

# Remedial Massage Therapy Interventions Including and Excluding Sternocleidomastoid, Scalene, Temporalis, and Masseter Muscles for Chronic Tension Type Headaches: a Case Series

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**Background:** Tension-type headache (TTH) is the most prevalent primary headache type world-wide. Chronic TTH (CTTH) of >15 headache-affected days per month for > 3 months can cause considerable pain and disability.

**Purpose:** This case series aimed to investigate whether massage therapy interventions were more effective when muscles of the anterior neck, jaw, and cranium were included.

**Design:** Four female clients suffering CTTH received six pre-determined massage therapy interventions, 45 minutes each, over three weeks. Case A and B (exclusion cases) received interventions addressing shoulder, posterior neck, and occiput muscles; Case C and D (inclusion cases) received interventions addressing the same areas as well as the sternocleidomastoid, scalene, temporalis, and masseter muscles.

**Intervention:** Treatment included myofascial trigger point release, neuromuscular therapy, and consideration of central sensitization mechanisms present in CTTH.

**Outcome Measures:** Headache frequency (primary), intensity, and duration (secondary) were recorded via headache diaries for baseline measures (one week), interventions (three weeks), and a run-out period (two weeks). Secondary measures also included a headache disability inventory (HDI) at baseline, intervention conclusion, and final measures. After final measures, clients received stretching education and four weeks later, a follow-up phone conversation to note subjective headache reports.

**Results:** All cases had headache frequency and HDI score reductions, while intensity and duration measures fluctuated. At final measures, exclusion Case A and both inclusion cases (C and D) had headache frequency reductions to below

CTTH diagnostic criteria, clinically meaningful (> 16%) HDI score reductions, and subjectively reported continued improvements after study completion. Inclusion cases overall had greater decreases in headache frequency and HDI measures.

**Conclusion:** Comparative results suggest there may be additional benefit in reducing headache frequency and disability with inclusion of anterior neck, jaw, and cranial muscles in treatment strategies of CTTH. However, limited sample size makes it difficult to rule out outliers or individual variables. Further investigation is recommended.

**KEYWORDS:** massage therapy; chronic tension-type headaches (CTTH); sternocleidomastoid; scalene; temporalis; masseter; myofascial trigger point; trigger point release; neuromuscular therapy; headache disability inventory (HDI); central sensitization

## INTRODUCTION

The most prevalent primary headache type world-wide is the tension-type headache (TTH).<sup>(1,2,3,4)</sup> Symptoms can include bilateral tension in frontal and occipital regions, dull ache across the forehead, sides or back of the head, and tenderness on the scalp or muscles of the neck, upper back, shoulders, and jaw.<sup>(1,2)</sup>

The International Headache Society (IHS) classifies TTH as episodic or chronic.<sup>(5)</sup> Episodes may be infrequent (< one day/month)<sup>(5)</sup> or frequent (1–14 days/month for > three months and > 180 days/year).<sup>(6)</sup> Episodic TTH diagnostic criteria includes bilateral, non-pulsating, pressing or tightening feeling of mild or moderate severity lasting 30 mins to seven days for at least 10 headache episodes.<sup>(6)</sup> The condition is not

associated with nausea or vomiting, and is not aggravated by routine physical activity. Either photophobia or photophobia may be present, but not both.<sup>(6,7,8)</sup> Primary episodic TTH is associated with higher prevalence in women and poor self-reported health. Mental stress, sleep problems, hormonal fluctuations,<sup>(1)</sup> postural tension and forward head posture (FHP) have been observed as influencing factors.<sup>(9,10)</sup>

When TTH frequency exceeds 15 or more headache-affected days per month for > three months, it is classified as chronic tension-type headache (CTTH)<sup>(7,11)</sup> and can cause considerable pain, debility, and negative impact on the individual's health and finances.<sup>(1,3,6)</sup> The pathogenesis of CTTH is not fully understood; however, several studies detail the most widely accepted theory of central sensitization (CS) through the presence of persistent nociceptive stimulus from active myofascial trigger points (TrP).<sup>(1,3,12,13)</sup> Clinical management is suggested to direct strategies to calm the central nervous system and normalize hypersensitivity.<sup>(3,12)</sup> There is suggestion this may be achieved by interrupting nociceptive stimulus and changing sensory input—for example, by using the contextual factors of light stroking or massage.<sup>(12,14)</sup>

Many successful treatment strategies for CTTH appear to have used neuromuscular therapy (NMT); incorporating stretch techniques, massage, and TrP release (TPR).<sup>(3,12,14,15)</sup> Muscles identified with a high presence of TrPs in cases of CTTH are upper trapezius, suboccipitals, sternocleidomastoid (SCM), temporalis, and superior oblique ocular muscles.<sup>(3,12,13,14)</sup> Other muscles identified have been levator scapula, semispinalis, splenius capitis, frontalis, and occipitalis.<sup>(10,12,14,16)</sup> Massage and manual therapy (MT) management of CTTH often addresses TrPs in shoulder and posterior neck muscles.<sup>(3,12,15,17)</sup> Few studies have also included TrPs in SCM,<sup>(3,10,12,14)</sup> and only three studies included full treatment of temporalis.<sup>(3,14,16)</sup> One CTTH study with emphasis on the treatment of TrPs in SCM, splenius capitis, upper trapezius, and temporalis muscles in nine children recorded a reduction in frequency of 67.7%, intensity reduction of 74.3%, and duration reduction of 77.3%.<sup>(14)</sup> A population-based study in 2014 concluded the most presented symptom of CTTH is pericranial muscle tenderness,<sup>(18)</sup> and other studies indicate TrPs from temporalis muscles contributed to CTTH pain.<sup>(19,20)</sup>

This case series addressed four cases of CTTH. The purpose of the study was to describe changes in the presentation and severity of headaches after two types of remedial massage intervention. This study had a comparative focus to investigate the importance, if any, of including the anterior neck, jaw, and cranial muscles, specifically SCM, scalene, temporalis, and masseter, in the clinical treatment of CTTH.

## METHODS

The study was carried out in Golden Bay, New Zealand, during May to July of 2017. The clinical application of interventions was implemented by the researcher, a massage therapist with eight years' professional experience qualified with a Diploma of Therapeutic and Sports Massage and, at the time of the study, was a student of Southern Institute of Technology (SIT) 3rd year Bachelor of Therapeutic and Sports Massage (BTSM) program. Ethical approval was granted by the SIT Human Research Ethics Committee.

### Client Selection

Clients were selected for this case series according to the established inclusion criteria of: meets IHS CTTH diagnostic criteria; otherwise healthy individuals; English speaking; male or female 18 to 60 years; and be available for baseline and final clinical measures, all interventions and headache diary recording throughout the six-week data collection period of the study without interruption. Clients with co-existent migraine, serious injuries, structural abnormalities, current or recent MT co-intervention, co-morbidity, eye issues, serious health conditions, and known interruption of upcoming stressful events were excluded.<sup>(12)</sup> Minor, medically controlled or history of minor medical conditions were allowed. Clients were also instructed to restrict lifestyle changes during data collection. Potential clients were recruited via a convenience sample from the community through an 'invitation to participate' posting on local community notice boards. All inquiries were screened and four female clients met the study criteria. They were given an information sheet which included an explanation of the study, treatment interventions, ethical considerations and rights, and possible

adverse effects of treatment. All clients gave written informed consent for all aspects of the study, with right of withdrawal at any time.<sup>(21)</sup>

## Interventions

Clients received predetermined massage therapy treatment protocols.<sup>(12,16)</sup> Two clients (Case A and B) received protocols which excluded SCM, scalene, temporalis, and masseter muscles, and two clients (Case C and D) received protocols including these muscles (Table 1). Treatment protocols were randomly allocated; however, the latter two allocations were modified to place clients with minor health conditions

in different treatment protocols. Both protocols included a total of six 45-minute interventions over three weeks. Five sessions were three to four days apart and the last intervention extended to seven days. The interventions were preceded by a one-week baseline period, and followed by a two-week run-out period. The second week of run-out was considered final measures for the study.

Areas of massage therapy for all cases included upper back, shoulders, posterior neck and occiput, specifically upper trapezius, levator scapula, semispinalis, splenius capitis, suboccipitals, frontalis, and occipitalis muscles. CS from chronic pain in participants was taken into consideration,

TABLE 1. Outline of Intervention Protocols (45 minutes each)<sup>a</sup>

Session	Intervention
Session 1: All cases Week One	<p><i>Introductory session with focus on relaxation and preparation.</i></p> <ul style="list-style-type: none"> <li>• Deep tissue relaxation massage of effleurage, petrissage and longitudinal stripping (LS) on back, neck, shoulders, gluteals and chest. – 30 mins</li> <li>• Neuromuscular therapy (NMT)<sup>b</sup> protocols on upper trapezius and sub occipitals. – 15 mins</li> </ul> <p>This session was applied to introduce the tissues to massage in general and encourage more receptivity to deeper muscle specific myofascial based treatment in subsequent sessions.</p>
Session 2: Cases A & B Week One	<p><i>Remedial massage with focus on upper shoulders, posterior neck and occiput (protocol 1).</i></p> <ul style="list-style-type: none"> <li>• Myofascial release (MFR)<sup>c</sup> to the whole back and across the superior aspect of gluteal muscles, shoulders and skin rolling<sup>d</sup> for warm up on the posterior neck. – 6 mins</li> <li>• Petrissage and LS used to warm upper trapezius (down to spinous process T5), levator scapulae, splenius capitis and semispinalis. – 3 mins</li> <li>• NMT applied to upper trapezius, levator scapula, semispinalis, splenius capitis. 10mins</li> <li>• Trigger point release (TPR)<sup>e</sup> applied to upper trapezius and levator scapula followed by myofascial facilitated stretch of lateral cervical flexion.<sup>e</sup> – 10 mins</li> <li>• Client turns over and MFR is applied across the top of the chest and superior aspect of pectoralis major. – 3 mins</li> <li>• NMT and TPR applied to sub occipitals and occipitalis. – 10 mins</li> <li>• MFR on frontalis and general head massage applied along with effleurage over the shoulder with sweeping strokes up to sub occipitals. Finish with gentle traction stretch of the head and neck. – 2 mins</li> </ul>
Session 2: Cases C & D Week One	<p><i>Remedial massage with focus on cranium &amp; jaw and including occiput &amp; anterior neck (protocol 2a).</i></p> <ul style="list-style-type: none"> <li>• MFR applied to the whole back and across the superior aspect of gluteal muscles, shoulders and skin rolling for warm up on posterior neck. – 6 mins</li> <li>• Petrissage and LS used to warm upper trapezius (down to spinous process T5), levator scapula, splenius capitis and semispinalis. – 3 mins</li> <li>• Client turns over and MFR is applied across the top of the chest and superior aspect of pectoralis major. – 3 mins.</li> <li>• NMT and TPR applied to sub occipitals and occipitalis. – 5 mins</li> <li>• NMT on sternocleidomastoid (SCM) and scalene muscle group are applied and TPR on SCM. – 7 mins</li> <li>• NMT and TRP on temporalis &amp; masseter including intra-oral compressions with a gloved hand -20 mins</li> <li>• MFR on frontalis and general head massage applied along with effleurage over the shoulder with sweeping strokes up to sub occipitals. Finish with gentle traction stretch of the head and neck. – 2 mins</li> </ul>

Session 3: All cases Week Two	<i>Repeat of Remedial massage with focus on upper shoulders, posterior neck &amp; occiput (protocol 1).</i>
Session 4: Cases A & B Week Two	<i>Repeat of Remedial massage with focus on upper shoulders, posterior neck &amp; occiput (protocol 1).</i>
Session 4: Cases C & D Week Two	<p><i>Modified Remedial massage with focus on cranial &amp; jaw and including occiput &amp; anterior neck (protocol 2b).</i></p> <ul style="list-style-type: none"> <li>• MFR applied to the whole back and across the superior aspect of gluteal muscles, shoulders and skin rolling for warm up on posterior neck. – 6 mins</li> <li>• Petrissage and LS used to warm upper trapezius (down to spinous process T5) and levator scapula, splenius capitis and semispinalis. – 3 mins</li> <li>• Client turns over and MFR is applied across the top of the chest and superior aspect of pectoralis major. – 3 mins.</li> <li>• NMT and TPR is applied to sub occipitals and occipitalis. – 5 mins</li> <li>• NMT and TPS on SCM and scalene muscle group are applied. – 15 mins</li> <li>• NMT on temporalis &amp; masseter including intra-oral compressions with a gloved hand. (excluding TPR) – 12 mins</li> <li>• MFR on frontalis and general head massage applied along with effleurage over the shoulder with sweeping strokes up to sub occipitals. Finish with gentle traction stretch of the head and neck. – 2 mins</li> </ul>
Session 5: Cases A & B Week Three	<i>Repeat of Remedial massage with focus on upper shoulders, posterior neck &amp; occiput (protocol 1).</i>
Session 5: Cases C & D Week Three	<i>Remedial massage with focus on cranial &amp; jaw and including occiput &amp; anterior neck (protocol 2a).</i>
Session 6: All cases Week Three	<i>Repeat of Remedial massage with focus on upper shoulders, posterior neck &amp; occiput (protocol 1).</i>

<sup>a</sup>All interventions were applied in accordance with the participants pressure/pain scale. A verbal scale of 1–10 was used, 1 being light pressure and 10 being strong pain that makes the client want to hold their breath. Pressure did not exceed an 8 on the clients' pressure scale.

<sup>b</sup>NMT Protocols for individual muscles: MFR warm up, skin rolling, cross-fiber and with-fiber friction strokes on origins and insertions of the muscles, compression of the muscle belly, deep longitudinal stripping and soothing effleurage strokes to finish.

<sup>c</sup>MFR: Stretching and release of facial tissues using a dry, oil free surface. Palmer hand strokes engaging with the myofascial and pulling tissues in various directions. This was a slow stroke where pressure was applied through the palm downwardly and not forcefully to engage the tissues. The palm and directional pressure then moved along the stroke line as the tissues let go.

<sup>d</sup>Skin rolling: Lifting of the superficial tissues between thumbs and fingers and rolling the tissues while lifted, to travel over the surface of the area being treated to release tissues.

<sup>e</sup>TPR: Myofascial trigger points (TrP) were palpated in specific muscles then manually treated with ischemic pressure, within the participants pressure scale, to elicit a referred pain response or autonomic referral. Pressure was maintained until the client reported a referral reduction of 50%, then additional pressure was added to bring the referral response back to a 7 or 8 on the client's pressure scale. This process was repeated up to 2 mins per TrP or until the TrP had resolved. The pressure was then released to flush the area with fresh oxygenated blood.

<sup>f</sup>Myofascial facilitated stretch of lateral cervical flexion: The client's neck was passively and gently moved by the massage therapist into lateral flexion with therapist providing overpressure to the shoulder to prevent elevation. This stretch was performed in a supine position within the client's comfortable end of range where they could feel a stretch. This was held for 25 sec.

as recommended,<sup>(3,12,14)</sup> the first 45-minute intervention for both protocols included 30 minutes of relaxation massage. All cases also received myofascial release (MFR) applied to back, gluteal, and chest areas to release fascial influence and partially address postural tension.<sup>(22,23,24)</sup> Cases C and D received 3 of their 6 sessions focusing on NMT and TPR protocols for SCM, scalene, temporalis, and masseter muscles,<sup>(3,12,14,22)</sup> using two variations to guard against overtreating and sensitization due to close succession of interventions. Warming or soothing strokes of effleurage, petrissage, and MFR were applied surrounding NMT and TPR protocols detailed in Table 1. All clinical interventions were applied within the participants pressure/pain scale.<sup>(22)</sup> Practitioner and participant interaction was kept to a minimum to reduce outcome bias.

After conclusion of data collection, participants were educated on stretches to assist in maintaining the benefits of clinical treatment.<sup>(16,22)</sup> Stretches included iliopsoas, gluteals, trapezius, levator scapula, scalene fascial line, suboccipitals, and pectoralis major. Particular stretches were chosen for their direct, myofascial, or postural impact on the soft tissues treated during interventions.<sup>(22,23)</sup>

### Evaluation Procedures

Keeping in line with IHS standards, the primary outcome measure was frequency of headaches.<sup>(12,25)</sup> Secondary outcome measures were peak intensity, duration per headache,<sup>(10,16,25,26)</sup> and Headache Disability Inventory (HDI) measuring quality of life.<sup>(8,10,12,27)</sup> Other measures taken were: analgesic medication taken,<sup>(26)</sup> FHP,<sup>(9,10)</sup> and cervical range of motion.<sup>(22)</sup>

The best, most accepted measure of frequency, intensity, and duration is through a headache diary,<sup>(12,16)</sup> shown to provide accurate data in three to four weeks.<sup>(12)</sup> Participants kept a daily headache diary for the six-week data collection phase, noting the number of headache-affected days per week. Headache durations were recorded in hours and minutes, and headache intensity was recorded using a 10 cm Visual Analogue Scale (VAS) with anchor points of 'no pain' at '0' and maximum pain at '10'.<sup>(10,12,16,26)</sup> The diary also included notations regarding analgesic medication taken.<sup>(26)</sup>

HDI is considered a reliable measure, consisting of 25 questions related to

disability experienced from a score of 0% (no disability) to 100% (severe disability).<sup>(8,12,27)</sup> These were completed by each participant with the researcher absent and on non-intervention days.<sup>(10)</sup> A change of > 16% is recognized as clinically meaningful.<sup>(8,12,27)</sup> HDI and clinical measures were recorded at three intervals: beginning of baseline week, conclusion of interventions, and conclusion of final measures. The researcher/massage therapist was blind to the headache diaries and HDI measures during data collection. As an extension to the study, participants agreed to a follow-up informal phone conversation four weeks after final measures, to note participants' current subjective estimated frequency, intensity, and duration of headaches.

### Data Analysis

All participants completed all clinical interventions and daily headache diary requirements. Due to scheduling requirements, the three-week intervention period included three weeks and one day; therefore, the run-out period data includes the last intervention day and 13 days of run-out. Frequency, intensity, and duration data were collated into weekly intervals with mean values per headache recorded for intensity and duration.<sup>(10,16)</sup> Duration data were converted into hour values and rounded to the nearest decimal point. In cases where participants recorded numerical value instead of a mark on the 10 cm VAS scale, numerical data were converted into cm value for collation. In cases of either start or finish duration recorded as 'sleep' or 'waking up', times were taken as per the participants' normal routine. HDI disability scores were recorded in percentage.<sup>(8,10,12,27)</sup> Changes to infrequent analgesic medication taken and clinical measures were unremarkable throughout the study, so this data were not reported on. Data collection and collation was implemented by the researcher.

## RESULTS

### Case A

Case A was a 55-year-old, part-time photographer who presented with CTTH which started one year ago. This client was a single female living in a house bus with

occasional house-sitting. She had a history of Graves' disease and had been symptom free for four years. Case A received treatment protocols excluding the anterior neck and jaw muscles (exclusion case). Overall her condition improved, with a decrease in frequency (Figure 1) of five headache-affected days per week at baseline reducing to three at final measures (run-out Week Two), and a decrease in intensity and duration values (Figures 2 and 3). HDI results (Table 2) showed a clinically meaningful (> 16%)<sup>(8,12,27)</sup> decrease of 18% overall out of 100% disability from the baseline score of 34%, reducing to 16% disability at final measures. At the conclusion of this study,

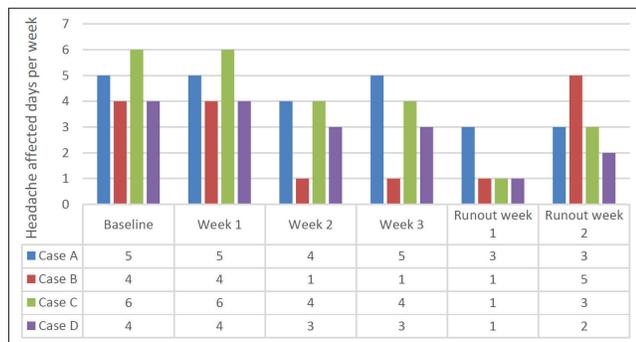


FIGURE 1. Headache frequency.

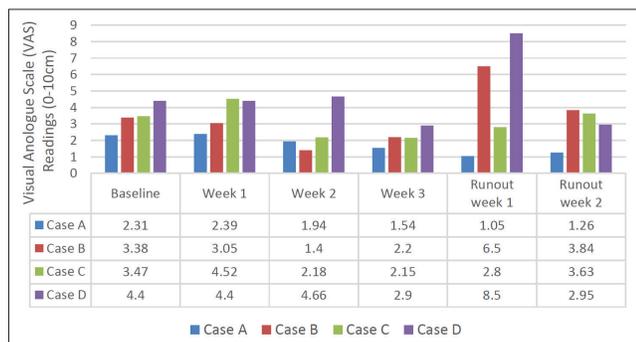


FIGURE 2. Headache intensity (weekly mean values).

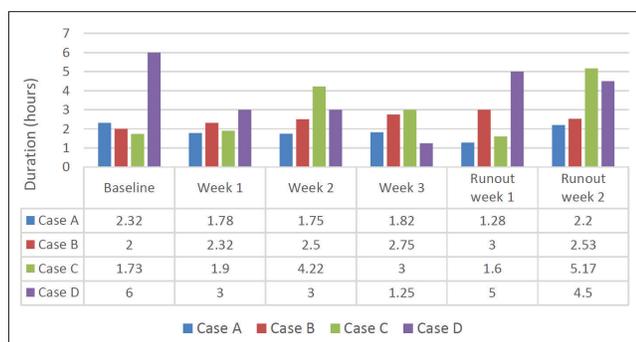


FIGURE 3. Headache duration (weekly mean values).

TABLE 2. Participant HDI Measures<sup>a</sup>

Case	Baseline Disability	Intervention Completion Disability	Final Measures Disability	Total % Decrease Baseline to Final Measures
Case A	34%	22%	16%	18%
Case B	56%	34%	40%	16%
Case C	38%	14%	18%	20%
Case D	66%	6%	6%	60%

<sup>a</sup>Percentage scores of disability out of 100%.

Case A no longer met the IHS frequency criteria (> 15/month) for CTTH.<sup>(11)</sup>

Case A was observed to have active TrPs familiar to her headache pain in trapezius and suboccipitals, though did not experience posttreatment exacerbation. Case A verbally reported sleep improvements from the first and subsequent interventions. Case A was noted to have engaged in lifestyle changes including nutritional improvements, irregular stretching, and home environment changes, with increased winter warmth potentially reducing TrP activity.<sup>(24)</sup> It is unknown how these factors may have affected the measures for this client; however, during data collation it was discovered the headache frequency increase in Week Three (Figure 1) had coincided with a change back to a colder living environment.

### Case B

Case B was a 29-year-old female, working part-time in customer service, who presented with CTTH which started 15 years ago. Her medical history included former Endometriosis four years prior to this study, and a minor right-side soft-tissue shoulder injury 16 years prior. Case B was an exclusion case. Figure 1 shows an overall increase in headache frequency from a baseline score of four headache-affected days per week to five at final measures. However, the general trend through the treatment phase was a decrease in headache frequency. Headache intensity (Figure 2) fluctuated with a dramatic increase in run-out Week One based on a single headache episode. Duration values (Figure 3) steadily increased slightly over the course of the study, and the results showed an overall increase in both headache intensity and

duration for Case B. HDI results (Table 2) decreased from a baseline score of 56% disability to 40% at final measures, with a total overall change of 16% disability.

Case B was also observed to have active, familiar TrPs in trapezius and suboccipitals and experienced posttreatment TrP exacerbation after Intervention 2. Case B reported improved sleep after Intervention 1. During Week Two of interventions she subjectively reported an increasing awareness of jaw tension and the impulse to stretch the jaw. As her headache severity decreased during the study, Case B engaged in increased activities of social time, recreation, and gardening. It was noted during data analysis that her most severe headache episodes were on Thursdays and Saturdays which may indicate the influence of lifestyle factors.<sup>(1,13)</sup>

### Case C

Case C was a 54-year-old female office administrator and grandmother who presented with CTTH which started three years ago. This client was diagnosed with hypothyroidism 15 years ago and this has been medically controlled since then. She received treatment protocols including the anterior neck and jaw muscles (inclusion case). Case C had an overall decrease in headache frequency (Figure 1) of a baseline of six headache-affected days per week, reducing to half with a result of three at final measures. Case C had fluctuating headache intensity (Figure 2) and duration (Figure 3) values from baseline to final measures with an overall increase in intensity and a dramatic increase in duration on the week of final measures. HDI results (Table 2) showed a clinically meaningful (> 16%)<sup>(8,12,27)</sup> decrease in disability of 20% total overall change from the baseline score of 38% disability, reducing to 18% at final measures. At conclusion of this study, Case C no longer met the IHS frequency criteria (> 15/month) for CTTH.<sup>(11)</sup>

Active, familiar TrPs were observed in trapezius, suboccipitals, SCM, temporalis, and masseter muscles. CS mechanisms and hypersensitivity were observed bilaterally in SCM, temporalis, and masseter muscles. It was noted by the therapist that these muscles may have benefited from more time during NMT than was allocated in protocols. Headache intensity trends on Figure 2 show a spike in intensity in Week One coinciding with strong posttreatment

TrP exacerbation, familiar to Case C's CTTH pain, following the first intervention addressing the anterior neck and jaw. Intensity values then decreased during the intervention phase and increased during the run-out period. Headache duration increases (Figure 3) on Week Two and final measures may have been affected by the presence of a cold virus<sup>(1)</sup> Case C was experiencing on Week Two that relapsed again on final measures week. Case C verbally reported considerable sleep improvements from the first intervention onward, and emotional responses to relief of pain and tension during early interventions was noted. Previous literature has suggested there may be psychological benefit from massage therapy in sufferers of TTH.<sup>(28)</sup>

### Case D

Case D was a 53-year-old self-employed family woman who presented with CTTH which started three years ago. Case D was an inclusion case and overall had an improvement to her condition, reporting a decrease in frequency (Figure 1) with a baseline of four headache-affected days per week, reducing to half with a result of two at final measures. Headache intensity (Figure 2) values show little change until a decrease on Week Three of interventions. In run-out Week One, a spike in headache intensity and duration (Figures 2 and 3) is seen and is based on a single headache episode for that week. Overall both headache intensity and duration values decreased for Case D from baseline to final measures. HDI results (Table 2) for Case D reported the largest clinically meaningful (> 16%)<sup>(8,12,27)</sup> decrease among all cases in this series. A baseline score of 66% disability reducing to 6% at final measures showed a total overall decrease of 60% disability out of 100%. At conclusion of this study, Case D no longer met the IHS frequency criteria (> 15/month) for CTTH.<sup>(11)</sup> This overall change in quality of life may be due to Case D having a baseline duration of more than double other cases, thus creating a greater decrease in headache-affected hours per week with any frequency reduction.

Active, familiar TrPs were also observed in trapezius, suboccipitals, SCM, temporalis, and masseter muscles for Case D, with CS mechanisms and hypersensitivity bilaterally in SCM, temporalis, and masseter. Case D also experienced strong posttreatment TrP exacerbation following the first

intervention including anterior neck and jaw that elicited familiar referrals to her CTTH patterns, experienced considerable sleep improvements throughout interventions, and expressed emotional response to treatment relief during interventions.<sup>(28)</sup> Case D engaged in increased social and recreational activities as treatment progressed and headache severity decreased.

### Six-Week, Post-Intervention Follow-Up (all cases)

During the informal follow up phone call, four weeks after final measures, effectively six-weeks post-interventions, all cases reported tension reducing benefit from prescribed stretches, as related in previous studies.<sup>(16)</sup> Cases A, C, and D all reported headaches continuing to decrease, with no bothersome headaches (Case C) or no headaches at all (Cases A and D) within the last four weeks. Case B reported a headache increase subjectively due to increased work hours.

## DISCUSSION

Whilst comparing two different massage therapy protocols is challenging in such a small case series, the findings do suggest that both intervention protocols may have been beneficial. All four cases in this series had headache frequency reductions (Figure 1) and, after completion of this study, one exclusion case (Case A) and both inclusion cases (Cases C and D) had headache frequency reductions that meant they were no longer classified under the IHS criteria for CTTH (> 15 headache-affected days/month).<sup>(11)</sup> These three cases subjectively reported continued improvement after the study concluded. Furthermore, all cases had a reduction in HDI scores (Table 2), with exclusion Case A and both inclusion cases showing clinically meaningful (> 16%)<sup>(8,12,27)</sup> reductions. Comparatively, between protocols, the data suggest the inclusion cases (C and D) overall had the largest decrease in frequency (Figure 1) and HDI (Table 2) measures from baseline to final measures. However, these comparative results could be skewed by the strong individual result of Case D.

Headache intensity and duration measures were variable with one-off incidences affecting the data, indicating lifestyle

factors may influence CTTH.<sup>(1,12)</sup> As such, these measures of change were less useful than headache frequency and HDI scores for a small sample.

Similar patterns in clinical evaluations were observed between the inclusion cases C and D; however, the results varied between the two exclusion cases (A & B). Differences in the two exclusion cases are potentially due to variables including age, years affected by CTTH, and lifestyle.<sup>(1)</sup> Case B's onset of CTTH was in adolescence and she was the only client of childbearing age, which may imply a hormonal influence.<sup>(1,7)</sup> Case B had also suffered CTTH 15 years, longer than any other cases of one to three affected years. Increased years of nociceptive stimulus from peripheral tissues may create greater degrees of CS and decrease success rates of MT for CTTH.<sup>(3)</sup> TrP exacerbation and potential CS was observed in all cases, except Case A who had suffered CTTH only one year. Future studies could consider participant age, gender, and number of years suffering CTTH. Exclusion Case A had improvements in all evaluations; however, she did alter lifestyle factors through the study thereby making it more difficult to compare findings. Previous literature recognizes recreational, emotional, and occupational exacerbating factors are difficult to fully eliminate.<sup>(1,12)</sup>

Of clinical interest were the sensations of increasing jaw tension with growing desire to stretch as reported by Case B as interventions progressed. The fascial lines of posterior neck and cranium (exclusion cases massage areas) and the anterior lines (inclusion cases massage areas) have a reciprocal relationship.<sup>(24,29)</sup> It is feasible, when unwinding posterior fascial lines, tension in the opposite anterior lines may feel pronounced. This may account for the increase in Case B's final measures. Myers likens this interplay to 'rigging on a sailboat',<sup>(24)</sup> implying importance in addressing both reciprocal lines of tension and considering how they relate.<sup>(24,29)</sup> Future studies also need to consider the ethical implications of potentially increasing participant discomfort with hypothetically imbalanced treatment protocols.

Further findings of this study support existing literature showing the benefits of NMT and TrP release as valid treatment strategies for CTTH.<sup>(3,12,14,15)</sup> Active TrPs eliciting familiar headache pain in trapezius and suboccipitals were observed in

all cases. Previous studies recognize initial improvements are often counterbalanced by aggravation from treatment.<sup>(12)</sup> Although care was taken during interventions, inclusion cases C and D both experienced posttreatment exacerbation and sensitization of SCM, temporalis, and masseter eliciting TrP referrals familiar to clients' headache patterns. This may further indicate importance of addressing these muscles in CTTH treatment, including introductory relaxation massage components of protocols. Previous studies also suggest that normalizing the nervous system response is as important as relieving the mechanisms creating CS.<sup>(3,12)</sup>

In future studies, more time during interventions may potentially assist this process of calming CS. A greater quantity of intervention sessions and longer run-out period to measure lasting benefit would also provide valuable information. Most importantly, a larger sample is needed to add weight and credibility to the recommendation of incorporating muscles of the anterior neck, jaw, and cranium into treatment plans for CTTH.

As this was a small-scale case series, the sample size, quantity, and duration of interventions and the run-out period duration were limited. Researcher bias with potential influence on clients, even with minimal interaction during interventions, cannot be ruled out due to the nature of clinical treatment. Another limitation of this study is the lack of male representation. Although CCTH is associated with a stronger prevalence in women,<sup>(1)</sup> more research into CTTH in males is needed and a larger sample may provide this.

Primary and secondary outcomes for this case series were in line with IHS recommendations and common practice in headache research.<sup>(12,14,16,25)</sup> While headache diaries are considered accurate and standard practice,<sup>(8,12)</sup> future studies are recommended to include a visual example for participants and diary checks after the first week at least, potentially at regular intervals throughout.<sup>(10)</sup> This check was forgone in this study in favor of researcher blinding. In a larger scale study, ideally the researcher would not administer the interventions and could perform diary checks. A timekeeper during treatment interventions to ensure accuracy<sup>(16)</sup> may also be helpful to create a more robust experiment.

In a normal clinical setting, a more pragmatic approach for the treatment of

CTTH may be required<sup>(12)</sup> when addressing exacerbating lifestyle factors, adding applicable stretches,<sup>(16)</sup> or catering treatment durations on specific muscles for the needs of the individual.

## CONCLUSION

The purpose of this case series was to address the question of whether massage therapy interventions for the treatment of CTTH were more effective with the inclusion of the anterior neck, jaw, and cranial muscles. The findings from each of the four cases suggest that massage therapy protocols including NMT, TPR, and calming of CS mechanisms may help address the symptoms of CTTH. Furthermore, there may be additional benefit in the inclusion of anterior neck, jaw, and cranial muscles for reduction in headache frequency and headache disability for the treatment of CTTH. A larger study investigating the inclusion of SCM, temporalis, and masseter muscles in the treatment of CTTH is recommended.

## CONFLICT OF INTEREST NOTIFICATION

The authors declare there are no conflicts of interest.

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