The Effect of a Specific Isometric Muscle Energy Technique and Therapeutic Jaw Exercises on Pain of the Temporomandibular Joint

Investigators

Cameron Gosling B.App.Sc (HM), Grad Dip (Ex Rehab) M.App. Sc[1]

Lisa Frois B. Sc (Clin. Sci)[2]

1. Centre for Rehabilitation, Exercise & Sports Science, Victoria University, Australia.
2. School of Health Sciences, Victoria University, Australia.

Mailing Address

Cameron Gosling

School of Health Sciences

Victoria University

PO Box 14428

Melbourne City

MC 8001, Australia

Email: Cameron.gosling@vu.edu.au

Phone: (03) 9248 1290

This manuscript is submitted as part of the requirements for the fulfillment of the Masters of Osteopathy.

ABSTRACT

Osteopaths use muscle energy techniques (MET) to reduce pain, to increase muscle length and to increase joint range of motion . Few investigations have focused on applications of MET and to date the temporomandibular joint (TMJ) has been completely overlooked. This study aimed to determine the effect of a specific MET technique and therapeutic jaw exercises on pain of the temporomandibular region. This study investigated whether changes occurred immediately after application of the treatment protocol and if those changes were maintained over the following thirty minutes and one week later. Twenty one subjects with an inter-incisal range of mouth opening of less than or equal to 40mm were randomly assigned to either a TMJ exercise group, MET group or to a control group. Participants underwent either a specific isometric MET to the muscles of mandibular elevation, therapeutic jaw exercises or received no treatment at all. Visual Analogue Scales were used to measure perceived pain and were recorded before and after either intervention. Initially post treatment pain scores increased in those persons who participated in the TMJ exercises. All other pain scores decreased following treatment however these changes were not statistically significant. The results of this study indicted that further investigation into the effects of both MET and TMJ exercises on pain is required and to allow the full effectiveness of MET and TMJ exercises to be explored the need to conduct research on purely symptomatic patients is vital.

KEY WORDS: Muscle energy technique, Temporomandibular Joint Exercises Temporomandibular Joint, Pain, Visual Analogue Scale.

INTRODUCTION

Temporomandibular disorders (TMD) have a wide range of symptoms including restricted range of mouth opening, locking, clicking, headaches and commonly joint and muscle pain[1]. TMD accounts for a large portion of non dental pain in the oro-facial region, with pain being one of the most frequently presenting symptoms[1], usually involving the muscles of mastication (temporalis, masseter and the medial and lateral ptyergoids), the pre auricular area and /or the temporomandibular joint. As this pain may be aggravated by yawning or chewing it is considered to have a remarkably detrimental effect on ones' quality of life and is considered to be a pathological clinical symptom that is representative of TMD[2]. Pain is primarily produced as a result of direct or indirect macro or micro trauma to a specific group of tissues, such as the joint capsule, muscle, ligament or connective tissue and prolonged pain and guarding can result in shortening and restricted motion of articular and soft tissue structures[3](e.g. the temporomandibular joint (TMJ) capsule, muscles of mastication etc). It is anticipated that between 85 to 90 percent of the population will demonstrate one or more of the symptoms of TMD in their lifetime[4] with five to six percent of the population reporting clinically significant TMD related jaw pain[5].

Current treatment of TMD includes pharmacological intervention, behaviour modification, nutritional counseling, occlusal therapy, physical therapy, orthodontics, prosthetics, orthotics and surgery. No single drug has been proved to be effective for all cases of TMD and consequently practitioners should be aware of the different families of drugs including non-steroidal anti inflammatory medication, opiates, muscle relaxants,

tranquillisers and anti depressants[7]. Occlusal therapy is the most common form of treatment and has been shown clinically to be effective in approximately 70% of patients[7]. Behavioural therapy aims to modify persistent habits, such as grinding the teeth or unnecessarily clenching the jaw, via counseling, biofeedback, hypnosis and relaxation therapy. Physical therapy aims to restore normal mandibular function, relieve pain and prevent recurrence through a number of physical techniques[3,7]. It is often used in conjunction with other treatment modalities and for post surgical rehabilitation[3,7,6] . Physical therapy can be a useful form of treatment to allow the proper function of the orofacial musculoskeletal complex[9]. A range of surgical procedures are used to treat approximately 5% of patients suffering from TMD, and it is generally preferred that the patient undergoes a period of non-surgical treatment before resorting to surgery[7]. Overall treated patients reported statistically and clinically significant symptom improvement when compared to untreated patients[7]. Non-surgical treatments continue to be the most effective way of managing over 80% of patients[8]. Considering the complexity of TMD, certain patients may benefit from more than one treatment modality at any one time.

Muscle energy techniques (MET) were introduced to osteopathy in 1958[9], and are used to treat muscles with excessive tension, which limit joint motion and cause pain. Greenman[10] states that MET can be used to lengthen a shortened, contractured or spastic muscle; to strengthen a physiologically weakened muscle; to reduce localised odema and to relieve passive congestion. However, treatment of the TMJ using MET has been limited in its documentation, although it may have a beneficial outcome on the pain frequently encountered in TMD. MET may prove to be useful for reducing the tension in

the jaw muscles, improving joint motion and subsequently reducing pain, be it localised or referred to the face and head. Royder[11] states that osteopathic treatment, including MET, is of considerable value in the resolution of the musculoskeletal component of temporomandibular joint pain and dysfunction. As MET works on both the joint (TMJ) and the muscles of mastication (mainly the temporalis and masseter) it is considered to be appropriate for treating both the limitation of mouth opening and the muscular component (strain and/or hypertonicity) of TMD[9]. If MET treatment of the TMJ can be shown to improve functional ability, then it must be considered as a valid treatment approach for temporomandibular pain and dysfunction.

TMJ exercises are of great value in the treatment of TMD and can be helpful after the acute symptoms have been relieved[12]. Stretching exercises are designed to increase the range of motion of the mandible. The purpose of exercises for the masticatory system are (1) to achieve relaxation of tense muscles, (2) to retain coordination and rhythmic muscle function, (3) to increase mandibular range of motion (isotonic exercises) (4) to increase muscular strength (isometric exercises)[13].

The Golgi tendon receptors play an important role in both MET and TMJ exercises. Such activity stimulates the muscle spindles and Golgi tendon organs reducing excessive activity[14]. Stretching of the muscle fibers stimulates the Golgi tendon receptors, which have an inhibitory influence on muscle tension, leading to muscle relaxation[15]. The principle is based on the theory that when a muscle is actively contracted, its antagonists are reflexly relaxed[11]. Therefore, opening the mouth against resistance is inclined to relax

contracted elevator muscles and vice versa for opening muscles[11]. The fact that physical therapy is non-invasive and does not appear to be fraught with irreversible changes makes it a very applicable modality in the area of clinical TMJ dysfunction management[16].

The aims of this investigation were to determine if a specific isometric muscle energy technique and therapeutic jaw exercises focused on the temporomandibular joint (TMJ) and the muscles of mandibular elevation decreased pain of the temporomandibular joint region and to see if these changes were maintained over a period of 30 minutes and one week later.

MATERIALS AND METHODS

Subjects

Twenty one volunteer subjects (14 female, 7 male, age: 26.14 ± 10.41 years) with an inter-incisal range of opening of less than or equal to 40mm, were recruited from the student population at Victoria University. Participants were excluded if they had been previously diagnosed with a systemic arthropathy such as rheumatoid arthritis, or malignant tumors of the face or jaw. Those with a previous history of jaw or TMJ surgery or fracture as well as those that had undergone dental/orthodontic treatment in the past seven days[17,18] were also excluded. All volunteers provided informed consent and the Victoria University Human Research Ethics Committee had approved the study.

Procedure

All treatment and data collection occurred at the Victoria University Student Osteopathic Clinic. Inter-incisal range of jaw opening was measured to ensure participants had a range of opening of less than 40mm, not including the degree of overlap between the teeth when in the closed position[14,19,20,21]. The inter-incisal measurement was taken with a transparent plastic ruler as the participant actively opened his/her mouth to the maximum possible distance. The distance between the edges of the upper central incisors, and the lower central incisors was determined as the inter-incisor range of opening[14,19,20,21]. The participants were randomly allocated via computer algorithm to three groups, (i.e. group A – therapeutic jaw exercises, group B – MET intervention, group C – control). Each group had an equal number of participants. Group A and B received treatment as described below. Group C, the control group, received no therapeutic intervention.

A Visual Analogue Scale (VAS) was administered prior to the intervention[22]. The VAS was used to determine the participants' own perception of pain. A VAS was administered immediately after and 30 minutes following the intervention and one week post intervention. Pain is a subjective measure and one patient may perceive pain very differently to another. A visual analogue scale (VAS) is a simple and effective method for the measurement of pain[23]. The VAS can be used as a comparative measure of pain intensity in one patient on separate occasions[24] and is useful for evaluating treatment outcomes[22].

The therapeutic jaw exercises, applied to group A, used in this study included stretching, guided opening and closing movements and manual opening of the jaw[25,26]. At the start

of the treatment period the treating practitioner gave all participants a presentation and practical demonstration of the exercise program. Participants used a clenched fist under the jaw to provide resistance to opening. Participants used their fingers to hold lower teeth and resisted closing the mouth. Using a clenched fist held on the side of the jaw, the participants resisted side movement (lateral excursion). By placing the thumb on the top row of teeth and index finger on lower teeth the participants actively stretched the mouth open. All movements were held for a couple of seconds. All movements were repeated 10 times to complete one set. Five sets were required for each movement. This regime occurred once.

(Insert figure 1 here of tmj exercises)

The treating practitioner instructed the participant to ensure that the force of contraction was approximately 20% of their total effort and was not excessive or likely to cause pain or muscle soreness.

The MET technique, applied to group B, used in this study involved the treating practitioner placing gloved thumbs on the lower molars on both sides of the participant's jaw, whilst the participant lay supine with the mouth open[9]. The participant was asked to attempt closing the jaw using 20% of their total effort as the practitioner provided an equal resistance with the thumbs, so that no movement occurred. The treating practitioner instructed the participant to ensure that the force of contraction was approximately 20% of their total effort and was not excessive or likely to cause pain or muscle soreness. After a five second contraction, the participant relaxed the jaw muscles, and then the practitioner gently opened the jaw to the maximal distance possible and the participant

was again asked to attempt closing the jaw using 20% of their total effort. This contract-relax procedure was repeated five times.

(Insert fig 2 here of MET)

Group C, the non-intervention group had measurements of jaw opening taken. A VAS was taken immediately after the initial range of motion was measured. Participants were asked to lie on a treatment table, in a comfortable position. The mouth was reopened and measured and a second VAS was taken two minutes later. The mouth was opened again 5, 10, 20 and 30 minutes later. A final VAS reading was taken immediately after 30 minutes. One week later another VAS was taken.

Statistics

All results are reported as means and standard deviations. All statistical calculations were performed using SPSS version 12.0. A repeated measures split plot ANOVA was used to detect any differences in VAS scores (perceived pain) within the subjects over the four time intervals (pre test, 0, 30 minutes and one week post) and between the subjects to determine any differences amongst the interventions. Post Hoc analysis using one way ANOVA to determine where the differences occurred was conducted. Measures of effect are reported as η^2 and p was set at ≤ 0.05.

RESULTS

It was observed that there was a significant mean difference in pain over time for all participants ($F=4.108$, $p=0.011$, $\eta^2=0.0186$). In addition to this it was observed that there was a significant mean difference in pain over time when group variations had been accounted for ($F=3.797$, $p=0.003$, $\eta^2=0.297$). This is demonstrated in figure 3, which showed that perceived pain decreased over time for the MET group and remained relatively unchanged for the TMJ exercise and controls groups. It should also be noted that there is an immediate increase in pain post treatment within the TMJ exercise group.

(Insert figure 3 here.)

The VAS readings showed a considerable increase between the pre test value of 1.17 ± 0.87 mm to 2.77 ± 1.96 mm immediately post treatment for the TMJ exercise group. The MET group demonstrated a decrease in VAS readings from 0.84 ± 1.72 mm pre test to 0.30 ± 0.60 mm. Thirty minutes post treatment VAS readings decreased for both the intervention groups. The 30 minute post treatment VAS reading for the TMJ exercise group was 1.17 ± 0.98 mm and 0.23 ± 0.29 mm for the MET group. Seven days post intervention both treatment groups again showed decreased VAS readings with the TMJ exercise group dropping to 0.80 ± 1.06 mm and the MET group to 0.00 ± 0.00 mm. The differences between the groups were significant ($F=6.546$, $p=0.007$, $\eta^2=0.421$).

A one way ANOVA with planned post hoc analysis showed a significant difference between the means for the TMJ exercise group ($F=3.227$, $p=0.040$, $\eta^2=0.287$). Post hoc analysis revealed that this significant difference lied between the scores immediately post treatment and the scores one week post. Both the MET and control groups showed no significant differences in pain levels over time.

The mean range of VAS scores for pre test was 0.27 ± 1.16 mm for subjects in the control group with no change after two minutes. At thirty minutes the VAS reading for the control group increased marginally to 0.31 ± 0.43 mm. At the seven day following up VAS readings for the control group dropped slightly to 0.24 ± 0.35 mm.

DISCUSSION

The results of this study demonstrate that the application of a specific isometric muscle energy technique to the muscles of mastication does not significantly decrease perceived pain in persons with restricted jaw movement. This supports the findings of Freshwater and Gosling[27], however differs from those of Royder[11], which stated that MET is considered valuable in the resolution of muscle spasms, myositis and pain of the temporomandibular region. The findings of this study did not support the work of several authors who state MET can reduce pain and is an effective way of relieving pain that originates in tense musculature[12,28,29]. A number of possibilities can account for these differences. The sample size used within this study may have been too small to elicit significant effects. However this is unlikely as effect sizes were large η^2=0.186 to 0.297. Furthermore, the application of a single treatment (be it either MET or therapeutic jaw exercises) may not have been enough to produce a significant therapeutic effect. The most likely reason is that both asymptomatic and symptomatic participants with a limited range of mouth opening were recruited as patients in the current study. This may have resulted in a ceiling effect, in that those participants with little or no pain demonstrated

little or no change in pain levels over time. Considering the complexity of TMD, patients that report pain as a primary symptom may show a greater responsiveness to the application of a specific isometric MET to the muscles of mastication. The large effect sizes reported indicated that whilst clinical significance was not achieved with the specific isometric MET or the TMJ exercises used within this study, they did indeed have an influence on pain of the TMJ over time.

Royder[11] stated that MET would offer substantial immediate and more importantly prolonged benefits in relieving the musculoskeletal component of TMD. The most noted change in perceived pain was seen on the seven day follow up with those persons receiving a single specific isometric MET reporting no pain at all. These differences were not found to be of statistical significance. This may be accounted for by the small sample size (n=7) and the fact that measurements were only recorded at a single point time one week post treatment. The fact that MET may be joint specific must be taken into consideration and subsequently, it may not be an effective treatment modality in relation to the tempromandibular joint.

This study also demonstrated that TMJ exercises significantly increased perceived pain immediately post treatment. Whilst patients had been instructed on the correct procedure and were supervised, it is possible that they may have not performed the exercises as specifically as instructed. It is more likely that the exercises used in this study may have induced muscle fatigue and thus resulted in the increased pain immediately post treatment[14]. The participants were instructed to use a muscular force no greater than

20%. There was no way of determining the amount of force used by participants and therefore we cannot be sure the participant used only 20% of muscular force. This may have contributed to the increased pain seen immediately post treatment. Clinically this may be relevant as it is always important to ensure patients have a correct understanding of any exercises prescribed to them to avoid fatigue and discomfort. Incidentally this increase in pain confounded the results to show a statistical significance over time across the groups. When analysed on their own the only area to show a statistically significant difference was between the immediate post treatment scores and the one week post scores of the TMJ exercise group. The lack of significant findings may be accounted for by many of the factors mentioned in relation to the specific isometric MET and therefore effectiveness of therapeutic jaw exercises cannot be underestimated. There was a decrease in pain levels over time. Again the large effect indicates that the TMJ exercises do influence pain levels over time. Previous research has demonstrated exercise therapy as being an effective in relieving the pain associated with TMD as well as other symptoms [3,6,12,14,30].

While this study showed that both MET and therapeutic jaw exercises did not significantly reduce pain, it would be of interest to see the effects of both treatments on symptomatic patients and the authors of this study feel further research into this area is warranted. Longitudinal studies investigating different areas of the body, have found MET effective in reducing pain[24]. A randomized controlled study into the longer term effects on jaw pain is required in order for the findings to be of greater use in clinical practice.

The results of this study demonstrated that perceived pain significantly increased post treatment when TMJ exercises were administered. Both MET and TMJ exercises showed a decrease in perceived pain over time, however these changes were not found to be significant. The large effect size reported for both TMJ exercises and MET demonstrated that both interventions did influence pain over time and consequently further research, particularly on symptomatic patients, is required.

[1] Yap, A., Chua, E., & Hoe, J. Clinical TMD, Pain-Related Disability And Psychological Status Of TMD Patients. Journal of Oral Rehabilitation 2002; 29:374-380

[2] Kitai, N., Takada, K., Yasuda, Y., Verdonck, A., & Carels, C. Pain And Other Cardinal TMJ Dysfunction Symptoms: A Longitudinal Survey Of Japanese Female Adolescents. Journal of Oral Rehabilitation 1997; 24:741-748

[3] Mannheimer, J. Overview of Physical Therapy modalities and procedures. In Pertes, R.A & Gross, S.D, eds. Clinical Management of Temporomandibular Disorders and Orofacial Pain. Quintessence Publishing Co, Inc: Chicago. 1990

[4] Saghafi, D. & Curl, D. Chiropractic Manipulation of Anteriorly Displaced Temporomandibular Disc with Adhesion. Journal Of Manipulative And Physiological Therapeutics 1995; 18:98-104

[5] Goulet, J.-P, Lavigne, G.J. & Lund, J.P. Jaw Pain Prevalence Among French-Speaking Canadians in Quebec and Related Symptoms of Tempromandibular Disorders. Journal of Dental

[6] McCarty,W.L., & Darnell, M.W. Rehabilitation of the Temporomandibular Joint Through the Application of Motion. The Journal of Craniomandibular Practice. 1993; 11(4):298-307.

[7] Gaudet, E.L. & Brown, D.T. Temporomandibular Disorder Treatment Outcomes: First Report of a Large Scale Prospective Clinical Study. The Journal of Craniomandibular Practice. 2000; 18(1):9-22.

[8] Dimitroulis, G. Temporomandibular Disorders: a clinical update. BMJ. 1998; 317:190-194.

[9] Chiatow, L. (2001) Muscle Energy Techniques. Churchill Livingstone: Edinborough

[10] Greenman, P. (1996) Principles of Manual Medicine. (2nd Ed.) Williams & Wilkins: Baltimore

[11] Royder, J.O. Structural Influences in Temporomandibular Joint Pain and Dysfunction. Journal of AOA. 1981; 80(7):460:467

[12] McNeill, C., Danzig, W.M., Farrar, W.B. & co workers. Craniomandibular disorders – The state of art. Journal of Prosthetic Dentistry. 1980;44(4): 434-437

[13] Pertes, R.A & Gross, S.D (1995) Clinical Management of Temporomandibular Disorders and Orofacial Pain. Quintessence Publishing Co, Inc: Chicago.

[14] Bell, W.E. Temporomandibular Disorders: Classification, Diagnosis, Management. 3rd ed. Year Book Medical Publishers 1995

[15] Roberts, B. L. Soft Tissue Manipulation: Neuromuscular and Muscle Energy Techniques. Journal of Neuroscience Nursing. 1997; 29(2):123-127

[16] Kirk-Ws J, Calabrese DK. (1989) Clinical evaluation of physical therapy in the management of internal derangement of temporomandibular joint. Journal of Oral Maxillofacial Surgery, 47,113.

[17] Austin, B. & Shupe, S. The role of physical therapy in recovery after temporomandibular joint surgery. Journal of Oral and Maxillofacial Surgery. 1993; 51:495-498

[18] Taylor, K., Newton, R., Personius, W., & Bush, F. Effects Of Interferential Current Stimulation For Treatment Of Subjects With Recurrent Jaw Pain. Physical Therapy. 1987; 67(3):346-350.

[19] Friction, J., and Schiffman, E., (1986), Reliability of a Craniomandibular Index, Journal of dental research, 65(11): 1359 –1364.

[20] Kraus, S., (1988), TMJ disorders; management of the craniomandibular complex. Churchill Livingstone, Melbourne.
[21] Malone, T., McPoil, T., and Nitz, A., (1997), Orthopedic and sports physical therapy, 3rd ed, Mosby, Sydney
[22] Bolton, J., and Wilkinson, R., Responsiveness of Pain Scales: A Comparison of Three Pain Intensity Measures in Chiropractic Patients, *Journal of manipulative and physiological therapies*, 1998, 21(1), 1-7.
[23] Scott, J, & Huskisson, E. Graphic Representation of Pain. Pain 1976; 2:175-184
[24] Hukisson, E. Visual Analogue Scales. In: Melzack R, ed. Pain Measurement and Assessment. New York: Raven Press; 1983: 33-37.
[25] Magnusson T, Syren M. Therapeutic jaw exercises and interocclusal appliance therapy. Swedish Dental Journal. 1999;23: 27-37.
[26] Pertes, R.A. & Gross. SD, Eds. Clinical Management of Temporomandibular Disorders and Orofacial Pain. Quintessences Publishing CO: Chicago 1995
[27] Freshwater, Z. & Gosling, C. The Effect of a Specific Isometric Muscle Energy Technique on Range of Opening of the Temporomandibular Joint. A Pilot Study. 4th International Conference on Advances in Osteopathic Reasearch. April 2003. Journal of Osteopathic Medicine. 2003; 6(1):36
[28] Lewit, K. & Simons, D.G. Myofascial Pain: Relief by Post Isometric Relaxation. Arch Phys Med Rehabilitation. 1984; 65:452-456.
[29] Brodin, H. Lumbar Treatment Using MET. Osteopathic Annals. 1982; 10:23-24
[30] Nicolakis, P., Erdogmus, B., Kopf, A., Djaber-Ansari, D., Piehslinger, E. & Fialka-Moser, V. Exercise Therapy for Craniomandibualr Disorders. Arch Phys Med Rehabilition. 2000; 81:1137-1142