerr and White, 2007; Vernon, Humphreys and Hagino, 2007). Reports on the prevalence of neck pain within a given population vary widely; A systematic review of the literature undertaken by the Canadian Institute for the Relief of Pain and Disability and the Massage Therapists' Association of British Columbia found that point prevalence of neck pain was 10-20%, while lifetime prevalence was up to 70% of the population (Kerr and White, 2007). Many forms of manual therapy are used by the public to provide relief from acute and chronic neck pain, including, but not limited to, chiropractic, physiotherapy, acupuncture, and massage therapy. It is the perception of this author, based on unpublished data provided through discussion with Registered Massage Therapists in the province of British Columbia, Canada, that neck pain is one of the most common presenting complaints in a general massage therapy practice. However, the results of several systematic reviews indicate that there is insufficient evidence to conclude that massage, spinal mobilization/manipulation, and therapeutic exercise (stretching and strengthening) are effective in providing relief from neck pain whether used alone or in combination (Haraldsson et al., 2006; Kerr and White, 2007).

While major systematic reviews of the literature have cited a lack of evidence either for or against the effectiveness of massage as applied to neck pain, they have also noted that much of this uncertainty may stem from problems in the existing literature, and does not necessarily reflect the actual clinical application of massage to neck pain (Haraldsson et al., 2006; Kerr and White, 2007). Many existing studies of neck pain fail to adequately define massage, or unnecessarily limit the scope of practice of massage therapy in an attempt to control the number of variables introduced into a study. Furthermore, outcome

measures used in clinical research vary widely, resulting in difficulties comparing results across trials (Haraldsson et al., 2006). While there is scientific validity in separating the various components of massage, this practice can result in misleading research conclusions. For example, Vernon, Humphreys and Hagino (2007) concluded that, while both spinal mobilization and manipulation were effective in treating chronic mechanical neck pain, massage did not show a comparable level of benefit. However, since spinal mobilization falls within the scope of practice of massage therapy, clients seeking relief of neck pain in a clinical setting could experience the benefits of mobilizations in the context of a massage treatment. The effectiveness of a comprehensive approach to treatment, as would be encountered in clinical practice, could logically be assumed to be very different from the effectiveness of each individual component of treatment. However, it is this author's perception that there is a tendency to define massage in terms of manual manipulation of the soft tissues only, thus limiting the evidence available for the efficacy of massage therapy.

In this study, massage therapy is defined as the manual manipulation of the muscular, fascial, and articular systems of the body using any and all techniques included in the scope of practice of massage therapy as defined by the College of Massage Therapists of British Columbia. These techniques include intra- and intermuscular fascial release, trigger point therapy, neuromuscular therapy, joint mobilizations (Maitland grades I to IV) and therapeutic exercise, applied as indicated by the subject's assessment results.

The Philadelphia Panel for evidence-based clinical guidelines on musculoskeletal interventions found that there was insufficient data with regard to massage to form any meaningful conclusions. Of the nine interventions examined by the Panel, only therapeutic exercise – stretching and strengthening exercises – showed clinical benefit for subjects experiencing neck pain (Harris and Susman, 2002). A recent study attempted to differentiate the effects of strength training and stretching in a combined intervention from the effects of stretching only. They found that both groups were effective at decreasing neck pain, but no difference in effectiveness between the groups. Interestingly, only minor improvements in neck strength and mobility were noted for either group (Hakkinen et al., 2008). In contrast, Viljanen et al. (2003) found that dynamic muscle training had no effect on neck pain, but did result in an increase in cervical range of motion. Thus, there is sufficient evidence to justify further investigation of the clinical efficacy of therapeutic exercise alone in decreasing pain and increasing cervical range of motion in a subject with chronic neck pain, particularly where this exercise intervention is tailored to the results of that individual's cervical assessment.

In this study, therapeutic exercise can be defined as any stretching and strengthening regime designed to correct muscle length and strength imbalances. In contrast to the Philadelphia Panel, systematic reviews have failed to find any clear benefit from therapeutic exercise interventions for the relief of mechanical neck pain (Kerr and White, 2007). However, a logical argument can be made in support of this avenue of treatment. Patients with chronic neck pain have been shown to have a reduced ability to maintain a neutral position of the neck when seated at a task for ten minutes. Over this interval, neck pain subjects demonstrated a consistent increase in anterior positioning of the head, accompanied by an increase in thoracic flexion when compared to pain-free controls (Falla et al., 2007). A relative strength imbalance between the deep craniocervical flexors

(longus colli and longus capitis) and the superficial cervical flexors (sternocleidomastoid and anterior scalene) has been proposed to explain this phenomenon. As the deep flexors weaken, the action of the superficial musculature takes over and draws the head into an anterior position relative to the glenohumeral joint. Furthermore, as the deep segmental muscles of the neck weaken, regions of local instability can develop (Falla et al., 2007). The tone of the superficial muscles increases in an attempt to stabilize the neck. This increased tone can directly result in referred pain to the neck and head, as well as restricted cervical range of motion. Falla et al. (2004) also found an increase in electromyographic activity in the sternocleidomastoid and anterior scalene muscles of subjects with neck pain, possibly due to a faulty pattern of activation in response to weakness or inhibition of other muscles (i.e. longus colli and longus capitis).

The objective of this study was to assess the effectiveness of therapeutic exercise alone, and of comprehensive massage therapy in reducing pain and increasing cervical range of motion in a subject experiencing chronic neck pain. In line with the definitions introduced earlier, this necessitates some overlap between the two interventions: therapeutic exercise and massage therapy. The author feels this is justified, as a client receiving massage therapy in a clinical setting would most likely receive both soft tissue manipulation and a home exercise regime as part of their comprehensive rehabilitative protocol. Differentiation between the results of each intervention is achieved by introducing the interventions at different times, separated by a midpoint assessment.

Chronic neck pain can be variously defined as neck pain lasting for longer than six to twelve weeks, versus acute neck pain which lasts no longer than four to six weeks (Kerr and White, 2007). Neck pain can be further classified according to the cervical structures from which the pain originates. Arthrogenic neck pain, typically arising from the facet joints is a common cause of upper cervical pain, and referred pain from these joints can result in a headache. Discogenic pain may arise from either acute disc herniation in the cervical spine or from degenerative changes to the intervertebral disc. Myogenic neck pain refers to pain with a muscular origin. Postural dysfunction and daily stress both contribute to increased tension in the cervical musculature with resulting strength and length imbalances in the muscles surrounding the neck (Hertling and Kessler, 2006).

METHODS

Case History

The subject was a 32-year-old female high school teacher who has suffered from chronic neck pain leading to occasional tension headaches in the suboccipital region for the past 10 years. Pain is aggravated by sleeping prone, and relieved by regular activity. Occasionally the subject takes Ibuprofen for pain relief, but none was taken during the course of this study. Onset of neck pain was insidious, but the subject had suffered two major neck injuries during her childhood. In both cases the injury seemed out of proportion to the precipitating trauma – at age 7 (1984), a whiplash-type injury occurred when opening a popsicle wrapper with her teeth; At age 12 (1989), the subject again injured her neck, this time performing a somersault in gym class. Both injuries resulted in the subject wearing a soft cervical collar. The subject has previously sought massage therapy for relief of her neck pain, but had not received any treatment for at least ten

months prior to commencing this study. The subject was asked to keep a neck diary starting two weeks before any intervention and continuing until the final assessment. The initial two weeks served to establish the subject's baseline levels of neck pain intensity (Blanchard, 1987) as well as daily stress and activity levels, sleep quality and quantity. At baseline, the subject's neck pain had an average intensity of 2.2 on a scale of 1 to 10, where 1 is minimal pain and 10 is the most excruciating pain imaginable. Her pain is typically right sided, concentrated just inferior to the right occiput. As the intensity of the pain increases, it spreads down the length of the right side of the cervical spine. At moderate intensity (3-4/10) the pain spreads to include the suboccipital region bilaterally and is described as a tension headache. The pain always lasts at least one day, and usually continues for several days to weeks, with steadily increasing intensity. The upper trapezius muscle is also often problematic for the subject, particularly on the right side. The subject had globally reduced cervical range of motion, and aggravated right suboccipital pain with bilateral rotation.

Assessment

Assessment generally followed the Cyriax model. Full assessments were performed at baseline, after 2 ½ weeks of therapeutic exercise intervention and at one week after the final massage intervention by the author, a graduating massage therapy student at the Okanagan Valley College of Massage Therapy. These assessments included a case history regarding the subject's current level of cervical pain and headache, palpation of the cervical musculature, active range of motion (AROM) of the cervical spine, isometric muscle testing for the strength of the cervical musculature (Kendall et al., 2005 - anterior neck flexors, p. 154; bilateral anterolateral neck flexors, p. 156; bilateral upper trapezius and levator scapulae, p. 158; bilateral posterolateral cervical extensors, p. 157; Magee, 2006 - bilateral cervical rotation, p. 137; cervical extension, p. 137 – modified to prone positioning for antigravity), posterior to anterior challenges of the C2-C7 vertebrae, and orthopaedic testing (Magee, 2006 - Spurling's test, p. 145; Rattray and Ludwig, 2000 - pectoralis major length test, p. 1079; pectoralis minor length test, p. 1079). Abbreviated assessments were performed prior to each massage treatment and included case history updates, AROM of the cervical spine, Spurling's test, and the pectoralis major and minor length tests. Post-treatment assessment included a reassessment of the subject's current pain level, and AROM of the cervical spine.

Primary outcome measures were right suboccipital pain as reported by the subject, and cervical AROM in bilateral lateral flexion and rotation, as estimated by the therapist. A secondary outcome measure was pain experienced by the subject during cervical AROM.

Treatment Plan

The treatment plan was developed based on the initial assessment to decrease the subject's perception of the intensity of her neck pain and to objectively increase AROM of the cervical spine. In order to separate the effects of the therapeutic exercises given and the massage, the intervention was applied to two parts. Initially, only therapeutic exercise was given. Stretches for sternocleidomastoid (Rattray and Ludwig, 2000; p. 484 - sternal and clavicular heads), levator scapulae (Kisner and Colby, 2007; p. 536, fig. 17.35B) and upper trapezius (Kisner and Colby, 2007; p. 536, fig. 17.35B – modified with ipsilateral rotation), and pectoralis major (Kisner and Colby, 2007 – p. 534, fig.

17.31A – modified to be performed in an open doorway) muscles were to be performed bilaterally two times per day, each being held for 30-60 s. Additionally, strengthening exercises for longus colli (Kisner and Colby, 2007; p. 457 – Core Activation) and the rhomboids (Kisner and Colby, 2007; p.542, fig. 17.44 – modified with internal rotation of the glenohumeral joint to isolate rhomboids) were to be performed once per day.

After two and a half weeks of therapeutic exercise, a second full assessment was performed in order to determine any affect the stretching and strengthening regime had on the subject's cervical pain and range of motion. At this point the massage intervention was introduced. Six one-hour massage treatments, performed by the author, were given over the course of the following four weeks (approximately two treatments per week). The massage protocol was designed based on the results of the assessment, and generally coincides with the treatment for tension headaches as described in Rattray and Ludwig (2000). The entire cervical region was addressed, specifically concentrating on the upper trapezius and levator scapulae, sternocleidomastoid, anterior scalene, longus colli, and posterior suboccipital muscles. These structures were the focus of treatment due to postural imbalances observed in assessment, and trigger point referral patterns to the posterior suboccipital and posterior cervical regions (St. John Method of Neuromuscular Massage Therapy – Trigger Point Posters, 1990). Massage techniques applied to these muscles included ischemic compression and trigger point release, muscle stripping and neuromuscular therapy, and frictions to breakdown adhesions. Specific fascial techniques were applied as required and included intramuscular release of the upper trapezius and sternocleidomastoid muscles, and release of the investing layer of superficial cervical fascia, concentrating on the anterior attachments. Minimal joint play was used as the assessment indicated that joint mobility was not a large contributing factor to the primary complaint.

During the 4 weeks of massage, the client continued with the therapeutic exercise previously assigned, as this is within the scope of practice of massage therapy, and would be given to the client as part of a comprehensive treatment protocol. The strengthening of the cervical core musculature continued with the addition of upper extremity movements while maintaining contraction of the longus colli muscle (Kisner and Colby, 2007; p. 457) as well as commencing strengthening of the posterior cervical stabilizers (Kisner and Colby, 2007; p. 458).

The final assessment was performed one week following the sixth massage treatment.

OUTCOMES

Baseline Assessment

The initial assessment and analysis of the subject's neck diary indicated that the subject's neck pain was located inferior to the right occiput with an intensity of 1.5/10 at that point in time. Postural analysis revealed the subject had a marked head forward posture, and bilateral anterior rotation of the glenohumeral joints with scapular protraction. Palpation of the cervical musculature revealed significant hypertonicity and tenderness in the right side of the neck – upper trapezius, levator scapulae, sternocleidomastoid, anterior scalene and longus colli all had an increased resting level of tension.

Cervical active range of motion was painful in all ranges, and limited in bilateral lateral flexion (right 50˚; left 50˚) and bilateral rotation (right 65˚; left 75˚) (figure 1). Both left and right lateral flexion elicited a significant (4-5/10) stretch in the contralateral lateral and posterolateral neck. Left and right rotation both elicited a painful (2 and 4/10 respectively) stretching sensation in the right posterolateral neck.

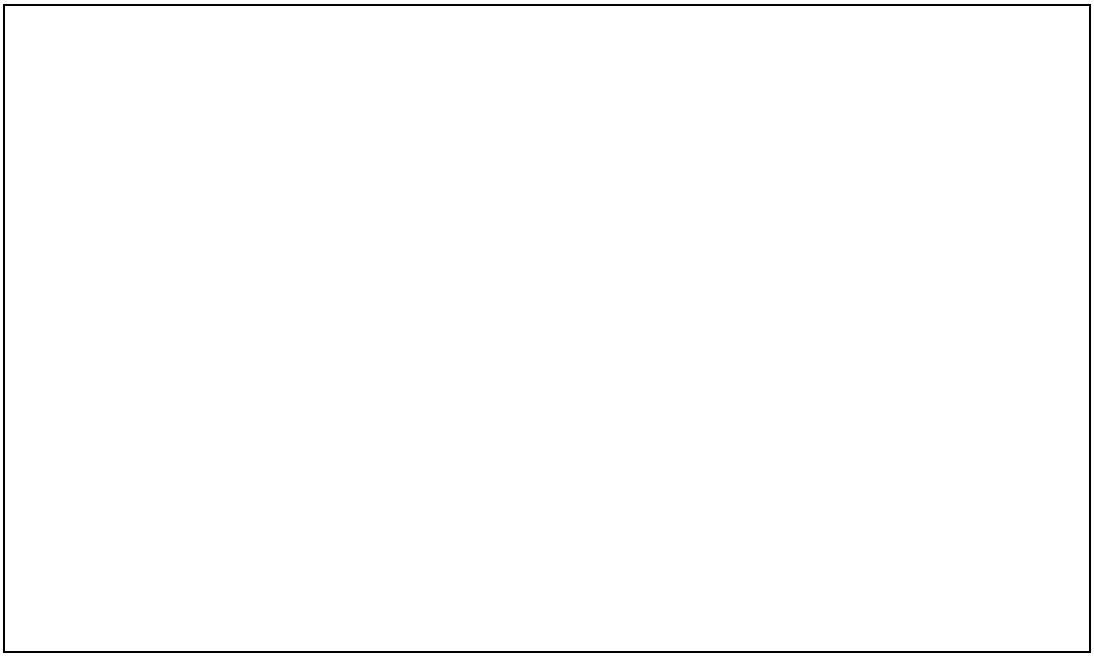

Figure 1: Cervical Active Range of Motion as estimated by the author at baseline (blue), midpoint (following therapeutic exercise intervention; purple) and at the final assessment (yellow). Available range of motion in all directions increased throughout the study. Lateral flexion showed the most significant increases, bilaterally.

Resisted isometric muscle testing of the right anterolateral neck flexors revealed significant weakness (3+/5) in the right sternocleidomastoid and anterior scalene muscle. Maximal contraction of these muscles reproduced the subject's right suboccipital pain at an intensity of 3/10. Moderate weakness was revealed in the left anterolateral neck flexors (4/5), as well as in the anterior neck flexors when contracted simultaneously on both left and right (4/5) but no pain was elicited with either test. Moderate weakness was also revealed in both the left and right posterolateral extensors(4/5), with each eliciting ipsilateral suboccipital pain at an intensity of 2/10.

Posterior to anterior mobilizations of the cervical vertebrae revealed minimal hypomobility of C3, but were otherwise unremarkable.

Orthopedic testing revealed facet joint irritation on the right side of the upper cervical spine, and shortening of the left pectoralis major (0.5 cm from table) and bilateral pectoralis minor muscles (left 2 cm from table; right 2.5 cm from table).

See Appendix A for a summary of all assessment results.

Therapeutic Exercise Intervention
The subject found stretching of the sternocleidomastoid, upper trapezius and levator scapulae muscles to be helpful in managing her chronic neck pain. Application of these stretches immediately reduced the intensity of the client's neck pain. As a result, compliance with the stretching portion of the home exercise program was good – all stretches were performed 1-2 times per day, with very few days missed. Compliance with the strengthening portion of the home exercise regime was less consistent. Strengthening was performed on approximately 50% of the days in this phase of intervention. Compliance with strengthening longus colli was slightly better than strengthening rhomboids.

Over the two and a half weeks of the therapeutic exercise intervention, the subject's neck pain averaged 2.8/10, representing a slight increase in average neck pain from baseline (2.2/10). Objectively, cervical active range of motion was improved (figure 1). In particular, rotation to the right had increased by 10˚ to reach 75˚. Bilateral lateral flexion was increased by 5˚ to reach 55˚ (Figure 1). Subjectively, the pain experienced with these motions was reduced, but still evident. The client perceived a stretch in the contralateral posterolateral neck with bilateral lateral flexion (right 1/10; left 2/10). Rotation to the right caused pain in the right suboccipital region (2.5/10), while left rotation was pain free.

Resisted isometric muscle testing revealed increased strength in the right anterolateral neck flexors (4/5), although maximal contraction of these muscles continued to cause 2/10 right suboccipital pain. Strength of the bilateral posterolateral neck extensors was also increased from baseline to 5/5.

Orthopedic testing revealed the length of the left pectoralis major muscle had increased (0 cm from elbow to table). Results of Spurling's test and pectoralis minor length test were unchanged.

Posterior to anterior mobilizations of the cervical vertebrae revealed normal mobility at all levels.

There was a slight decrease from baseline in average stress level (1.7/5 decreased to 1.4/5). Sleep quantity also decreased from baseline (8.5 h to 7.7 h). There was no apparent correlation between quality of sleep and neck pain on the subsequent day. Average activity level remained fairly constant from baseline (2.9/5) to midpoint assessment (2.8/5).

Massage Therapy Intervention
The average intensity of the client's neck pain over the four weeks of the massage therapy intervention was 1.6/10, representing a marked decrease from both the baseline and midpoint assessments. On the date of the final assessment, the subject had no neck pain, and had not experienced neck pain at intensities >1/10 for the full week between the final massage treatment and the final assessment.

Cervical active range of motion continued to increase throughout the massage therapy intervention (figure 1). In particular, lateral flexion increased by 15˚ to reach 70˚ bilaterally. There was a small decrease in rotation bilaterally – right rotation decreased 5˚ to 70˚, while left rotation decreased 2˚ to 75˚. Pain experienced with cervical range of motion decreased steadily throughout the massage intervention, and was pain free in all ranges at the final assessment.

Strength of the anterolateral neck flexors continued to increase, grading 4+/5 at the final assessment. Maximal isometric contraction of these muscles was pain-free bilaterally at the final assessment. All other resisted isometric muscle tests were strong and pain-free.

Orthopedic testing with Spurling's test was negative, indicating there was no longer any facet joint irritation in the cervical spine. Length testing of pectoralis major and minor did not change from the midpoint assessment. Posterior to anterior mobilizations of the cervical spine continued to be within normal limits at all levels. Neck diary entries ceased 3 days prior to the sixth massage. Based on the partial data set available, stress levels were increased to an average of 1.7/5, and average activity level had increased to 3/5. Average sleep quantity was 8.3 h per night.

Subjectively, the client experienced relief following each massage treatment. While not always eliminated, the intensity of the right suboccipital pain was reduced by 20% (figure 2), and the pain that typically accompanied cervical active range of motion was also reduced or eliminated following each massage treatment (figures 3 and 4). Palpably, the health of the subject's cervical musculature improved steadily throughout the massage intervention. In particular, by the third treatment the superficial anterior neck muscles (sternocleidomastoid and anterior scalene) were less hypertoned and elicited less tenderness upon application of direct pressure. Release of upper trapezius, levator scapulae, and the posterior suboccipitals occurred more rapidly as the treatments progressed, however the level of tenderness and hypertonicity at the beginning of each treatment was fairly constant.

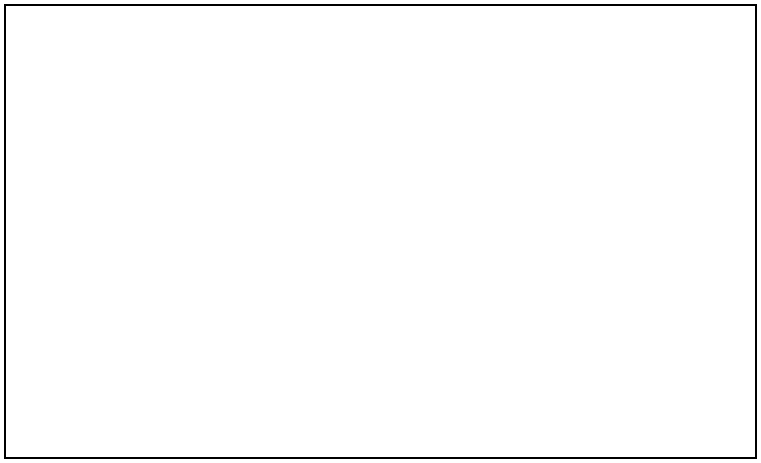

Figure 2: Right suboccipital pain as rated by the subject prior to massage treatment (blue) and post-treatment (purple) on a 10 point scale. Where no post-treatment bar is shown, pain was rated as 0/10. The subject consistently experienced relief from pain with massage treatment.

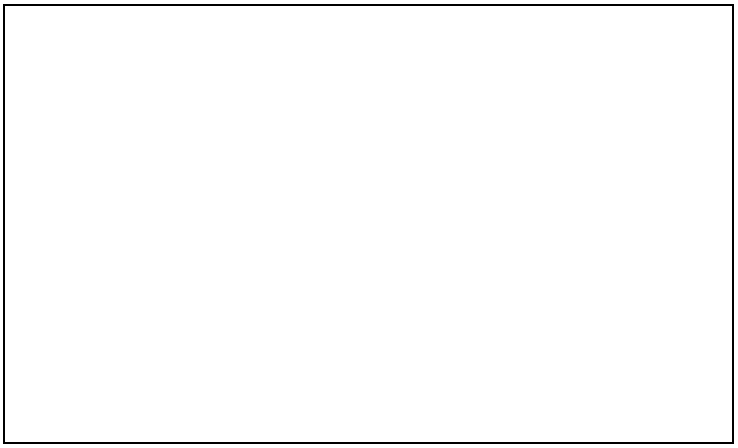

Figure 3: Pain experienced during active cervical rotation as rated by the subject on a 10-point scale. Pre-treatment pain scores are compared with post-treatment pain scores. Where no bar is shown, pain was rated at 0/10. Pain with active rotation was consistently decreased post-treatment, but the trend across treatments is not well-defined.

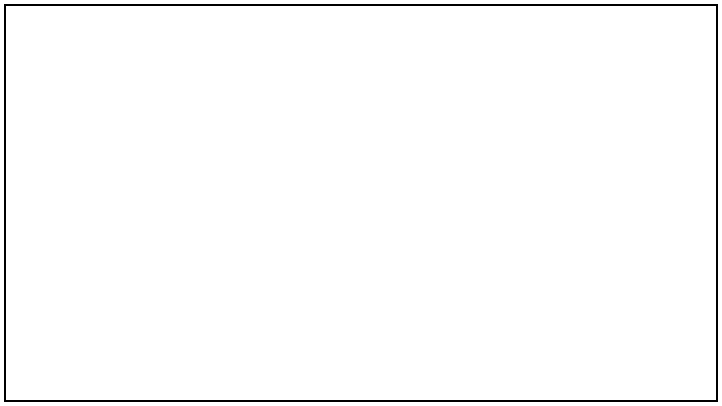

Figure 4: Pain experienced during active lateral flexion of the cervical spine, as rated by the subject on a 10-point scale. Pre-treatment pain scores are compared with post-treatment pain scores. Where no bar is shown, pain was rated as 0/10. Across treatments, the pain experienced with lateral flexion decreased.

DISCUSSION

This case study demonstrated that both comprehensive massage therapy treatment and therapeutic exercise when applied alone were effective in increasing the subject's cervical active range of motion, and decreasing the pain experienced with cervical AROM. The massage intervention reduced the subject's average daily right suboccipital pain, while the therapeutic exercise intervention resulted in an increased average daily pain rating.

The results of the therapeutic exercise intervention on daily average pain were particularly surprising when considering the subjective relief the client experienced with performance of the stretching exercises. The subject expressed experiencing immediate relief of neck pain with performance of the sternocleidomastoid and upper trapezius/levator scapulae stretches on several occasions. She was appreciative of the stretches and used them regularly in managing her neck pain over the course of this study. This would seem to indicate that, while the targeted muscles were indeed responsible for

causing the subject's neck pain, there was some unidentified factor that was causing and/or perpetuating the muscular imbalances in the client's cervical spine. Thus, while stretching provided symptomatic relief throughout the day, the cause of the cervical pain was unaffected by this intervention and no long term relief was experienced.

As noted in the Outcomes, compliance with the strengthening portion of the therapeutic exercise intervention was poor compared with the stretching portion. While not ideal for the purposes of this study, this is a realistic situation. The majority of clients do not perform home care exercises for as long or as frequently as requested by their health care practitioner (Kisner and Colby, 2007, p.31-32). While compliance with the stretching exercises was excellent due to the relief the client experienced, no such immediate gratification is forthcoming with strengthening exercises. The results of these exercises are slow but cumulative, as demonstrated by the increased strength in the client's anterolateral neck flexors. In subjects with chronic neck pain, there are often imbalances in the strength of the anterior neck musculature. Weakening of the deep craniocervical flexors, longus colli and longus capitis, is accompanied by increased activity of the superficial cervical flexors, sternocleidomastoid and anterior scalene. This results in an observable head forward posture, as well as a decreased ability to maintain a neutral cervical posture for even ten minutes (Falla et al., 2007). A corollary to this imbalance is reduced neuromuscular efficiency of the superficial cervical flexors. The altered neural input to these muscles necessitates far more activity in these muscles to produce a force comparable to that produced by subjects without neck pain (Falla et al., 2004). This imbalance was demonstrated in this case study both in the head forward posture observed in the subject's postural analysis, and in the weakness demonstrated during resisted isometric muscle testing. The reduced neuromuscular efficiency of the anterolateral neck flexors was demonstrated by weakness and pain under load. Furthermore, when the client performed cervical flexion in the supine position, it was very difficult for her not to dominate the movement with the larger superficial flexors as manifested by initiating the movement with a chin thrust instead of sequential rolling up of the cervical vertebrae. Following two and a half weeks of strengthening exercises targeting the deep longus colli and longus capitis muscles, the client showed a decreased chin thrust on initiation of cervical flexion, and increased strength of the superficial anterolateral cervical flexors. Thus, the therapeutic exercise intervention was effective in correcting the muscle imbalance between the layers of anterior cervical musculature.

A comprehensive approach to massage therapy continued to facilitate the subject's improvement. Average pain experienced on a daily basis was reduced markedly from the midpoint assessment to the final assessment. Analysis of the raw data demonstrates a trend towards decreasing daily pain scores over the 4 weeks of the massage intervention. Range of motion in cervical lateral flexion increased greatly during this phase of the study. Interestingly, cervical rotation decreased by 5˚, from the midpoint assessment to the final assessment. There are at least two possible explanations for this outcome. While range of motion is an objective finding, there is a significant amount of subjectivity introduced by the chosen method of measuring range of motion. Estimation by the author is subject to human error and is therefore relatively unreliable (Gajdosik and Bohannon, 1987). With years of practice, an experienced massage therapist can refine his or her

consistency at estimating degrees of motion. However, within the first several years of practice there is likely a large margin of human error that is introduced to this objective outcome. Thus, it is entirely plausible that the 5˚ decrease observed is due to inconsistency in estimation, and that cervical rotation may have remained constant through the massage intervention. This is an area in which improvement could be made to this study. Practiced use of a goniometer could increase the accuracy of measurement of cervical range of motion.

The second possible explanation for decreased range of motion in cervical rotation assumes that massage, like therapeutic exercise, was providing symptomatic relief more so than addressing the cause of the subject's neck pain. The first five massage treatments were performed at a frequency of 2 per week, so the majority of gains made in one treatment were carried over to the next. However, the sixth massage was given a full week following the fifth, and the final assessment was performed another full week following the sixth massage. Thus, the client had more time to lose gains acquired during the beginning of this intervention, and may have lost some range of motion.

The possibility that massage was providing symptomatic relief is supported by the subject's ratings of pain pre- and post-treatment, as well as her rating of pain experienced during cervical AROM. While the subject's pain ratings were consistently decreased post-treatment, often to 0/10 (figure 2), there was no trend towards decreasing pain at the beginning of each subsequent treatment. The same pattern can be observed with pre-treatment vs. post-treatment pain during cervical rotation (figure 3) – pain was consistently decreased after each massage treatment, but had returned by the beginning of the next treatment. While this motion was pain-free at the final assessment, the trend across all six treatments is not well defined. In contrast, pain with lateral flexion did decrease consistently from the second to the sixth massage treatment. However, the case history indicates that rotation was most consistently affected by the subject's neck pain, and it was this motion that aggravated the subject's right suboccipital pain. Pain experienced with lateral flexion was more often described as being a strong stretch down the contralateral posterolateral and lateral neck. It is likely that this was due to compensatory tightening of the lateral cervical musculature, while the cause of the primary neck pain was originating from elsewhere in the body.

Postural analysis of the subject presents two alternative sources for the subject's neck pain. Anterior rotation of the glenohumeral joint with concomitant scapular protraction indicates muscular imbalance in the thoracic region – this common pattern of strong, shortened musculature on the anterior aspect of the chest, and weak, lengthened musculature across the posterior thoracic region is labeled shoulder-crossed syndrome, and is almost always accompanied by head forward posture (Rattray and Ludwig, 2000). In this syndrome, the primary elements of treatment would be lengthening and decreasing tone of the pectoralis major and minor muscles, and increasing strength of the rhomboid major/minor and middle trapezius muscles. Addressing the muscle imbalances within the cervical region would be secondary. In this case study, the therapeutic exercise intervention attempted to address the imbalances occurring in the thoracic region, with stretching of the pectoralis major muscles and strengthening of the rhomboids. However,

compliance with these exercises was less consistent than with the stretches given for the cervical region. Furthermore, the massage intervention did not address the tissue health of the thoracic musculature. Future studies would be helpful in determining whether primary treatment of the thoracic region is helpful in the treatment of chronic neck pain.

The second region that presented as a possible causative site for the subject's neck pain was the pelvis. At the baseline assessment the subject had a posterior rotation of the left ilium, as determined by palpation of the anterior superior iliac spine, the posterior superior iliac spine, and performance of the standing forward flexion test (Hertling and Kessler, 2006, p. 950). Furthermore, the left anterior superior iliac spine was palpated to be anterior to the right, suggesting a rotation of the pelvis towards the right in the horizontal plane. It is possible that imbalances surrounding the pelvis traveled up the kinetic chain and contributed to the thoracic and cervical imbalances and the resulting cervical pain. Again, future studies are required to determine whether primary treatment of the pelvis is effective in relieving pain in the cervical region.

It is also possible that the subject's cervical pain was not entirely myogenic. While all assessment results indicate that the musculature was unhealthy and was most definitely contributing significantly to the subject's pain, it is possible that the cervical articulations were making a larger contribution than was assumed based on the results of cervical mobilizations. While all cervical segments had normal passive mobility in the antero-posterior dimensions, lateral movement, rotational movement and atlanto-axial/atlanto-occipital movements were not assessed. Active mobility of the cervical spine, as assessed by motion palpation during active cervical flexion, was also within normal limits. However, as rotation is the most affected range for this subject, active mobility in this range could present some salient assessment findings not considered for this study. Thus, the inclusion of cervical vertebral mobilizations in various dimensions could be of benefit in future studies or treatment of cervical dysfunction. With regards to joint health, grade I or II Maitland oscillations (Kisner and Colby, 2007) or muscle energy techniques may have been of benefit even in cases of myogenic cervical pain.

While there is always additional assessment that could be done to further clarify the nature of the subject's dysfunction, an attempt was made to keep the assessments to a time frame that was applicable to a clinical setting. However, in a clinical setting, further assessment could be performed at each subsequent treatment, and the treatment protocol modified as indicated. For the purposes of this case study, and in the interest in maintaining consistency across treatments, continuing assessments were not done, and the treatment protocol was not modified.

One of the most remarkable changes that resulted from this treatment protocol was the change in tissue tension and pliability of the anterior cervical musculature. By the third treatment, the bilateral sternocleidomastoid and anterior scalene muscles were markedly softer and easier to manipulate than at the commencement of the massage intervention. Additionally, the time required to obtain a release from these muscles decreased markedly as the tissue health improved. By the third treatment, patient response to intramuscular fascial release and trigger point therapy occurred in a matter of seconds, as

compared to the several minutes required for release at the commencement of the massage intervention. It should be noted that if half-hour or forty-five minute treatments are used instead of one-hour treatments, this change in tissue health could take longer to present.

This study has several limitations, some of which have been mentioned in the preceeding discussion. With regards to study design, it must be recognized that studies of a single individual have limited external validity. Personal history and response to treatment vary greatly among the population. Thus, while a case study provides valuable information regarding avenues for further research, the outcomes of each individual case study may not apply to the entire population suffering from chronic neck pain. Further, the separation between therapeutic exercise and comprehensive massage therapy could be more defined within the study design. A second baseline period in which no treatment is given could be included between the two interventions to ascertain more clearly the separate effects of each intervention. As presented in this case study, it could be argued that the therapeutic exercise continued to be the effective component of the comprehensive massage treatment. However, the palpable changes in the cervical musculature provide strong support for the efficacy of the massage treatment above and beyond the contribution of therapeutic exercise.

Another component to be considered is the effect of the subject's activities of daily living on the perpetuation of her neck pain. While daily stress, activity and sleep levels were recorded in the neck diary, it is difficult to draw any meaningful conclusions from an subject population of one. A larger study population would be required to have the statistical power to overcome individual variation and draw any conclusions regarding the effect of daily activities on chronic neck pain. One way to begin to address this issue in a case study format would be the use of an established neck pain questionnaire that includes measures of daily function and disability. The Neck Disability Index and the Neck Bournemouth Questionnaire are two such indexes that have been established to have good sensitivity to change and internal consistency (Gay, Madson and Cieslak, 2007).

CONCLUSION

This study provides support comprehensive massage therapy being an effective method of increasing cervical range of motion and decreasing pain experienced in a subject with chronic myogenic neck pain. Therapeutic exercise was also found to be effective in increasing cervical range of motion, but was less effective than massage at decreasing subjective pain ratings. Both interventions provided the subject with symptomatic relief from her chronic neck pain.

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Appendix A: Comprehensive Assessment Results

Table 1: Summary of results from baseline, midpoint and final assessments.

	Baseline Assessment	Midpoint Assessment	Final Assessment
Neck Diary Data			
Average Daily Pain (/10)	2.2	2.8	1.6
Average Daily Stress Level (/5)	1.7	1.4	1.7
Average Activity Level (/5)	2.9	2.8	3.0
Average Sleep Quantity (h/night)	8.5	7.7	8.3
Pain at Assessment (/10)	1.5	2	0
Active Range of Motion of Cervical Spine (degrees; pain/10)			
Flexion	70; 4	80; 1.5	80; 0
Extension	50; 0	50; 0.5	60; 0
Right Lateral Flexion	50; 5	55; 1	70; 0
Left Lateral Flexion	50; 4	55; 2	70; 0
Right Rotation	65; 4	75; 2.5	70; 0
Left Rotation	75; 2	77; 0	75; 0
Resisted Isometric Muscle Testing (strength /5; pain /10)			
Anterior neck flexors	4; 0	4; 0	5; 0
Right anterolateral neck flexors	3+; 3	4; 2	4+; 0
Left anterolateral neck flexors	4; 0	4; 0	4+; 0
Right posterolateral neck extensors	4; 2	5; 2	5; 0
Left posterolateral neck extensors	4; 2	5; 0	5; 0
Right upper trapezius/levator scapulae	5; 0	5; 0	5; 0
Left upper trapezius/levator scapulae	5; 0	5; 2	5; 0
Right cervical rotators	5; 0	5; 0	5; 0
Left cervical rotators	5; 0	5; 0	5; 0
Orthopedic Testing			
Spurling's Test			
Neutral	3/10 BL suboccipital pain	2/10 BL suboccipital pain	No pain
Extension	No pain	No pain	No pain
Left rotation	No pain	No pain	No pain
Right rotation	1/10 R suboccipital pain	1/10 R suboccipital pain	No pain
Pectoralis Major Length Test (distance from elbow to table in cm)			
Right Sternal head	0	0	0
Right Clavicular head	0	0	0
Left Sternal head	0.5	0	0
Left Clavicular head	0.5	0	0
Pectoralis Minor Length Test (distance from posterior acromion process to table in cm)			
Right	2.5	2.5	2
Left	2	2	2