Massage Therapy in the Treatment of Temporomandibular Dysfunction: A Case Report

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Abstract:

This study investigated the effects of massage therapy including both external and intra-oral ischemic compressions and kneading of muscles of mastication, Swedish relaxation massage, and home exercises including chin-tucks to address forward-head posture and isometric jaw strengthening exercises on arthralgic, non-myogenic temporomandibular dysfunction pain and daily functioning. The subject reported ten years of right TMJ pain that radiates behind the right eye and into the jaw, clicking at the right TMJ, teeth grinding and clenching. Ten massage therapy treatments were administered over an eight-week period. Pre- and post- treatment pain levels were recorded, and a symptom log was kept documenting intensity of pain and associated symptoms on a daily basis.

Results: Pain levels showed a marked improvement immediately following treatment. However, no long-term pain or symptom reduction was seen and no significant effects on daily functioning were reported.

Conclusion: Massage therapy may be able to provide immediate transient symptomatic relief from arthralgic, non-myogenic TMD related pain. Further research on massage therapy and TMD should focus on a specific subset of patients who demonstrate pain of a musculature origin as per the Diagnostic Criteria for TMD (DC/TMD).

Acknowledgements:

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safe and effective treatments to my patients using therapeutic massage. I extend my heart-felt gratitude to all of my classmates for their support and kindness throughout the program. And finally, my thanks go out my case study supervisor Ray Ranger for their wisdom and guidance.

Introduction:

Temporomandibular disorders (TMD) are common; it is estimated that in the United States, for every 100 million working adults, temporomandibular dysfunction (TMD) contributes to 17.8 million lost work days annually (2). The National Institute of Health and Cranial Research places the prevalence of TMD in the range of 5-12% (3) and it is estimated that the annual TMD management cost in the USA, not including imaging, stands at around $4 billion annually (4).

TMD is particularly debilitating because of its impact on daily functions such as chewing and swallowing in addition to self expression through talking and laughing (7). Over 95% of TMD pain patients exhibit psychosocial distress (29).

TMD-related complaints place a considerable burden on the healthcare system and on TMD patients' wellbeing. Effective therapies for the management of TMD related pain and dysfunction are needed.

Chronic pain is the overwhelming reason for seeking temporomandibular joint dysfunction (TMD) treatment (1). The intent of this study was to investigate the effectiveness of massage therapy in reducing the frequency and intensity of pain associated with TMD.

Literature Review:

There is some evidence that supports the use of manual therapy techniques for the treatment of TMD that fall within the scope of practice of registered massage therapists in Canada.

One study of note investigated the efficacy of intra-oral myofascial therapies for chronic TMD in patients with periarticular pain with or without joint sounds (19). The 30 participants ranged from 18 to 50 years old and had experienced jaw pain for at least 3 months. They were randomized into three groups; one receiving specific manual therapy treatments, another receiving specific manual therapy treatments combined with self-care exercises, and the third receiving no intervention (19). Treatments were delivered two times per week for a five-week period. The results showed statistically significant differences in resting, opening, and clenching pain and opening range scores in both treatment groups compared to the control group, though no difference was seen between the two treatment groups (19). The myofascial therapies included intra-oral temporalis, medial and lateral pterygoid ischemic compressions with light kneading (19). Self-care exercises included post-isometric relaxation techniques (self-administered passive opening and lateral deviation of the mandible) (19).

Another study investigated the effects of grade IV distraction mobilisation on patients with TMD, specifically patients who suffered from pain in the region of the TMJs and associated masticatory muscles and limited mandibular movement for the last 6 months. EMG activity in the masseter muscle was measured both before and after mobilization in addition to range of mandibular movement. Results showed a significant decrease in masseter EMG activity and a significant increase in mandibular movement following mobilization when compared with sham treatment. EMG activity remaining significantly decreased for 15 minutes (23).

A study considering the efficacy of physical therapy (a 12-week course of treatment, two times per week, of mandibular passive traction and translation and passive release of jaw elevator muscles) as compared to splint therapy in the treatment of arthrogenic TMD patients with painfully restricted jaw opening found that the physical therapy was more effective (21).

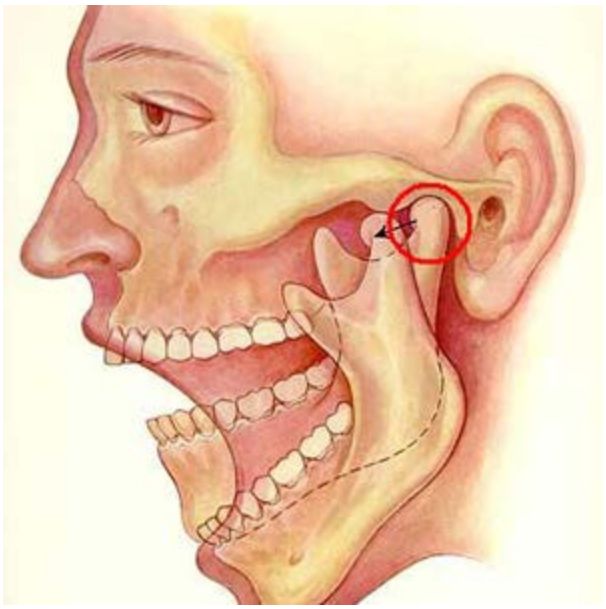
In another study, forty subjects with TMD (specifically myogenous TMD with anterior disc displacement with reduction) were randomly divided into two groups, one receiving manual therapy and performing home physical therapy and the other performing home physical therapy only. Manual therapy included cervical tissue mobilization and TMJ mobilization and stabilization. Home physical therapy included breathing exercises, relaxation techniques, posture correction exercises, and mandibular resistance exercises. Both groups showed improvement but a greater improvement was seen in the manual therapy with home physical therapy group, who saw a clinically significant reduction in pain with active opening (24).

Because the inclusion criteria for studies investigating the use of manual therapy techniques in the treatment of TMD and the actual techniques applied vary widely, there remains a paucity of robust evidence for the efficacy of any particular manual therapy in the treatment of TMD. An effort to create greater clarity in not only diagnosis but also in assessment and treatment and to help pave the way for more meaningful research, the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) was established, with the most recent version having been published in 2014 (15). It is the most widely recognized and studied clinical examination method for the diagnosis of TMD. Symptomology / possible origins of pain are broken down into groups along with specific criteria that must be met for a patient to fall into a diagnostic group. Examples of diagnostic groups include myalgia, myofascial pain, arthralgia, disc displacement with reduction, disc displacement with reduction and intermittent locking, and degenerative joint disease (and several more) (15). Each of the groups has an associated ICD-10 code. The DC/TMD published in 2014 includes dual-axis diagnostic criteria for TMD, with Axis I providing "physical assessment, using reliable and well-operationalized diagnostic criteria" and Axis II providing for "assessment of psychosocial status and pain-related disability" (15).

There is robust evidence for the efficacy of massage therapy in the management of anxiety and stress (6), both factors that are highly associated with TMD and likely playing a causal role in the experience of TMD symptoms. "Massage therapy has been shown to stimulate parasympathetic activity, engaging the relaxation response, which in turn reduces stress and anxiety as measured by psychological, hormonal, and autonomic indicators" (6).

TMJ Anatomy & Biomechanics:

The temporomandibular joints (TMJs) are articulations between the temporal fossa on the inferior surface of the temporal bone and the condylar process of the mandibular bone (11). The external auditory meatus is located just posterior to the TMJ. The TMJ is a synovial joint with a biconcave intraarticular disc that divides the joint into an upper (discotemporal) and lower (discomandibular) joint space (12). Rotational movement, occurring from the beginning to the mid-range of movement, occurs in the dicomandibular cavity. Gliding movement, occurring as a second movement, is a translatory movement of the condyle and disc along the slope of the articular eminence. This gliding occurs in the discotemporal cavity (13). The upper head of the lateral pterygoid draws the disc forward, preparing for rotation of the condyle (13). On opening the mouth, the disc rotates and translates forward under the articular eminence of the temporal bone (11). In normal function, the disc follows the condyle closely, being pulled forward by the lateral pterygoid during mouth opening, and pulled back by the elasticity of its posterior attachment during mouth closing (11). During opening, closing, protrusion, and retrusion the convex surface of the condylar head of the mandible moves across the convex surface of the articular eminence of the temporal bone (11). The intraarticular disc compensates for the incongruency of the two convex bony surfaces (11).



Translatory movement of the mandibular condyle

The outer edges of the disc are connected to the joint capsule with synovial membranes lining the two cavities above and below the disc (11).

The disc is divided into three parts: the anterior band which has both vascular and neural elements; the intermediate zone which is positioned between the articular surfaces of the temporal bone and mandibular condyle, bears weight, and is aneural and avascular; and the thick posterior band which again has both vascular and neural elements (11). Anterior displacement of the disc may place inordinate pressure on a vascularized, neural posterior retrodiscasl tissue possibly contributing to pain.

The stomatognathic system (i.e. the TMJ and related structures) is unique in comparison to for example the spine or the knee in that it contains teeth (occlusion), there are two bilaterally functioning joints, and the articular surfaces are lined with dense fibrocartilage, not hyaline cartilage like most other synovial joints (5). Fibrocartilage is better able to withstand sheer forces than hyaline cartilage can, it is less susceptible to the effects of aging, less likely to break down

over time, and it has a better ability to repair (14). However, fibrocartilage may be targeted differently from hyaline by sex hormones, predisposing it to degenerative changes (14).

Muscles of Mastication

Mandibular elevation relies on the coordinated action of the masseter, temporalis (for retrusion), superior head of the lateral pterygoid (for stabilization), and the medial pterygoid (for protrusion) (11).

Mandibular depression relies on the inferior head of the lateral pterygoid acting synergistically with the suprahyoid muscle group to translate the condylar head downward, inferiorly and contralaterally during opening (11).

Mandibular retrusion relies on the posterior fibers of the temporalis, drawing the condyles backward during retrusion. This action is assisted by the suprahyoid muscles (11).

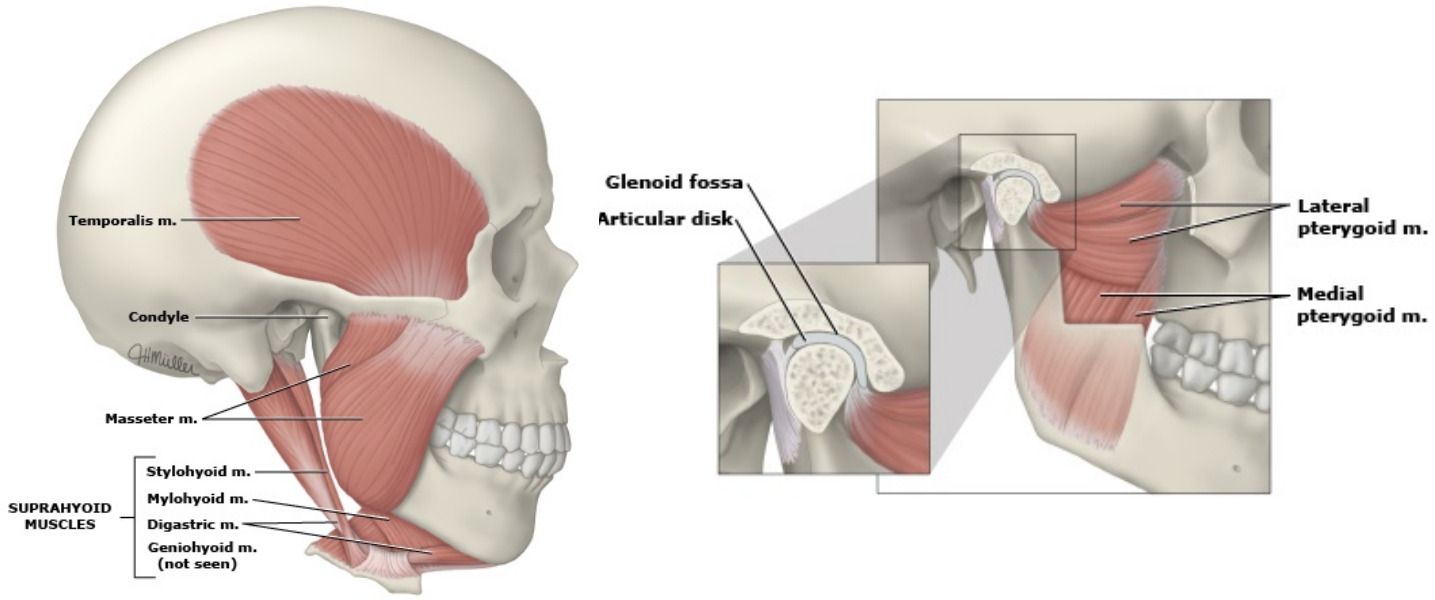
Mandibular protrusion relies on the masseter and medial and lateral pterygoids (11).

Lateral movements of the mandible are achieved by the lateral and medial pterygoids (11).

The masseter attaches to the maxillary process of the zygomatic bone and the zygomatic arch proximally and to the angle and ramus of the mandible distally (3).

The temporalis is attached to the temporal fossa of the temporal bone and the coronoid process and anterior border of the ramus of the mandible (3).

The medial pterygoid attaches to the lateral pterygoid plate and the medial surface of the ramus of the mandible (3).



Anatomy of the TMJ (2)

TMD Etiology:

There is no scientific consensus on a definitive causal factor for TMD. Contributing factors to TMD include a variety of potential factors stemming from the TMJ itself including shape of the mandibular condyle; degenerative changes (incongruent surfaces predispose TMJ); and disc derangement/displacement (12). Extra-articular contributing factors may include trauma to local tissues; spasms of muscles of mastication; chronic malocclusion; repetitive chronic microtrauma (bruxism/clenching teeth); unaccustomed jaw use (e.g. opening mouth wide for a long time e.g. dentist); referred pain from the neck/shoulder muscles; and possibly even sacral dysfunction (7). The etiology of TMD is complex and the addition of the possible causal contribution of factors like anxiety, stress, and depression which are highly associated with TMD creates even greater challenges in both fully understanding the etiology of TMD and in finding a scientific consensus on effective treatment modalities.

The majority of TMD patients in clinical samples are female, a fact that has been explained to be due to an interaction of a variety of factors ranging from biological and hormonal to psychological and social (5).

Forward head posture is often discussed by authors presenting the etiology of TMD because of the effect that forward-head posture has on dental occlusion (11). When the head is held forward the line of vision extends downward, so to correct for visual needs the head is tilted backwards which causes a posterior migration of the mandible (11). The posterior cervical muscles are shortened and forced to contract excessively while the anterior submandibular muscles are stretched causing retrusive forces on the mandible and an altered occlusal contact pattern (11).

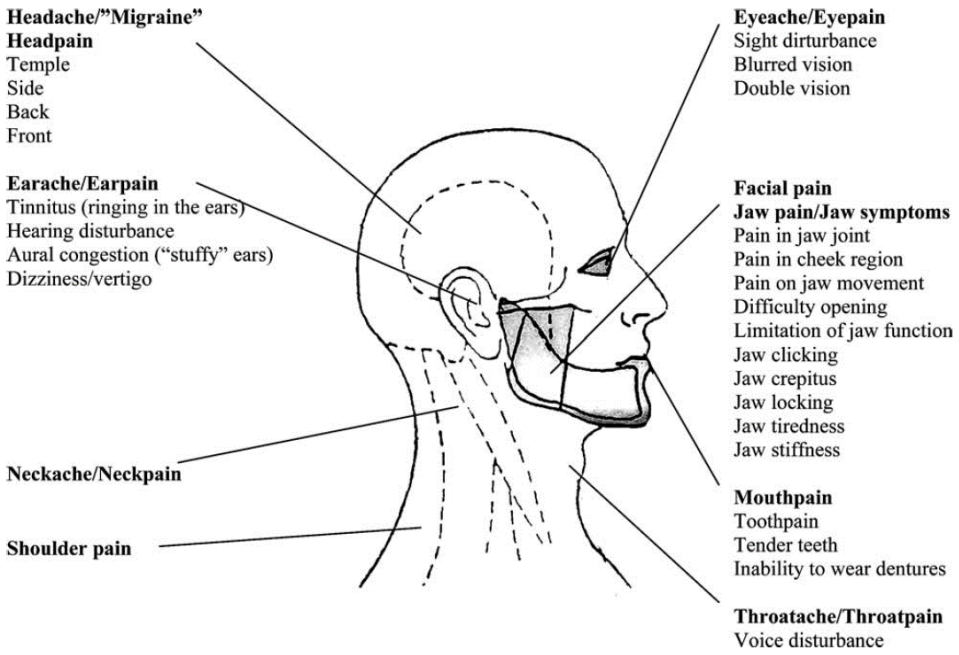
Mouth breathing has been implicated in TMD by some authors (25). When breathing through the mouth, as when sinuses are blocked inhibiting normal breath through the nose, the jaw is held in open-mouth position (i.e. not in rest position) for a prolonged period of time. It is hypothesized that mouth breathing may be a contributing factor to TMD pain, potentially because of the strain it puts on the muscles of mastication.

The current consensus among researchers is that "temporomandibular disorders resemble musculoskeletal disorders and chronic pain disorders in general, and that combined biomedical and biopsychosocial methods best support the assessment and management of the cardinal features of TMD" (i.e. pain and dysfunction) (5).

Symptoms of TMD:

TMD is characterized by musculoskeletal or myofascial pain with dysfunction of the masticatory system. The pain may radiate to the ear, jaw, or posterior cervical region and is aggravated by movements of the jaw, and can include tenderness on palpation of the joint or

muscles, limited mandibular range of motion, deviation or deflection of the mandible on opening, and jaw sounds (7). In addition, patients with jaw pain often report headaches, dizziness, depression, poor sleep, and low energy (7).



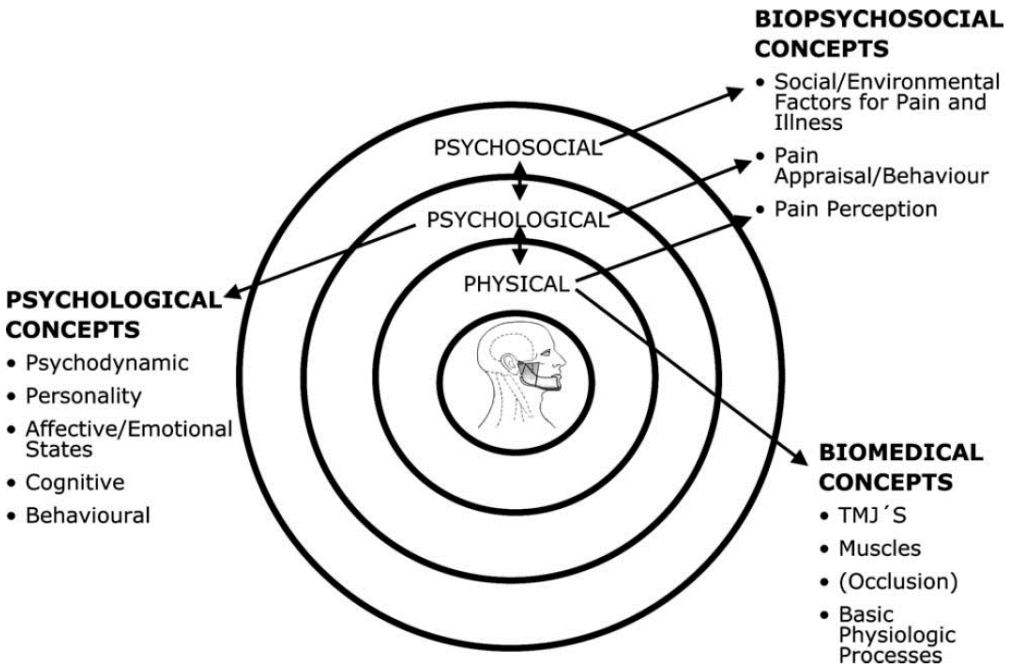
A schematic drawing of some of the various symptoms and signs causing pain and dysfunction in the temporomandibular region (5)

A Biopsychosocial View:

An approach that takes both biomedical models and psychosocial models into account enables a practitioner to gain a more holistic perspective, including what the structural elements of dysfunction are, how they are reported, and the impact of the symptoms of dysfunction and pain on the psychological status and psychosocial functioning of the patients.

A particularly heuristic therapeutic model is presented by Suvinen et al. (5). According to this model, at the neurophysical level the receptive systems detect, modulate, and transmit pain stimulus to the perceptive system, which recognizes pain depending on the pain threshold and

tolerance and thereby leads to experience of pain. This basic system, however, is influenced by a complex interplay of emotions, cognitions, learned principles like pain behaviour and societal and environmental factors. This theory posits that "peripheral events are reflected, integrated, and then acted upon in a dynamic fashion as the ongoing resolution of peripheral pathology with central information processing that incorporates into perception, appraisal, and response to pain, such higher order functions as attention, memory, emotions, and organized behavioural response patterns" (5). Suvinen et al hypothesize that some form of "peripheral event" (e.g. an injury or trauma) to the temporomandibular region disrupts part of the masticatory system in a susceptible person. Examples of injuries or traumas include various macro- or micro- trauma like a motor vehicle accident, overload or repetitive strain injury or muscle fatigue (5). When the initial peripheral event does not heal due to a variety of possible underlying factors (vulnerability based on genetics, hormonal factors, behavioural habits) a chronic condition ensues. The general feature that sets in motion the response to the peripheral sign is "I don't like this sensation" which leads to a change in physiology, negative affect, and general pain behaviours (depression, social isolation, loss of interest, inactivity, somatic distress, poor response to biomedical treatment approaches, excessive healthcare use) (5), perpetuating an ongoing pain-tension cycle.



Summary of the biopsychosocial concepts reviewed in the etiology of TMD (5)

Methods:

Patient History

The patient is a 32-year old male small business owner who has been suffering from painful TMD-related symptoms for the last 10 years. He was unaware of the source of pain at its onset and did not seek help until the late Autumn of 2016 at which time the pain became unbearable; described as a 7 on a 1-10 pain scale. He feels the pain initially in the right TMJ, and only after that pain has progressed in intensity will he feel pain at his left TMJ. He describes the pain as being centered over the TMJ joint line just anterior to the external auditory meatus, but at its height the pain radiates to behind the right eye, over the forehead, and down the mandible on the right side. The pain on the left side, when it does commence, is described as a "somewhat tingly sensation spreading over the lips". He feels a "background pain" of 2 to 3 out of 10 on a consistent basis. He also experiences pain in a molar in the bottom left quadrant, described as a "constant ache",

however when his TMJ symptoms flare it becomes a more intense “throbbing pain”. He does not have sensitivity to temperature or sweet foods; instead it is sensitivity that dentists have attributed to nerve invovlement due to jaw clenching. He experiences this pain when chewing and it is felt as “excruciating sharp pain that goes away quickly”. On the day of initial assessment, he reported his pain level to be at a 3/10 and located only at his right TMJ. He describes “a weird feeling like my mouth and tongue are never in the right place; a restless feeling”. He chews gum infrequently (once per month), but interestingly he reports that it gives the illusion of relieving the pain because it “gives the jaw something to do”.

He suffers from congestion, which he can keep under enough control in the day to avoid mouth-breathing, however he wakes up to mouth-breathing. He suffers from restless, low quality sleep that he attributes to his congestion. He finds himself yawing more frequently when he hasn’t slept well. He recently addressed several environmental sources of congestion in addition making some dietary changes which have seemed to improve his symptoms of congestion.

As the owner of a craft soda business, he does do a lot of speaking in his daily life. He reports that in a typical 24-hour period, the symptoms get worse towards the end of the day, especially if he’s had too much coffee, has been stressed, or has had to talk a lot during the day.

He recently has given up his nervous oral tick of biting his nails. He does habitually lean on his jaw or temple, though he is making an effort to stop, and does find himself tilting his head to the side habitually.

His hobbies include cycling, tinkering with electronics, reading and cooking. His typical work day involves sitting, lifting/moving boxes, and sitting doing office work. He sometimes helps

with production and bottling of product, runs errands in his car, and occasionally will sell his product at local farmer's markets.

The patient sleeps on his right side, but he has been trying to sleep on his back on the advice of the TMJ specialist he has been seeing.

The onset of the more acute attack in the late Autumn of 2016 was preceded by a road trip from Vancouver to Calgary. He reported having a habitual exacerbation of his head-forward posture when driving, and high stress levels while in Calgary due to a funeral he was attending.

The patient describes clenching his teeth during the day, in addition to grinding his teeth at night. His teeth present as maloccluded.

The patient takes one medication: an SSRI (Escitalopram Oxalate) to help control symptoms of anxiety and depression.

He has never had his jaw lock in an open or closed position.

Current Management

The patient wears a dental splint. He wears one on the bottom jaw during the day to keep the jaw in resting position, encouraging better alignment. He removes that splint and wears a separate splint over his upper teeth at night. Both splints mitigate the adverse effects of clenching. He began using these splints about 1.5 months before the start of this study, and has felt a significant improvement as a result.

He also receives a "cold laser" treatment once per week. He says that it "feels relaxing" though he does not feel much benefit in terms of pain reduction from it.

Assessments:

A complete overview of the assessments that were conducted can be found in appendix I.

Significant observations included head-forward posture and a slightly retracted mandible.

The following muscles were palpated for tenderness: temporalis (externally), masseter (intra-orally), medial pterygoid (externally and intra-orally), lateral pterygoid (externally and intra-orally), digastric, mylohyoid, geniohyoid, infrahyoids, upper trapezius, and sternocleidomastoid. Some degree of tenderness was reported on intra-oral palpation of lateral pterygoid and masseter only.

There was a palpable and audible click at the right TMJ with maximal opening with pain at the right TMJ just prior to maximal opening, and a reciprocal click within the first 5% of closing. The clicking was eliminated with protrusion while opening, indicating a likely anterior disc displacement with reduction (13).

There was a visible S-wobble near full opening and upon closing again, which is indicative either of a muscular imbalance or a medial displacement as the condyle “walks around” the disc (13).

At 60 mm of mandibular opening, this patient is on the side of hypermobility. However, it is interesting to note that he describes that his jaw "feels tight" and it feels "unnatural" to open his mouth too much. He puts in concerted effort in opening his mouth more when enunciating his words on a daily basis.

The Limitation of Daily Function Questionnaire was completed before the first treatment, prior to the 6th treatment, and after the 10th as a method to gauge the effects that the patient's pain and dysfunction were having on his everyday life (see appendix II).

Diagnostic Criteria Met:

According to the criteria presented in the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications, the patient presents with disc displacement with reduction and arthralgia, however the criteria for myalgia or myofascial pain were not met (15).

Treatment Goals:

Based on the findings of the initial assessment, treatment goals were established and included:

- Decrease immediate pain via direct massage treatment of muscles of mastication
- Decrease head-forward posture via chin-tuck exercises
- Decrease hypermobility of TMJ via strengthening of lateral and medial pterygoids
- Decrease stress levels via relaxation massage and diaphragmatic breathing exercises
- Decreased long-term pain via interruption of the pain-tension cycle

A 60-minute massage therapy protocol was developed to be applied by the massage therapist 1-2 times per week, combined with strengthening and posture correction exercises for the patient to do on a daily basis at home.

Tracking Progress:

Five indicators were monitored in a patient log recorded every evening: pain level on a 1-10 scale (left and right side rated independently of each other); quality of sleep; waking to mouth breathing the previous night; stress level on a 1-10 scale; tooth pain and intensity of tooth pain on a scale of 1-10 (if experienced).

Patient pain levels were queried immediately prior and immediately following treatments, using a 1-10 pain scale (1 being very little pain and 10 being excruciating pain).

Manual Therapy Protocol:

This protocol was developed based on the treatment protocol suggested by Rattray and Ludwig in their book “Clinical Massage Therapy” (25).

Stress Reduction Part 1 (13 minutes): Patient in prone position. The patient was instructed to take deep belly breaths (diaphragmatic breathing) for one minute. Myofascial release was applied via the bowing of the upper traps and erector spinae group. Lumbar decompression via pressure in an anterior-caudad direction on the sacrum, followed by the application of a variety of Swedish massage therapy techniques on the upper trapezius; levator scapula; supraspinatus; infraspinatus; and erector spinae group (thoracic and lumbar) using slow rhythmic strokes.

The patient turned to a supine position for the remainder of the treatment. All of the below techniques were provided at each treatment with the exception of pectoral and anterior neck treatments, which alternated from treatment to treatment.

Pectoral Treatment (10 minutes): Myofascial release over the sternum using a cross-hand technique and skin rolling. Treatment of the pectoralis major using myofascial release, Swedish massage, followed by the static compression of the pectoralis minor via the axilla. Joint play at the clavicle was applied, then treatment of the subclavius muscle using fingertip kneading.

Anterior Neck Treatment (10 minutes): Release of the sternocleidomastoid using myofascial picking up and bowing. Fingertip kneading and pin-and-stretch techniques were applied to the anterior, middle and posterior scalene muscles. While stabilizing the hyoid bone, fingertip kneading was applied to both the infrahyod and suprahyoid muscles, and stripping of the inferior margin of the mandible was applied.

Muscles of Mastication External (13 minutes): Swedish "petrissage" techniques including fingertip kneading and muscle stripping were applied to the temporalis muscle, the masseter, and along the zygoma. The medial pterygoid was accessed externally on the internal aspect of the mandible, near the angle.

Muscles of Mastication Intra-Oral (12 minutes): Using a non-latex examination glove, the muscles of mastication were treated intra-orally. The masseter, the lateral pterygoid, and the medial pterygoid were addressed using ischemic compressions and gentle and subtle kneading. The patient was then instructed to open and close his mouth 3-4 times (active range of motion).

Stress Reduction Part 2 (12 minutes): Various Swedish massage techniques were applied to the posterior and lateral neck and upper trapezius, including knuckle kneading of upper trapezius,

fingertip kneading of semispinalis capitis and splenius capitis, pin-and-stretch of levator scapula, sustained cervical spine traction, and cranial base release. Slow, intentional strokes were used.

Home Exercise Protocol:

Studies have found that isometric jaw exercises are useful for patients with temporomandibular joint dysfunction syndrome (2). Isometric exercises designed to strengthen muscles responsible for protrusion (masseter and medial and lateral pterygoids) and depression (inferior head of the lateral pterygoid and suprahyoid muscle group) were prescribed based on positive outcomes in mitigating TMJ pain (16). The resistance and muscle contraction are held for 5 to 10 seconds before relaxing. This was repeated 5 times, once per day.

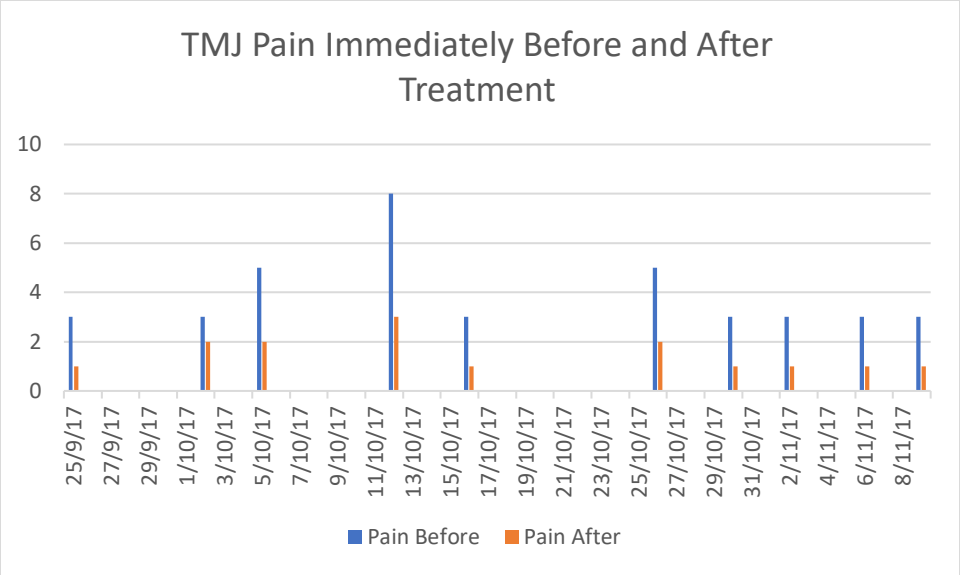
Isometric jaw forward thrust exercises (16)

Isometric jaw depression exercises (16)

An exercise to address head-forward posture was prescribed. This particular exercise was found to be beneficial by the patient in the past, having corrected more severe head forward posture for him already. It is aimed at resetting neurology via arm postures that stimulate nerve roots (17).

Results

A significant improvement in pain levels were experienced immediately following treatments.



However, symptoms fluctuated profoundly through the course of this study with no trend seen relating massage to lasting pain reduction (see Appendix III). Factors beyond the patient's or therapist's control seem to have contributed to these fluctuations in symptoms including adverse reactions to environmental factors such as an old duvet leading to sleeplessness, workplace stress, and night-time open-mouth breathing due to congestion.

No change was seen in mandibular range of motion, muscle tenderness on palpation, daily functioning, or visible head-forward posture.

Discussion:

This study illustrates that in TMD stemming from non-myogenic sources, massage therapy may be beneficial for transient relief of symptoms. The limitations of this study are inherent in the "case study" design and are methodological issues commonly encountered in alternative therapy research (e.g. small sample group, lack of control group, lack of random assignment, only one massage therapist providing standardization of the protocol).

However, the practice of massage therapy is in a unique position in that it is reasonable to hypothesize that it is likely to impart effect on both the physiological and the psychological aspects of the pain-tension cycle likely involved in TMD pain and disability. Techniques such as intra- and extra- oral myofascial therapies applied to the muscles of mastication, trigger point therapy, and grade IV distractions and joint mobilizations have been shown to be effective in treating TMJ pain of muscular origin and/or with limited opening (19, 20, 21, 22, 23, 24). There is ample evidence supporting the efficacy of massage therapy in reducing symptoms of affective states including anxiety and depression in addition to pain in various settings and conditions (26, 27, 28).

In order to derive more robust and transferrable results, future studies should adhere to the DC/TMD diagnostic criteria, selecting only participants who fall into diagnostic groups with myalgia, local myalgia, myofascial pain, and/or myofascial pain with referral. By narrowing down the patient group studied, there are more likely to be meaningful results. Manual therapy techniques that have been included in previous successful studies and that fall into the scope of practice of registered massage therapists in Canada should be applied including the release of the muscles of mastication both intra-orally and externally, and the application of grade IV joint mobilizations to the TMJ, and relaxation Swedish massage to downregulate the patient's sympathetic nervous system.

Conclusion

This study illustrates that massage therapy techniques can be effective in providing transient relief of TMD pain stemming from a non-myogenic source. Registered Massage Therapy in Canada provides a robust set of skills that have real potential to impart lasting effect on a specific subset of TMD patients. Further study is needed to establish massage therapy as a legitimate part of a multidisciplinary approach to managing TMD according to the biopsychosocial model of pain.

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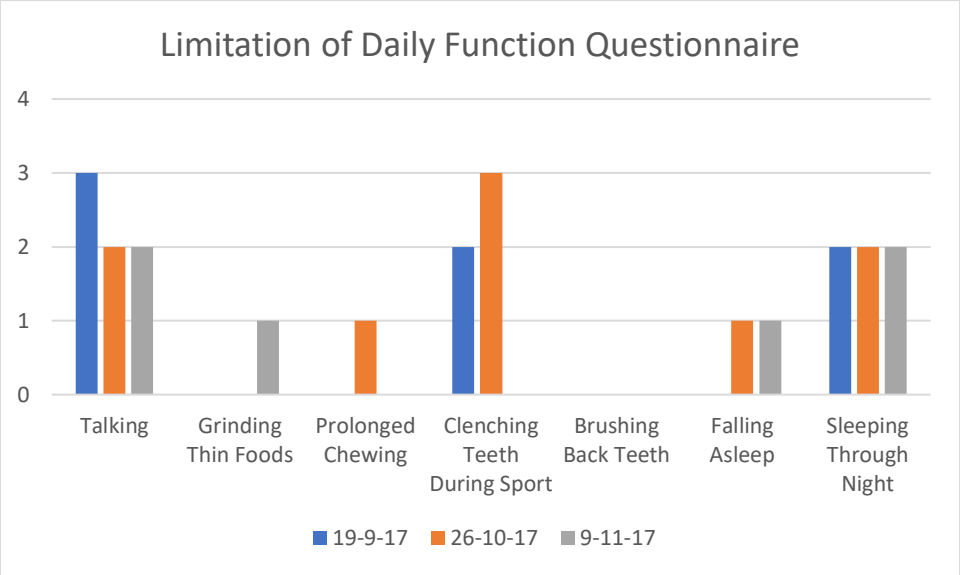
Appendix 1: Assessments

September 29, 2017	October 26, 2017	November 9, 2017
Observation		
-Moderate head forward posture with increased cervical lordosis -Asymmetry b/w right and left mandibular angles (right is higher than left) -Anteriorly rotated shoulders -Slightly retracted mandible	-Slight head-forward and increased cervical lordosis (no visible change) -Asymmetry b/w right and left mandibular angles (right is higher than left) -Anteriorly rotated shoulders -Slightly retracted mandible	-Slight head-forward and increased cervical lordosis (no visible change) -Asymmetry b/w right and left mandibular angles (right is higher than left) -Anteriorly rotated shoulders -Slightly retracted mandible
Palpation		
-hypertonicity palpated in the upper trapezius, levator scapula, sternocleidomastoid, semispinalis capitis, pectoralis major and minor, thoracic and lumbar erector spinae group, and scalenes - All of the muscles of mastication were palpated → mild tenderness reported upon palpation of lateral pterygoid on the right side only	-hypertonicity palpated in the upper trapezius, levator scapula, sternocleidomastoid, semispinalis capitis, pectoralis major and minor, thoracic and lumbar erector spinae group, and scalenes -All muscles of mastication palpated → mild tenderness upon palpation of both masseter and lateral pterygoid	-hypertonicity palpated in the upper trapezius, levator scapula, sternocleidomastoid, semispinalis capitis, pectoralis major and minor, thoracic and lumbar erector spinae group, and scalenes -All muscles of mastication palpated → mild tenderness upon palpation of lateral pterygoid only
Range of Motion C-Spine (active, passive and resisted) Flexion, extension, side flexion, rotation		
Active: -L rotation → excessive "tension" experienced -R side flexion → "intense stretching" sensation Passive: -R side flexion → "intense stretching" sensation	Passive: -L side flexion → "intense stretching" sensation -R side flexion → "intense stretching" -Forward flexion → "intense stretching" travelling down ESG muscles	Passive: -L side flexion → "feels really tight" -R side flexion → "feels really tight" -Forward flexion → "feels really tight"
Range of Motion Mandible (active, passive, and resisted) Protraction, retraction, lateral deviation, depression, elevation Only		
Active Opening: -Audible/palpable click at right TMJ with maximal opening -Visible S-wobble near full opening and upon closing again -pain at right TMJ just prior to maximal opening Active elevation: -reciprocal click within the first 5% of closing -clicking eliminated with combined active protrusion/opening (likely an	-No mandibular range of motion performed	Active Opening: -Audible/palpable click at right TMJ with maximal opening -Visible S-wobble near full opening and upon closing again - pain at right TMJ just prior to maximal opening Active elevation: - reciprocal click within the first 5% of closing -clicking eliminated with combined active protrusion/opening (likely an

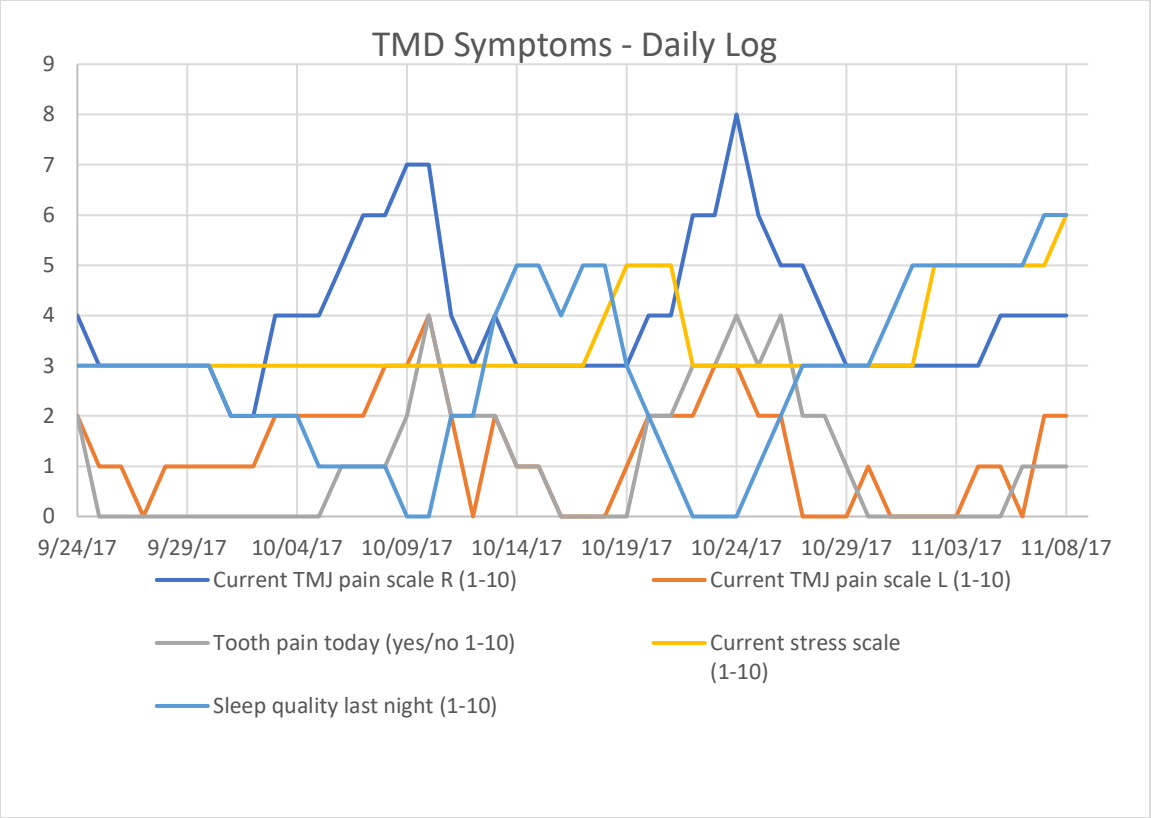
anterior disc location that reduces)		anterior disc location that reduces) Passive Protrusion: - pain at right TMJ Passive Right lateral deviation: -pain at right TMJ
Mandibular Measurements		
-Three Knuckle Test: patient can easily fit three, almost four of his own knuckles into his mouth -Maximal unassisted measurements: +Depression: 60mm +Right lateral: 3mm +Left lateral: 2mm +Protrusion: 4mm *Instrument used for measurements: TMJ TriMeasure by Robert Hackwood, RMT	-Three Knuckle Test: patient can easily fit three, almost four of his own knuckles into his mouth -Maximal unassisted measurements: +Depression: 60mm +Right lateral: 3mm +Left lateral: 2mm +Protrusion: 4mm *Instrument used for measurements: TMJ TriMeasure by Robert Hackwood, RMT	-Three Knuckle Test: patient can easily fit three, almost four of his own knuckles into his mouth -Maximal unassisted measurements: +Depression: 60mm +Right lateral: 3mm +Left lateral: 2mm +Protrusion: 4mm *Instrument used for measurements: TMJ TriMeasure by Robert Hackwood, RMT

Appendix II: Limitation of Daily Function Questionnaire



This questionnaire asked the following:
-How much does your present jaw problem prevent or limit you from talking for long periods of time, including telephone conversations?
-How much does your present jaw problem prevent or limit you from grinding thin foods?
-How much does your present jaw problem prevent or limit you from clenching teeth when participating in sports?
-How much does your present jaw problem prevent or limit you from brushing your back teeth?
-How much does your present jaw problem prevent or limit you from falling asleep?
-How much does your present jaw problem prevent or limit you from sleeping through the night?
0=No problem; 1=slight difficulty; 2=moderate difficulty; 3=very difficult; 4=extremely difficult

Appendix III: Daily Symptom Log



Dates of Treatment:

Monday September 26, 2017
Monday October 2, 2017
Thursday October 5, 2017
Thursday October 12, 2017
Monday October 16, 2017
Thursday October 26, 2017
Monday October 30, 2017
Thursday November 2, 2017
Monday November 6, 2017
Thursday November 9, 2017