Massage Therapists' Association of British Columbia

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Alison Ritchie

Temporomandibular Joint Dysfunction: A case study

P: 604.873.4467
F: 604.873.6211
research@massagetherapy.bc.ca
massagetherapy.bc.ca

Massage Therapy and Temporomandibular Joint Dysfunction

Background

The TMJs are one of the few synovial joints in the human body with an articular disk. The disk divides each joint into two. The disc is hypovascular but is attached to retrodiscal connective tissue that is highly vascularized and well innervated. Loading of the joint is distributed over the articular surfaces by the intra-cartilaginous disk (Tanaka and Eijden, 2003). When improper loading begins to occur within the joint it can lead to internal derangement (Tanaka et al., 2007).
Pain in and around this joint has several names, the most common being temporomandibular joint dysfunction (TMD), craniomandibular dysfunction (CMD) and myofacial face pain. TMD can be caused by a combination of many factors. The most common are imbalances or overuse of the muscles of mastication, malocclusion, cranial bone misalignment, postural dysfunction, increased stress, trauma, sinus infection and joint pathology.

Signs and symptoms of TMD

The common signs and symptoms of TMD are pain in the temporomandibular joint and masticatory muscles, restricted mouth opening, joint noises, tinnitus, headaches and neck pain (Dworkin and LeResche, 1992).

Schiffman et al., 2007).
Rattray and Ludwig (2000)

Etiology of TMD

Mild symptoms of TMD occur in 20 – 85% of the population (Wanman, 1996; Ciancaglini et al., 2001) and clinically significant TMD is reported in approximately 5-6% of the population (Goulet et al., 1995; Conti et al., 1996). Several factors can trigger TMD including occusal interference, hyperactivity of the temporal and masseter muscle, bruxism, stress, osteoarthritic degeneration, disk dislocation and postural abnormalities such as cervical spine dysfunction (Cooper and Cooper, 1991; Flor et al., 1991). Glaros et al (1998) suggested that parafunctional low level clenching is a factor in the development of TMD.
TMD is most common between the ages of 25-44 years (Dekanter et al., 1993). It is 2 times more prevalent in women and 80% of the treated cases are women (Dworkin et al., 1990). Approximately 2% of the patients with TMD have jaw locking in the closed position from a permanently displaced disc (Le Resche, 1995). This advanced stage of TMD can cause pain and impairment of function (Schiffman et al., 2007).

Hypothesis

The hypothesis of this paper is that massage therapy treatments can decrease the pain associated with TMD, can reduce the range of motion restrictions of the TMJ caused by soft tissue and can assist in the correction of postural factors contributing to the dysfunction.

MUSCLE INVOLVEMENT IN TMD

Muscles of the head and neck are divided into functional groups such as mastication, facial expression or postural (Chandu et al., 2005). Muscles from all three functional groups are involved in TMD as demonstrated through increased electromyography (EMG) levels either at rest or during contraction. This technique evaluates and records physiologic properties of muscles. EMG is performed using an electromyograph to produce a record called an electromyogram. An electromyograph detects the electrical potential generated by muscle cells when these cells contract, and also when the cells are at rest. Increased EMG activity can be a hyperactivity response to pain, or the hyperactivity can result in pain. Hyperactivity can lead to further pain and dysfunction and the patient can enter the 'vicious cycle' as described by Travell and Simons (1983).
The muscles most commonly involved in TMD are temporalis, masseter, medial pterygoid, lateral pterygoid, sternocleidomastoid and the upper trapezius. Through their study of EMG activity of the temporalis, masseter and sternocleidomastoid, Ries et al. (2008) showed that TMD patients have less symmetry in the jaw and neck muscles. This asymmetric activation can be attributed to a compensatory strategy to achieve stability for the mandibular and cervical systems in the presence of a pain pathology.

(Jacke et al., 1996), (Horio, 2003) (Veldhuizen et al., 2003). (Kapel et al., 1989; Glaros et al., 1997). (Chandu et al., 2005) (Kapel et al., 1989).
(Tanaka et al., 2007). (Hiraba et al., 2000; Okeson, 1998).
(Ries et al., 2008).
(Clarke et al., 1993). (Musculino, 2005). (Davies, 1979). Santander et al (2000) (Ehrlich et al., 1999; Travell and Simons, 1983).
Ceneviz et al. (2006).

POSTURAL CONSIDERATIONS IN TMD

There are anatomic, neurologic and physiologic interactions of the TMJ and the cervical spine. The connection between the masticatory and cervical motor systems is a form of co-activation – an anatomical, physiological, developmental and functional coupling (Clarke et al., 1993, Browne et al., 1993). From a functional aspect, the masticatory, neck and trunk muscles are strongly connected due to reciprocal innervation of the trigeminal and cervical systems that creates mutual inhibition and activation (Tecco et al., 2007; Browne et al., 1998). Trigeminal sensory afferents were found in several 'non trigeminal' areas of the central nervous system (Eriksson et al., 1998), and trigeminal inputs from the periodontal, temporomandibular joint and muscle receptors can have influence in the modulation of cervical muscles (Tecco et al., 2007). This means that the cranio-cervical complex functions as one, where changes in one part can have an effect elsewhere in the system (Ceneviz et al., 2006). It has been suggested that poor posture can irritate the trigemino-cervical and central nervous systems (Austin, 1997). Due to the connections between the craniofacial and cervical spine areas, the treatment of TMD may not be successful if there is an untreated cervical pathology (Browne et al., 1998). The presence of pain can lead to compensatory motor action and a modified habitual mandibular position at rest and during mastication as well as changes in the cervical spine (Ries et al., 2008)

EMG studies have been conducted to show how movements of the head affect mandibular position (Preiskel, 1965; Boyd et al., 1987) and how changes in mandibular position affect both masticatory and cervical muscles (Miralles et al., 1992; Jimenez, 1989; Zuniga et al., 1995). The mandible rotates posteriorly in the upright position and anteriorly in the supine position, with the condyles moving antero-inferiorly (Tingey et al., 2001). Upright positioning of the mandible is an important factor in TMD as the muscles that elevate the jaw are continuously working against gravity as well as working during chewing, swallowing and talking (Rattray and Ludwig, 2000). Mal-alignment in the rest position of the mandible affects the ability of the surrounding muscles to function properly due to hypertonicity or stretch weakness. Mal-alignment can be related to both the cervical spine and the shoulder girdle.

Cervical spine and shoulder girdle.

The position of the cervical spine has an effect on the lower jaw (Goldstein et al., 1984; Visscher et al., 2000). De Wijer et al. (1996) showed that TMD patients with myogenic involvement also had mobility restrictions in the cervical spine. Stiesch – Scholz et al. (2003) found a significantly greater restriction in rotation, lateral flexion and extension of the cervical spine in patients with TMD. They also found more hypomobile zygopophyseal joints and a higher incidence of cervical and dorsal shoulder muscle tenderness upon palpation compared to the control group. TMD and cervical dysfunction can have a common etiology, or one can play a role in the development of the other (Stiesch-Scholz et al., 2003).

Sleeping position and bruxism

Hibi and Ueda (2005) conducted a pilot study in which they looked at the relationship between habitual body posture in sleep and the occurrence of TMD with anterior disk displacement. They discovered that more than half the patients with unilateral anterior disc displacement had an ipsilateral habitual body posture, while none had contralateral posture. Head positioning follows body positioning therefore side postures during sleep alter the mandibular rest position through gravity. The ipsilateral condyle is re-positioned superiorly, posteriorly and lateral. With habits such as bruxism, additional force is applied posteriorly to the disk. The retrodiscal tissue degrades, the condyle moves posteriorly and the disk moves anteriorly relative to the condyle.

Bruxism that involves predominately clenching as opposed to grinding exerts continual and excessive force on the TMJ and masticatory muscles because protective reflexes are not as functional during sleep (Hibi and Ueda, 2005). Forces are more harmful than during voluntary mastication because the contractions are often isometric, for longer periods of time and the mandibular contact is in an unstable position (Rugh and Ohrbach, 1988).

PSYCHOLOGICAL CONSIDERATIONS IN TMD

Pain perception and Hypothalamic-Pituitary Axis

TMD can be considered a chronic musculoskeletal disorder such as back pain, arthritis and headache. The understanding of these chronic disorders includes psychological or behavioural factors (Dworkin and Suvinen, 1998; Dworkin and LeResche, 1992). The onset and exacerbation of the symptoms of TMD are associated with the occurrence of environmental stressors and thus TMD is classified in the group of stress related disorders that includes fibromyalgia and chronic fatigue syndrome (Korszun et al., 1998).
The perception of pain is mediated by numerous influences and involves a widely distributed neural network that comprises the body's stress – regulation systems (Melzack, 1999). Dysregulation of pain hormones has been documented in both depression and stress related disorders (Demitrack, 1998). The main neuroendocrine system in the body involved in stress is the hypothalamic pituitary adrenal axis that controls the release of glucocorticoids from the adrenal gland. Pain from musculoskeletal damage activates the hypothalamic – pituitary axis, which results in the release of glucocorticoids, including cortisol. Cortisol levels have been shown to be significantly higher in TMD women TMD women with higher cortisol levels were more likely to report greater pain severity (Korszun et al., 2002). Korszun et al. (2002) suggest that the high levels of cortisol represent a psychological response to chronic stress such as pain.

Other hormonal considerations

TMD occurs most often in women during their reproductive years. A major biological process for women during this time is the menstrual cycle and its associated fluctuations in hormones, physiology and behaviour (Vignolo et al., 2008). Although there have been varying results in the effects of the menstrual cycle on pain perception, Vignolo et al. (2008) found that although TMD women had higher reports of pain sensitivity, the phase of the menstrual cycle did not have a significant effect compared to the non TMD women. They found there was an increase in pain perception during the menstrual phase for all participants and women taking oral contraceptives had an enhanced pain-pressure threshold.

RESEARCH ON MASSAGE THERAPY TREATMENT AND TMD

There were no studies found regarding massage therapy and TMD. There is a lack of research regarding the effectiveness of massage therapy in general – and the research that has been done defines massage therapy strictly as the manipulation of soft tissue and the primary modality studied is Swedish massage (Tsao, 2007). As a practice, massage therapy includes joint mobilizations and rehabilitation exercises, but in the existing literature these modalities tend to fall under the category of physical therapy. With respect to TMD, Schiffman et al (2007) conducted a study to compare the outcome of patients with close lock TMD after medical management, rehabilitation, arthroscopy with post-operative rehabilitation and arthroplasty with post-operative rehabilitation. They defined medical management as education on the condition, optimistic counseling, a self - help program, administration of non-steroidal anti-inflammatory drugs for 3-6weeks and the use of muscle relaxants as needed. Rehabilitation was defined as treatment from a dentist, physical therapist and health psychologist. The physical therapy component involved joint mobilization, soft tissue treatment and a home exercise program. The cognitive behavioural component involved an oral habit assessment and habit reversal sessions. In this study, no difference in the magnitude or timing of improved function or pain was found between the four treatment strategies. Although massage therapy was not explicitly examined in this study, the results show that soft tissue manipulation, joint mobilization and appropriate home care exercises can be effective in treating TMD.

CASE STUDY

This case study was a 28 year old female who presented with symptoms of TMD and who reported a high frequency of those symptoms for the past 8 months. The patient received seven massage therapy treatments and a daily home care routine.

ASSESSMENT

An initial scan exam was performed and ranges of motion were measured for the jaw (measuring tape) and the cervical spine (goniometer). Head forward posture was also measured (measuring tape) as the distance from the wall when standing in a neutral posture with the heels against the wall.

History form

The patient completed a chewing ability questionnaire, a thorough history questionnaire and an interview. See Appendix A for the completed history form and initial interview.
The results of the patient's history questionnaire and assessment indicates that the patient may be suffering from TMD.

Palpation Tenderness

The following muscles were palpated using a steady level of index finger pressure: trapezius, sternocleidomastoid, supraspinatus, infraspinatus, suboccipitals, masseter, temporalis, medial pterygoid and lateral pterygoid. These muscles were palpated on the initial visit and after the seventh treatment (see Figure 5 and 6).

INTERVIEW AND ASSESSMENT FINDINGS

History

The patient is a 28 year old female who spends large amounts of her time sewing, singing and playing guitar. The patient presented with pain in both right and left sides of the face, which she recalled as starting eight years ago, but had been worse for the past 8 months. The pain was felt to a greater degree and more frequently on the left side, in the TMJ and the muscles of mastication.
She stated that for years she only chewed on the left side of her mouth. She has problems chewing hard or chewy food. She either swallows normally or gulps depending on the pain in her jaw.
She reported that she clenches her jaw and grinds her teeth at night. She had a mouth guard made four years prior, but does not wear it. She reported that she awoke with the left side of her jaw locked every morning for the past four months. She uses manipulation with her hands to open her jaw, and is worried about the long-term effects of this.
On the interview day her pain was a three out of ten, although she had experienced pain up to an eight out of ten in the past six months. She associated this increase in pain with periods of high stress. She reported that she holds a lot of tension in her jaw. She noticed that in the past eight months the pain in her jaw had been persistent and she had been experiencing pain in her neck.

She stated that she tended to hold things in her mouth such as guitar picks, sewing pins and pens.
She had surgery to remove an ovarian cyst in November 2005.

Observation

The patient had a click in the right side of the jaw on opening and a loud clunk on the left side before the mid-range of the opening swing. She had a click in both sides during closing. She stood with a head forward posture and had internal rotation of the left and right glenohumeral joints. She exhibited slight hyperlordosis in the lumbar spine and hyperkyphosis in the thoracic spine.
She presented with a tongue resting position that caused her to push the posterior aspect of her tongue into her soft palate. She had teeth imprints on both sides of her tongue

Palpation

The following muscles were palpated Temporalis , Masseter, Stylohyoid, digastric, Lateral/Medial pterygoid, Frontalis, Upper and Lower Trapezius, Sternocleidomastoid, Suboccipital, Splenius capitus, Infraspinatus, Rhomboid major

The patient evaluated the pain on palpation on a scale of 0 to 3 where 0 is no pain, 1 is mild pain, 2 is moderate pain and 3 is severe pain. See Results section for before and after scoring.

Movement

A right corrected S swing was apparent on jaw opening and closing. She had limited range of motion in unassisted opening of the jaw and could fit 2 knuckles in her mouth at maximum opening. She had decreased range of motion in her cervical spine in right lateral flexion and right rotation. See Initial Interview Form in Appendix A.

Neurological

Chovstek's test was negative**.**

Referred Pain

Trigger points were discovered in the right upper trapezius, the left sternocleidomastoid and both subscapularis muscles.

Special tests

The jaw reflex for cranial nerve five was normal (grade 2) and the patient could fit only two knuckles in her mouth at maximum opening. Axial compression test and maximum cervical compression (quadrant) test were negative.

TREATMENT GOALS

The main goals over the course of the seven treatments were:
1. To decrease pain in the TMJ
2. To increase the range of motion of the TMJ, primarily in opening
3. To increase the range of motion of the cervical spine, primarily in right lateral flexion and right rotation
4. To decrease the hypertonicity of the muscles of mastication

Management Plan

The management plan focused on postural re-education with respect to head forward posture, anterior roll of the glenohumeral joint, resting position of the tongue and sleeping position. The patient also presented with hyperlordosis that was not treated during these sessions, but was included in the management plan. See Appendix B for the completed management plan.

TREATMENT

Seven treatments were performed in total between March 5, 2008 and April 4, 2008 varying between one or two treatments per week depending on scheduling. Each treatment included the following modalities: myofascial release, swedish, petrissage, trigger point release, joint mobilizations, muscle energy technique, active and resisted range of motion and intra-oral massage. Each treatment was 60 minutes in duration, with 15 minutes of interview and assessment and 45 minutes of hands on treatment. See Appendix B for treatment records.

Soft Tissue

The primary areas targeted during the treatments were the muscles of the neck and the muscles of mastication as well as subscapularis and pectoralis major and minor. Fascial release was performed on the thoracolumbar fascia as well as on the fascia over pectoralis major muscles and the platysma muscles.

Swedish and Petrissage

Swedish and petrissage was performed on the shoulders, neck and scalp.

Trigger Point Release

Trigger point release was most commonly applied in the right upper trapezius and both subscapularis muscles.

Bowing and active release

Bowing and active release was performed on the pectoralis major. Picking up and bowing was performed on the upper trapezius and the sternocleidomastoids. Suboccipital release was performed on the suboccipitals.

Stripping

Stripping was applied to the pectoralis minor, the scalenes, splenius cervicis, masseter, and the digastrics.

Intra-Oral

The lateral pterygoid, medial pterygoid and masseter were treated intra-orally with light compressions, stripping and bowing.

Joint Mobilizations

Thoracic spine

Posterior glides to T1-T12 and de-rotation of the thoracic spine as needed - usually T2, T3 and T5.

Cervical spine

Lateral challenge to C2-C7 and tractioning from the level of C3

TMJ

Inferior glide and lateral deviation of the left TMJ, lateral rocking to the right and left TMJs, and joint distraction

Muscle Energy Technique

Shoulder complex
MET to decrease the anterior inferior position of the humeral head in the glenohumeral joint via pectoralis minor
Cervical spine
MET for right lateral flexion, usually at the level of C3-C4
MET for capital flexion at occiput-C1

Stretching

Contract relax stretching was performed for the left lateral pterygoid

Strengthening

Resisted opening of the jaw was performed to strengthen the pterygoids while inhibiting temporalis. This was done to improve the coordination between the right and left sides of the TMJ.

HOMECARE

The patient was given a series of homecare exercises including stretching, strengthening and postural/proprioceptive awareness.

Stretching

Pectoralis major doorway stretch in three positions for sixty seconds each, twice a day.
Lateral pterygoid contract relax stretches- seven second sub maximal contraction, three second relaxation and ten second stretch repeated three times, twice a day.

Strengthening

Resisted active opening of the jaw fifteen repetitions twice a day.

Postural/proprioceptive

Head to wall exercises (stand against wall and push occiput against wall promoting capital flexion), fifteen repetitions, twice a day.
Mirror exercises – maintaining a neutral head position (no left capital tilt) watch jaw opening and attempt to keep it in a straight line, fifteen repetitions, twice a day.

Sleeping position

The patient was instructed to try sleeping flat on her back with her head in a neutral position or to sleep on the right side as much as the left.

Chewing

The patient was instructed to try and chew equally on the right and left sides.

Hydrotherapy

The patient was instructed to apply deep moist heat to her upper traps and neck for 20min a day. The patient was instructed to massage her jaw with hot water by using her removal shower head each day in the shower.

RESULTS

Active range of motion of the TMJ (measured in cm)

Throughout the course of the treatments the patient showed an increase in active opening of the jaw. By treatment four, she was able to fit three knuckles in her mouth – before the treatments started she was at two knuckles. By treatment 7 she had full range of motion in opening without pain (4.0cm). See Figure 1 for ranges of motion in the TMJ before treatment 1 and after treatment 7.

TMJ opening pattern, pain and noise

In the pre - treatment assessment it was found that the right side of the jaw clicked on opening and the left side made a clunking noise before the mid - point of the swing. The noise occurring before the mid - point of the swing indicated an anterior disc displacement, and this finding was in line with the jaw locking in the closed position. The jaw appeared to deviate to the right in opening, however on palpation it felt as though the right side was opening first. It was hypothesized that the right side was initiating the movement but was not strong enough to complete it. This movement was too small to been seen when watching the jaw open and the stronger left side, once the mandibular condyle moved over the inter-articular disc, took over the movement giving the appearance of a right corrected swing. Throughout the course of the treatments the noise in the right side disappeared and the clunk on the left side changed to a click. The opening pattern changed from a right corrected to a left corrected swing. The left corrected swing was much less apparent than the right corrected seen at the initial assessment. In the initial assessment the patient reported pain in her left and right TMJ and the surrounding muscles; however the pain was worse on the left side and was felt in the joint itself. The patient reported a decrease in pain in the jaw after each session and reported that the movement of her jaw felt more free and comfortable. Prior to the treatments, the patient had been experiencing daily locking of her jaw in the closed position upon waking for the past four months. In treatment 5 the patient noted that her jaw was not locked the morning after the previous treatment and in treatment 6 the patient reported a decrease in the incidence of jaw locking and also indicated that the nature of her pain had changed. She stated that it "feels like a post workout, it has never felt this way before." By treatment 7 her pain had changed from resting joint and muscle pain to pain only upon palpation.

Active range of motion of the cervical spine (measured in degrees)

The patient presented with decreased range of motion in her cervical spine in right lateral flexion and right rotation. By eliminating reinforcing habits such as sleeping with her head rotated to the left, standing with left capital lateral flexion and chewing only on the left, as well as reducing head forward posture, these restrictions in range of motion were greatly improved. The following contributed to the improvement of the cervical range of motion: myofascial release of the pectoralis major and platysma; trigger point release in the subscapularis, upper trapezius, sternocleidomastoid and suboccipitals; Swedish and petrissage techniques to the scalenes and levator scapulae and muscle energy technique for right lateral flexion. See Figure 2 for range of motion of the cervical spine before treatment 1 and after treatment 7. See Figure 3 for before and after photos of right lateral flexion and Figure 4 for before and after photos of right rotation.

Palpation tenderness and Tissue Response

The patient reported an overall decrease in her pain on palpation. Palpatory tenderness was tested before treatment 1 and after treatment 7. See Figure 5 and Figure 6. The patient reported significant decrease in pain in the right stylohyoid, upper trapezius and sternocleidomastoid; and the left medial pterygoid, upper trapezius and sternocleidomastoid. In all seven treatments there was a decrease in hypertonicity (evaluated through palpation), release of trigger points (evaluated through palpation and patient feedback regarding referral pain) and increase in tissue mobility (evaluated though palpation). In treatment 1, the masseter, the lateral pterygoid and the medial pterygoid were all found to be hypertoned and hypertrophied in comparison to the right. By the end of treatment 7 there was a marked decrease in the difference between the right and left sides.

Visual analogue scale

The patient completed a visual analogue scale about the pain in her jaw before treatment 1 and as part of the follow up questionnaire completed two months after treatment 7. There was a reported decrease in pain at the present time as well as a decrease in the worst pain level. See Figure 7 for the VAS before treatment 1 and from the follow up questionnaire.

Head forward positioning

Head forward positioning was measured as the distance of the base of the occiput to the wall when standing in a neutral posture with the heels against the wall. The pre treatment measurement was 9cm and the post treatment measurement was 6cm. See Figure 8 for postural images.
The patient also had a slight capital tilt to the left in the pre treatment assessment. The patient accomplished the correction of this through her homecare activities.

Sleeping position

The patient normally sleeps either on her left side (ipsilateral to the locking side) or on her back but with her head turned to the left. It was hypothesized that these sleeping positions were contributing to both her TMD and her decreased range of motion in right lateral flexion and right rotation of the cervical spine. Attempts were made to alter her sleeping position so that she slept on the right side or with her head in a neutral (no rotation) position. The patient also reported bruxism and has agreed to discuss with her dentist having a mouth guard made to relieve the stress on her TMJ.

Psychological

Although no biological marker such as salivatory cortisol levels were used in this study, there was subjective feedback from the patient that addresses the psychological component of this treatment. The patient reported that she felt her bruxism and her TMD associated symptoms greatly increased in times of stress. She also reported that many times after treatments she returned home and cried, as she felt a lot of emotion being released from her jaw throughout the treatment. This was overwhelming for her the first time it happened, but then she began to see it as a welcoming release. In the follow up questionnaire the patient reported her stress levels as high at the time of the worst pain experienced and her stress levels as low when she was experiencing no pain. Becoming aware of when she was clenching her jaw allowed her to become more in tune with when she was feeling stressed throughout the day. Diaphragmatic breathing and postural awareness played a role in the mitigation of the stress related habits that were contributing to her symptoms.

FOLLOW UP QUESTIONNAIRE

The patient completed a follow up questionnaire on June 16, 2008. The purpose of this questionnaire was to assess the longevity of the results obtained during the treatment phase of this case study. Follow up treatments were planned for the month of June but unfortunately they did not happen due to scheduling conflicts. The follow up questionnaire demonstrated that the improvements in symptoms of TMD were maintained two months after the final treatment. The patient was continuing with her homecare but at a diminished rate – she was performing the exercises a couple of times a week as opposed to daily. See Appendix A for complete form.

DISCUSSION

The history questionnaire, the interview questionnaire and the chewing ability questionnaire were developed based on the Temporomandibular Pain and Dysfunction Questionnaire and Clinical Form developed by Dworkin and LeResche (1992) in their Research Diagnostic Criteria for TMD. The patient's pain rating on the visual analogue scale, the tenderness to palpation and the range of motion assessment provided the baseline data for this study. The most substantial findings were an increase in the range of motion of the jaw and the cervical spine, a decrease in pain on palpation of muscles around the TMJ and the cervical spine and a decrease in the incidence of jaw locking upon waking. The combination of massage therapy treatments and diligent homecare exercises resulted in a positive hypothesis as the patient showed a decrease in her symptoms of TMD throughout the treatments.

The initial restriction in cervical spine range of motion and the high tenderness on palpation were consistent with the research findings of TMD patients. The limitation in opening of the jaw (2.5cm) was consistent with the range of motion found in close locked participants in the study done by Schiffman et al (2007) where mean opening was 2.9cm. As cited earlier in this paper, increases in EMG activity in muscles of mastication and neck posture are common in TMD patients. As massage therapy directly contributes to a decrease in sympathetic nervous system firing and a decrease in hypertonicity it seems viable that this would lead to a decrease in EMG activity and an improvement in TMD symptoms. A decrease in hypertonicity and postural improvements most likely contributed to the decrease in pain on palpation found during the post treatment testing. It is also possible that during the course of the treatments the patient became accustomed to the touch of the therapist and therefore perceived the palpatory pressure to the less painful. The assessment of pressure pain threshold has been proven to be valid and reliable in TMD patients (Reid et al. 1994), but as only digital pressure was used for the palpatory evaluation, not a pressure device such as an algometer, there could also be variations in the amount of pressure applied, resulting in a variance in response.

Joint mobilizations and intra-oral stripping of the muscles of mastication contributed to the improvement of the range of motion of the jaw and the decrease in pain.

Although cortisol levels were not measured, the patient reported a strong emotional/stress connection with the severity of her symptoms. Awareness of her tendency to clench her jaw and correction of the resting position of her tongue allowed to patient to employ relaxation techniques to alleviate pressure in the TMJ throughout the day – a factor which could also contribute to the decrease in pain on palpation. The patient had also reported in the initial interview that she was worried about the long term effects of her jaw locking and she reported feeling stressed about the noises of her jaw. Her level of worry decreased with the decrease of locking of her jaw as well as with education regarding non-symptomatic jaw sounds.

The patient initially presented with a left capital tilt and was unaware of this postural habit. She also claimed to be unable to feel how her jaw was moving. The patient's homecare involved looking in the mirror and re-educating her neuromuscular pathways and proprioception of her head placement and the movement of her jaw.

It should also be stated that a trusting relationship between the therapist and patient had been established before the onset of the treatments. The patient had also previously received massage therapy for her jaw. These two factors made it possible to begin intra-oral work in the first treatment.

The patient presented with hyperlordosis which was addressed only in the management plan, and not in the seven treatments. It is possible that this postural aspect is contributing to the patient's experience of TMD. The patient is aware of this possibility and is actively working to strengthen her core through yoga and other exercise.

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Figure 1.

Active range of motion of the TMJ before treatment1 and after treatment 7.

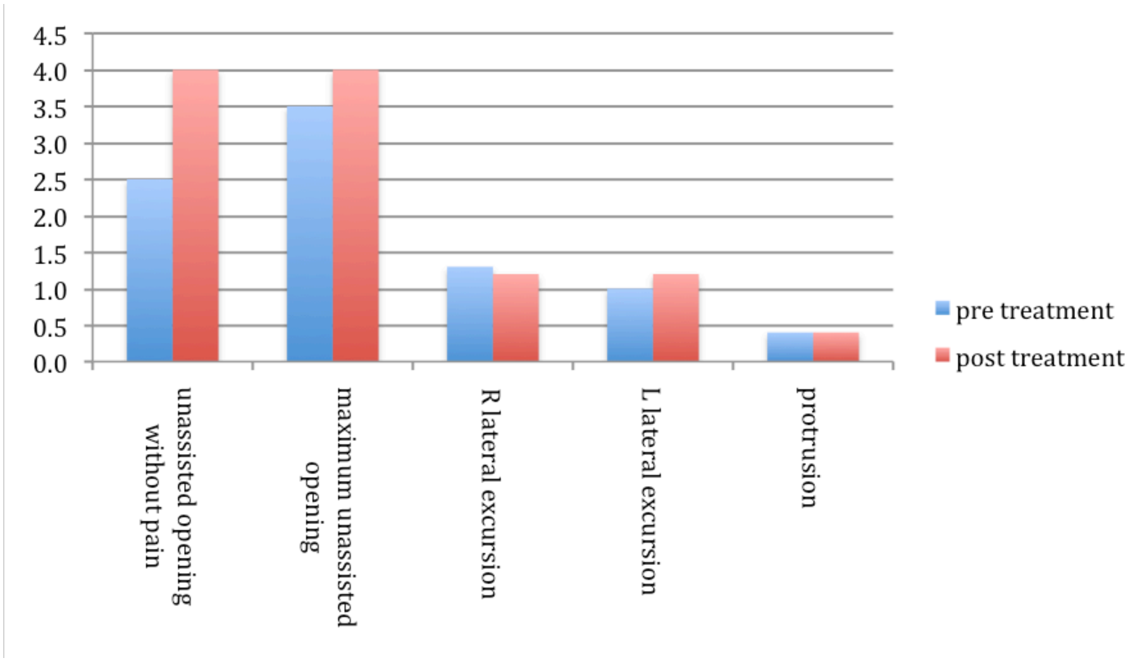

Figure 5.

Palpation tenderness on the right side before treatment 1 and after treatment 7.

0 is no pain, 1 is mild pain, 2 is moderate pain, 3 is severe pain

	Pre treatment	**Post treatment**
Temporalis (posterior)	2	0
Temporalis (anterior)	1	0
Masseter (superior)	2	0
Masseter (middle)	1	0
Masseter (inferior)	1	0
Stylohyoid/Post digastric	3	0
Anterior digastric	1	0
Medial pterygoid	2	1
Frontalis	0	0
Upper trapezius (superior)	3	1
Upper trapezius (middle)	2	0
Upper trapezius (inferior)	2	0
Sternocleidomastoid (superior)	2	0
Sternocleidomastoid (middle)	3	1
Sternocleidomastoid (inferior)	1	0
Suboccipital	2	2
Splenius capitus	1	2
Infraspinatus	1	1
Rhomboid major	2	1

Lower trapezius	1	0
Lateral pterygoid	2	1

Figure 6.

Palpation tenderness on the left before treatment 1 and after treatment 7.

0 is no pain, 1 is mild pain, 2 is moderate pain, 3 is severe pain

	Pre treatment	**Post treatment**
Temporalis (posterior)	1	0
Temporalis (anterior)	1	0
Masseter (superior)	2	0
Masseter (middle)	2	1
Masseter (inferior)	2	1
Stylohyoid/post digastric	3	1
Anterior digastric	2	1
Medial pterygoid	3	1
Frontalis	0	0
Upper trapezius (superior)	1	1
Upper trapezius (middle)	2	0
Upper trapezius (inferior)	3	0
Sternocleidomastoid (superior)	2	1
Sternocleidomastoid (middle)	3	1
Sternocleidomastoid (inferior)	1	1
Suboccipital	2	3
Splenius capitus	2	1
Infraspinatus	1	0
Rhomboid major	2	1
Lower trapezius	2	0
Lateral pterygoid	3	2