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The effectiveness of soft tissue manipulation as compared to a home program in decreasing pain and increasing range of motion for individuals with temporomandibular disorders

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Recommended Citation

Owens, Krystyna, "The effectiveness of soft tissue manipulation as compared to a home program in decreasing pain and increasing range of motion for individuals with temporomandibular disorders" (2014). *PT Critically Appraised Topics*. 40.
<https://commons.pacificu.edu/ptcats/40>

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The effectiveness of soft tissue manipulation as compared to a home program in decreasing pain and increasing range of motion for individuals with temporomandibular disorders

Disciplines

Physical Therapy

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TITLE: The effectiveness of soft tissue manipulation as compared to a home program in decreasing pain and increasing range of motion for individuals with temporomandibular disorders.

CLINICAL SCENARIO: I have seen a variety of methods used to treat headaches that are associated with temporomandibular pain and other indications of temporomandibular joint (TMJ) dysfunction during my clinical rotations. One treatment that I was instructed in was soft tissue manipulation (STM) for the face externally, intraoral massage, and upper thoracic/cervical STM. While many patients appeared to benefit from this form of treatment in addition to their home exercise program (HEP), it was unclear whether our STM was influencing the recovery process in a significant way.

BRIEF INTRODUCTION: Soft tissue manipulation increases blood flow to the muscles of a treated area and encourages relaxation of these muscles.ⁱ During my clinical rotation in outpatient orthopedics soft tissue manipulation was one tool proposed to help relax the temporomandibular muscles that may be excessively tight and contributing to the patient's TMD symptoms. During this clinical, I was instructed in both intraoral and external soft tissue techniques. Intraoral techniques are used to access the masseter muscle, medial and lateral pterygoid muscles, and insertion of the temporalis muscle. Additionally, from an external approach a therapist can manipulate the frontalis muscle and the belly of the temporalis muscle. Each of these muscles has an influence on the several directions that the TMJ is capable of moving in (opening, closing, protrusion, retrusion, and lateral deviations).ⁱⁱ Because the mandible depends on two joints for movement, one TMJ per side, it became obvious in clinic that an imbalance of the muscular tone can influence the biomechanics of the joint.

CLINICAL QUESTION: Does soft tissue manipulation produce superior results to a home exercise program in treatment of temporomandibular disorders, as measured by decrease in pain and improved range of motion?

CLINICAL PICO:

Population: individuals 18-65 y.o. with TMD

Intervention: soft tissue manipulation

Comparison: Home program/education

Outcome: ROM and pain

OVERALL CLINICAL BOTTOM LINE:

The research by Kalamir et al found that manual therapy or a combination treatment of manual therapy and home exercise program provides greater pain relief than no treatment at one year follow up. It was not possible to determine the clinical importance of these treatment effects because there were insufficient data to calculate the size of treatment effects between manual therapy and no treatment and between combination treatment and no treatment. When comparing the two interventions, there was a clinically important difference in reduced pain during mouth opening at 1-year follow up that favored combined treatment.

Tuncer et al compared a combination treatment of manual therapy and home program with “home program only” treatment. This study design more closely matches my clinical question. The only clinically important difference between groups after completing the intervention (4 weeks) was a greater reduction in “pain with stress” (pain during gum chewing) that favored the combination treatment group. There was no clinically important difference between groups for pain-free maximal mouth opening. There was no long-term follow up in this study so it is unclear whether these differences are maintained beyond the 4-week follow up.

The inclusion criteria in both studies created a population of participants who are likely to come into any outpatient clinic, suggesting that the results are applicable to the patient population of my clinical PICO. Due to the high applicability of this study to my clinical PICO, the low cost of learning the techniques, the positive outcome measures, and the overall feasibility of treatment, I would feel comfortable replicating these methods of treatment on individuals that present with signs and symptoms consistent with TMD. The difference in intervention groups between studies creates some disconnect when comparing results (ideally both would have had a manual group, home exercise group, and combination group), however both concluded that the combination treatment was the most beneficial for individuals with TMD in reducing pain. The consistent results favoring combination treatment suggest that it might be more appropriate to combine manual therapy with a home program when treating patients experiencing TMD in order to maximize pain relief. The results from both studies suggest that manual therapy or combination treatment is better than no treatment for improving ROM in patients with TMD, but one approach is not better than the other. Ideally, to clarify the results of these studies and increase their applicability, future studies should include the combination treatment group and one group per intervention within the combination treatment (ie, combination of manual and home program, home program only, and manual only).

SEARCH TERMS: manual therapy, temporomandibular joint, temporomandibular disorder

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RATIONALE FOR CHOSEN ARTICLES:

Table 1. Comparison of patient population, intervention, outcome measures, and PEDro Scores

	Kalamir et al	Tuncer et al	Von Piekartz and Hall
Patient Population	Individuals 18-50 years old with chronic jaw pain	Individuals 18-72 years old with TMD	Individuals 18-65 years old with cervicogenic headache and signs of TMD
Intervention	Intraoral myofascial therapy (IMT) vs. IMT plus education vs. wait-list control	Manual therapy + home PT vs. home PT only	Orofacial treatment + cervical manual therapy vs. cervical manual therapy only
Outcome Measures	Mandibular opening ROM and pain	Pain free maximum mouth opening, pain at rest, pain with stress	Cervical ROM, flexion-rotation test, and manual examination of upper cervical joints
Random Allocation	1	1	1
Allocation Concealed	1	1	1
Groups Similar at Baseline	1	1	1
Blind Subjects	0	0	0
Blind Therapists	0	0	0
Blind Assessors	1	1	1
Adequate Follow-up	1	0	1
Intention-to-Treat	1	1	0
Between Group	1	1	1
Point Estimates & Variability	1	1	1
Total Score	8	7	7

Article 1: Kalamir A, Bonello R, Graham P, Vitiello A L, and Pollard H. Intraoral Myofascial Therapy for Chronic Myogenous Temporomandibular Disorder: A Randomized Controlled Trial. *Journal of Manipulative and Physiological Therapeutics*. 2012; 35(1): 26-37.

Article 2: Tuncer AB, Ergun N, Tuncer AH, and Karahan S. Effectiveness of manual therapy and home physical therapy in patients with temporomandibular disorders: A randomized controlled trial. *Journal of Bodywork & Movement Therapies*. 2013; 17:302-308.

Article 3: von Piekartz H and Hall T. Orofacial manual therapy improves cervical movement impairment associated with headache and features of temporomandibular dysfunction: a randomized controlled trial. *Manual Therapy*. 2013; 18:345-350.

For the purposes of the clinical scenario of interest, I have chosen to examine the articles by Kalamir et al and Tuncer et al. These two articles fit my clinical scenario and have good PEDro scores. Both articles lack clinician and patient blinding, which is to be expected in many physical therapy/treatment related studies. It is difficult to blind a clinician and their patient to the treatment that they are receiving. Additionally, I consider Tuncer et al to lack adequate follow-up as they only have data for the end of the four-week study. Adequate follow-up should include the condition of the patients longitudinally after the treatment has been completed in order to determine the long-term effects of the treatment. I have chosen to set aside the von Piekartz and Hall article because there was no intention to treat analysis performed and because this article focused more on the cervical spine than the temporomandibular joint.

Article 1: Kalamir A, Bonello R, Graham P, Vitiello A L, and Pollard H. Intraoral Myofascial Therapy for Chronic Myogenous Temporomandibular Disorder: A Randomized Controlled Trial. *Journal of Manipulative and Physiological Therapeutics*. 2012; 35(1): 26-37.

Clinical Bottom Line: This study found that myofascial therapy and a combination of education/home exercise/myofascial therapy both provide significant improvements in mandibular opening, resting pain, clenching pain, and opening pain levels compared to no treatment. Within-group changes in all pain outcomes at 1-year follow-up were clinically important for the combination treatment group. In contrast, within-group changes at 1-year follow-up for the myofascial therapy only group were only clinically important for resting pain. Although between-group differences for all pain outcomes were statistically significant and favored combined treatment over myofascial therapy alone, only the between-group difference in opening pain at 1-year follow-up was clinically important. Based on these results and the overall good internal validity and fair external validity I would feel comfortable incorporating myofascial therapy into my treatment plan for individuals with TMD. For individuals with opening pain, I would encourage utilization of education and HEP as this study demonstrated there was both statistically and clinically significant difference between groups on this outcome measure. I would provide them the tools to improve on their own, while using myofascial therapy to promote and monitor healing through a hands on assessment of muscle tone and patient tolerance to pressure. While it is unclear if the HEP would be more successful without the therapist hands on intervention, I believe there is a certain amount of interaction necessary to encourage the patient to continue their HEP and it allows for the therapist to assess change on the level of the tissues during recovery. This may be especially useful when a patient is discouraged about progress or has difficulty assessing their progress over time. The treatment is beneficial to the patient and does not require continuing education for the therapist, however may not be covered by insurance companies. In such cases, I would put a heavier emphasis on adherence to the HEP and educating the patient about their condition to supplement and minimize the out of pocket cost to the patient.

Kalamir et al PICO:

P: Individuals 18-50 years old with a daily history of periauricular pain (with or without joint sounds) lasting a minimum of 3 months.

I: Intraoral myofascial therapy

C: Wait list control group and combination treatment of intraoral myofascial therapy with education of self-care exercises

O: Pain during resting, opening, and clenching; interincisal range of motion

Blinding: Subjects enrolled in the trial and therapists providing treatment were not blinded, however the individuals responsible for allocating subjects and assessing them were blinded. The receptionist, who answered telephone questions, screened participants for inclusion/exclusion criteria, made appointments, prepared participant files, and numbered them for allocation, was blinded to the randomization schedule and the assessment outcomes. A study assistant was responsible for creating the randomization schedule and allocating the participant files. This individual was blinded to the assessments as well. The assessor, a dental nurse, was blinded to the randomization schedule and assessment outcomes during the study.

Controls: This study utilized a wait-list control group. Individuals in this group were instructed that their symptoms would be monitored for 1 year, at which time they would become eligible to begin treatment.

Randomization: Participants were randomized into one of three groups using a random number generator. Randomization was concealed. A research assistant not involved in data collection created the randomization schedule, and study personnel responsible for enrolling participants and gathering baseline and follow-up data were blinded to the randomization schedule. This randomization process resulted in similar groups at baseline for all outcome measures except opening range-of-motion.

Study: This study required that participants were between 18 and 50 years old with a minimum history of 3 months of periauricular pain (with or without joint sounds). Individuals consented to voluntary participation in the immediate study and long term follow up. Volunteers were excluded if they had previously received treatment from the clinic, were toothless, had experienced a malignancy within the last 5 years, and had physical contraindications to manual therapy, experiencing a metabolic disease, connective tissue disease, rheumatic disorder, or hematologic disorder. Volunteers that met the baseline criteria signed an informed consent and were evaluated using research diagnostic criteria (RDC), which established the guidelines for their secondary inclusion and exclusion criteria. To remain in the study, individuals had to have a baseline chronic pain score of at least 3 out of 10 and individuals were excluded if the RDC determined they had severe depression. Each eligible volunteer was assigned a number according to the order of entry into the study and then were randomized into one of three treatment groups using a random number generator. The three groups had 31 participants each and were the control, intraoral myofascial therapy, and combination intraoral myofascial therapy with education for self-care at home. Individuals assigned to the control group were told that their symptoms would be monitored for one year, after which they would be eligible to receive treatment. The intraoral myofascial therapy group received 10-15 minute treatments twice a week for five weeks. These treatment sessions consisted of three manual techniques performed in the following order: intraoral temporalis release, intraoral medial and

lateral pterygoid, and then the intraoral sphenopalatine ganglion technique. Finally, individuals in the combination treatment group received additional instruction at the end of their first four treatments explaining the anatomy and biomechanics of the temporomandibular joint, dysfunction of the joint, impact of psychoemotional factors, and a home exercise program (HEP) that should be completed in the morning and at night. The HEP consisted of two types of exercise: the Macquarie University mandibular body-condylar cross-pressure chewing technique and postisometric relaxation stretches for laterotrusion and opening. Individuals were reassessed at six weeks, six months, and twelve months post initiation of the study.

Outcome measures: The outcome measures of interest in this study were opening range of motion, resting pain, opening pain, and clenching pain. Pain measures were determined using a 11-point chronic pain scale and the authors have reported that the minimal detectable change (MDC) is 0.45 and the minimum clinically important change (MCID) is 2 points. The MCID for interincisal range of motion was determined by the authors to be 9mm based on reports of an MDC anywhere between 5 and 9 mm.

Study losses: There was one subject lost from the control group in this study after six months. The reported reason for this individual leaving the study was impatience due to being on the waiting list and not receiving treatment. Intention to treat analysis was performed by the authors to account for this loss by using each subject's baseline values in place of the missing outcome measure data points.

Summary of Internal Validity: The internal validity of this study is good. There were two minor threats to the validity of the study: lack of blinding of the subjects and lack of blinding of the therapist. These are considered minor threats because they allow for the potential of bias to occur on part of the therapist, the primary author, and also for possible placebo effects to take place on part of the subjects, as they are aware of the treatment they are receiving. The threats are considered minor because extensive efforts were made to ensure the presence of a true control group, assessor blinding, and true randomization to minimize threats to validity. Groups were equal at baseline for all outcome measures except opening range, which due to the stringent randomization process was considered to be chance effect.

Evidence: The outcome measures of this study were opening pain, clenching pain, resting pain, and opening range. These were measured at baseline, six weeks, six months, and twelve months post initiation of interventions. The study does not provide raw numbers for follow up data, but do provide the chi-square comparisons and p-values calculated for between group comparisons related to each outcome measure.

Statistical analysis showed that there was a significant interaction between time and group assignment ($p < .001$). This meant that the change in outcomes over the course of the study were significantly different between the 3 groups. Specific results of post hoc analyses were not reported, and follow-up data for participants were only presented in box plots that did not allow for accurate extraction of mean values and standard deviations for independent calculations. However, the authors stated pain scores for both treatment groups were significantly lower than the control group at 6-week, 6-month, and 1-year follow-ups. When comparing the two treatment groups, pain scores at 1-year follow-up were significantly lower

for the combination group than the myofascial only group. Differences between these two groups at 6-week and 6-month follow-ups were not significant. The mean values for change scores in pain at 1-year follow-up for the combination and myofascial only groups are shown in Table 1.

Table 1: Mean change in pain scale points for intraoral and combination treatment groups.

	Resting Pain	Opening Pain	Clenching Pain
Intraoral Myofascial Therapy	3.1	1.9	1.7
Combination Treatment	4.0	4.1	3.6

The myofascial only treatment group exceeded the MCID of 2 points for change in resting pain, however did not meet this minimum change for opening or clenching pain. The combination treatment group exceeded the MCID for average change in pain for all three relevant outcome measures.

When comparing the two treatment groups using the mean change in pain, there is a difference of 0.9 points in resting pain, 2.2 points for opening pain, and 1.9 points for clenching pain. This indicates that only opening pain for the combination treatment group showed a clinically important change over the myofascial only group. It was not possible to calculate 95% confidence intervals for these between group differences because standard deviations could not be extracted from data that was only presented in graph format.

Applicability of Study Results:

Benefits vs. Costs: While little additional education is required for these statistically significant improvements in pain and range of motion, many insurance providers do not cover TMD for treatment. This poses a financial burden for the patient, in which they may have to pay out of pocket for the services. More information about the benefits of HEP alone could elucidate the possibility of minimizing therapy visits (and thus minimizing cost to the patient) through maximizing patient knowledge of symptom management.

Feasibility of Treatment: This treatment requires little additional education on part of the therapist and is thoroughly described in the study, making it easily replicable. However, due to the lack of comparison of manual therapy only to HEP only, it is unclear whether both aspects are necessary for optimal results. The potential benefits of the HEP include patient control and management of the condition without dependence on the therapist for manual techniques.

Summary of External Validity: The external validity of this study is fair, with only one study loss from the control group attributed to impatience. Some minor threats to validity were the use of a private chiropractic office, the small population that the applicants for the study came from, and the lack of a HEP only group for comparison. Study subjects came from a suburban area and were mostly referred to the study by a dental practice. Additionally, while the study points out that manual therapy with education and HEP is better than manual therapy alone, it does not address the question of whether a HEP is sufficient treatment alone. The authors point out that this is a point of interest that requires additional research. Lastly, presentation of data did not allow for extraction of information needed to accurately calculate the potential

clinical importance of between group differences and their associated 95% confidence intervals.

Article 2: Article 2: Tuncer AB, Ergun N, Tuncer AH, and Karahan S. Effectiveness of manual therapy and home physical therapy in patients with temporomandibular disorders: A randomized controlled trial. *Journal of Bodywork & Movement Therapies*. 2013: 17:302-308.

Clinical Bottom Line: This study suggests that both a home exercise program (HEP) and a HEP combined with manual therapy (HEP + MT) are associated with clinically important within-group reductions in resting pain and pain with stress after a 4-week intervention in patients with TMD. Between-group differences for reductions in resting pain were not statistically significant, but between-group differences for reductions in pain with stress favored HEP + MT and were both statistically significant and clinically important. There were no clinically important within-group or between-group differences for pain-free maximal mouth opening. There was no long-term follow-up, so it is unclear whether treatment effects are maintained after therapy is completed. Considering these results and the validity of the study I would incorporate manual therapy into my treatment of individuals with TMD. Due to the structure of the study and the lack of a “manual therapy only” group I would still emphasize the importance of an HEP to the patient. Not only will this encourage the patient to maintain gains achieved through hands on work during therapy sessions, but it will also provide them with the knowledge and tools to address future episodes of TMD pain.

Tuncer et al PICO:

P: Individuals 18-72 years old with myogenous temporomandibular disorder

I: manual therapy with home physical therapy

C: home physical therapy only

O: pain intensity and pain free maximum mouth opening

Blinding: Although participants knew whether they received manual therapy with home program or home program only, they were did not know which group the authors were using as the ‘control’ group. The therapist who collected baseline and follow-up data was blinded to group assignments and provided instruction in the home program to all participants prior to group allocation. Clinicians who provided manual therapy could not be blinded to group assignments.

Controls: There was no true control group in this study because all participants received some form of treatment, however the authors treated the home program only group as the control for this study.

Randomization: A computer-generated randomization list was created for group allocation. Randomization was concealed because baseline measurements were completed prior to revealing each participant’s group assignment, and the therapist who collected baseline and follow-up data was blinded to group assignments. Randomization was successful because the

groups were similar at baseline for demographic factors, duration of symptoms, and outcome measures.

Study: A dentist examined potential study subjects using Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD). There were three potential groups of inclusion criteria. First, individuals with myogenous TMD according to the RDC/TMD and three out of twelve painful palpation points were eligible to participate. The second group consisted of individuals with anterior disc displacement with reduction accompanied by painful clicking, crepitation on opening and loaded closing, elimination of click sound on opening-closing movements when the jaw was protruded, and pain during compression testing. Lastly, individuals with a minimum of a three month history of TMJ pain were included in the study if the pain could not be attributed to trauma, inflammation, or infection of the muscles. Exclusion criteria included disc displacement without reduction, arthritis or TMJ arthritis according to RDC/TMD; history of chronic TMJ pain, clinical pathology, or previous surgery to the jaw or cervical spine; history of TMD treatment in previous three months; neurological or psychiatric disorders that could interfere with therapy or use of any medications that affect the musculoskeletal system. A therapist blinded to group designation took baseline measures for pain intensity at rest, pain intensity with stress, and pain free maximum mouth opening. Individuals were placed in either the home physical therapy only group or the combination treatment group that included home physical therapy and manual therapy. Each group consisted of 20 subjects. All individuals were instructed in a home physical therapy program. This consisted of education about the cause of their pain, ergonomic advice, breathing exercises, relaxation techniques, posture correction, and mandibular exercises. In addition to this instruction, the combination treatment group received manual therapy consisting of soft tissue mobilization (intraoral and extraoral), TMJ mobilization, TMJ stabilization, coordination exercises, cervical spine mobilization, and post-isometric relaxation and stretching techniques for the jaw and neck. These treatment sessions were performed three times a week for 30 minutes per session over the course of four weeks. Individuals in both groups were instructed that they should maintain their home exercise program throughout the duration of the four week study even if they felt no pain.

Outcome Measures: Outcome measures of pain at rest, pain intensity with stress, and pain-free maximum mouth opening were measured at baseline and again at four weeks. Pain at rest and pain with stress were measured using a visual analogue scale which the authors report to be both valid and reliable. Patients marked on a line where they felt the intensity of their pain rested with 0 being “no pain at all” and 100 being “worst possible pain.” The MCID was stated to be a 30% change in VAS rating. Pain free maximum mouth opening was measured in millimeters, using the distance between central incisors of the mandible and maxilla. The largest of three trials was the measurement used for data analysis. The MCID for this measure was a change of 9 mm.

Study Losses: No subjects were lost during this study.

Summary of Internal Validity:

The internal validity of this study was fair due to four minor threats. The authors of this study were able to successfully randomize the participants, provide a clear design, provided references for the reliability of their instrumentation, performed appropriate statistics, and followed a strict protocol. However, the control group in this study was not a true control group according to the definition because these individuals did receive some form of treatment. This raises the minor threat of maturation affecting the comparison of results, however both intervention groups received this basic treatment and allows the threat to be minimized. Additionally, there was no blinding of the therapists or subjects in this study. This is a minor threat because subjects did not know which group (combined treatment or home program only) the authors considered to be the 'control' group and assessor blinding was performed in order to minimize potential bias in measurement. The third minor threat is that the authors provide no evidence for the statistical power of their study. It is unclear whether 40 participants were sufficient to identify differences between groups that the authors deemed to be clinically important. Finally, follow-up measurements were taken only at the completion of the 4-week intervention period. It remains unclear whether individuals would maintain improvements after cessation of therapy.

Evidence: The relevant outcome measures in this study were pain measured at rest, pain with stress, and maximal pain free opening of the jaw. Pain measurements were taken using the visual analogue scale (VAS) and opening was measured in millimeters. Measurements were taken at baseline and at the end of treatment (4 weeks after baseline). The mean within-group percentage change scores in pain at rest at 4-week follow-up were -34.6% for the home program only group and -59.2% for the combined treatment group. These within-group reductions in pain were statistically significant and clinically important because they exceeded the stated MCID of a 30% change from baseline. However, there were no statistically significant differences between groups for changes in pain at rest at 4-week follow-up.

Similar to pain at rest, within-group reductions in pain VAS with stress were statistically significant and clinically important (-35.7% for home program only; -91.3% for combined treatment). Reductions in pain with stress at 4-week follow-up were significantly greater for the combined treatment group ($p < 0.001$). This difference between groups for pain with stress at 4-week follow-up also appeared to be clinically important given an effect size > 2.0 and a difference between group means of 36.5mm (95% CI 24.96 to 48.04) (Table 2). Furthermore, the percent reduction in pain with stress at 4-week follow-up was 56 percentage points greater for the combined treatment group (ie, difference between groups for percentage reduction in pain exceeds MCID of 30%). These findings indicate that, while both treatments were successful at decreasing pain with stress to the TMJ, the combination treatment of home program and manual therapy was significantly better at reducing this pain measure than home program alone.

Table 2: Between-group effect sizes for change in pain VAS scores with stress (with 95% confidence intervals in parenthesis).

	HPT	MT-HPT	Effect Size Between	Mean Difference
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Baseline	66.5±20.6	62.5±20.5	n/a	n/a
After	43.5±20.8	7.0±12.6	2.12 (1.35 to 2.9)	36.5 (24.96 to 48.04)

Data for pain-free maximal mouth opening are shown in Table 3. As stated previously, the MCID for this outcome measure was 9mm. Within-group changes in pain-free mouth opening for the home program only group were not statistically significant because the 95% confidence interval for the within-group mean difference contained zero (Table 3). In contrast, within-group changes in pain-free mouth opening for the combined treatment group were statistically significant but were not clinically important (within-group mean difference < 9mm) (Table 3). The difference between groups for pain-free maximal mouth opening at 4-week follow-up is borderline statistically significant. The 95% confidence interval for the effect size does not contain zero, but the 95% confidence interval for the difference between group means does contain zero (Table 3). Regardless of statistical significance, the difference between group means for pain-free maximal mouth opening was not clinically important because it was less than 9mm (Table 3).

Table 3: Comparison within and between group effect sizes and mean differences in pain-free maximal mouth opening with 95% confidence intervals in parenthesis.

	Baseline	After	Mean difference within groups (mm)	
HPT	39.0±6.1	41.4±4.7	2.4 (-1.25 to 6.05)	
MT-HPT	38.6±6.7	44.4±4.4	5.8 (2.0 to 9.6)	
	HPT	MT-HPT	Effect Size Between groups	Mean Difference Between groups
Baseline	39.0 ±6.1	38.6 ± 6.7	n/a	n/a
After	41.4 ±4.7	44.4 ± 4.4	.66 (0.02 to 1.30)	3 (-.05 to 6.05)

Applicability of Study Results:

Benefits vs. Costs: Manual therapy for TMD requires little additional education and, when combined with a home program, provides clinically important benefits beyond a home program alone for pain with stress placed on the jaw. However, as discussed previously, many insurance providers do not cover TMD treatment. This study provides insight into whether individuals could manage this condition on their own and achieve similar therapeutic results. It is seen here that a home program could minimize cost to the patient by minimizing the amount of office visits necessary for pain relief, however the statistical analyses identify that the addition of manual therapy can provide significantly more pain relief than home exercise alone.

Feasibility of Treatment: Any trained entry-level therapist can perform the treatments used in this study and the protocol is thoroughly explained by the authors. This study shows that manual therapy combination with home physical therapy is appropriate for TMD treatment, however does not explore the effectiveness of manual therapy alone.

Summary of External Validity: The external validity of this study is good, with no study losses and only minor threats to internal validity. Threats include the lack of a manual therapy only group, no long-term follow up, and there is no indication of how compliant patients were with their home programs. The patient population in this study encompasses the population of interest that was defined in the clinical PICO and the results of the study can thus be extrapolated to the patients that I have seen in the clinic fitting this diagnostic category.

ⁱ Pesco MS, Chosa E, and Tajima N. Comparative Study of Hands-On Therapy with Active Exercises vs Education with Active Exercises for the Management of Upper Back Pain. *Journal of Manipulative & Physiological Therapeutics*. 2006: 29(3):228-135.

ⁱⁱ Matsumoto R, Ioi H, Goto TK, Hara A, Nakata S, Nakashima A, and Counts AL. Relationship between the unilateral TMJ osteoarthritis/osteoarthrosis, mandibular asymmetry and the EMG activity of the masticatory muscles: a retrospective study. *Journal of Oral Rehabilitation*. 2010: 37(2): 85-92.