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Cervical Spine Thrust Joint Manipulation, Education, and a Home Exercise Program for the Management of Individuals with Temporomandibular Disorder: A Prospective Case Series

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Abstract

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ABSTRACT
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Key Words: high-velocity thrust, manipulation, manual therapy, mobilization, exercise, temporomandibular joint

BACKGROUND AND PURPOSE

Temporomandibular disorder (TMD) is a common and costly musculoskeletal condition reported in up to 60% of sample populations.[1-4] TMD is the 3rd most common chronic pain condition with annual health care costs estimated up to $4 billion.[5,6] Despite the estimated prevalence, only a small percentage of this population (5-10%) seeks treatment.[3,6] The National Institutes of Health (NIH) and National Institute of Dental and Craniofacial Research (NIDCR) recognize that the TMD population is underserved, often lacking a clear path to specialists.[5,6]

Diagnosis of TMD is made via clinical symptom presentation. Symptoms may include pain in the jaw, head, and neck regions, headaches, periauricular pain, tinnitus, limited jaw opening, and loss of function.[1,3] Greater intensity of pain is associated with increased likelihood to seek care.[7] While some research has reported up to 3 times greater risk of TMD in women, a large prospective cohort study noted approximately equal prevalence for male and female participants.[8,9] It is possible the previous gender association with TMD is confounded by influences to seek medical care.[10]

Dentists are the primary referral source for TMD patients to physical therapy (PT); however, dental literature often reports lack of quality research to support PT in the TMD population.[4,11] PT literature also reports lack of clear description, quality, and consistency to support TMD intervention.[12-16] Despite conflicting findings, there is evidence supporting PT interventions for individuals with TMD. Treatments reported in the literature include manual therapy and exercise for both the masticatory system and the cervical spine, behavioral education, and modalities.[13]

TMD Treatment

Behavioral modification education is frequently part of pain management interventions, and has shown results comparable to intra-oral appliances in individuals with TMD.[17] Suggestions include improving sleep and diet, avoiding caffeine, minimizing stress, masticatory relaxation techniques, and avoiding parafunctional habits.[17] Parafunctional habits are movements of the jaw that are not necessary for normal function,[3] including gum chewing, awake clenching and grinding, biting the tongue or cheeks, holding the jaw forward in protrusion, and biting fingernails.[3,18,19] Education focuses on awareness and reduction in frequency.

The Rocabado 6x6 is the most commonly reported exercise intervention; however, other exercises have been evaluated.[20,21] While evidence is lacking support for superiority of any specific exercise, there is support for jaw, cervical, and postural exercises in the TMD population.[12,22] The Rocabado 6x6 includes the resting position of the jaw, controlled jaw opening, self-mobilization for C0/1 distraction, isometric jaw movement, scapular retraction, and cervical retraction.[21,22]

Cervical Spine and TMD

A known biomechanical and neurophysiological relationship between TMD and the cervical spine exists.[23] The convergence of upper cervical nerve roots with the trigeminal nerve in the trigeminocervical nucleus partially explains why neck pain may be perceived in the head or face.[24,25] While a causal relationship is unclear, the presence of cervical spine disorders may contribute to orofacial pain complaints.[26,27] Between 43-68% of TMD patients report associated neck pain.[2,25] There is a strong correlation between jaw dysfunction and neck disability in persons with chronic TMD.[28,29] Manual therapy directed at the jaw, thoracic spine, and cervical spine have been addressed in a limited fashion in TMD literature.[15,16,30] Evidence supporting the use of thrust joint manipulation (TJM) of the cervical and thoracic spine for TMD is available but limited.[31] A 2016 case report noted cervicothoracic TJM combined with exercise and education had positive outcomes in a patient with a primary complaint of TMD.[31-33] Cervical spine non-thrust joint mobilization and exercise targeting the cervical spine demonstrated reduced pain and improved pain pressure thresholds in subjects with TMD.[34-36]

Purpose

Physical therapists often report lack of preparation and confidence in treating the TMD population.[25] Barriers to PT treatment may include limited access to clinicians who are comfortable treating TMD and insufficient evidence of PT effectiveness. Understanding the impact of various interventions on pain modulation and functional change can guide informed and evidence-based clinical practice. Early intervention and implementation of effective treatments may have an impact on patient outcomes and/or chronicity for the underserved TMD population. The purpose of the case series was to describe outcomes in participants with a primary complaint of TMD treated with PT interventions including cervical spine TJM, behavioral education, and exercise.

METHODS

Participants

Participants were recruited on a volunteer basis responding to flyer advertisement in Peoria, IL. Individuals interested in participation reached out to researchers via email or phone calls. Therefore, this case series utilized a sample of convenience. All participants were screened for eligibility prior to admission into the study. Inclusion criteria were age 18-60 and a primary complaint of TMD with myalgia. Exclusion criteria included recent trauma, recent cervical manipulation, prior neck surgery, signs of medical red flags (non-mechanical nature of symptoms, signs of systemic or neurological disease), contraindications to manual therapy or cervical spine TJM (example: fracture, acute infection or inflammatory disorder, vertebral artery insufficiency, etc.), and insufficient English language skills.

Seven participants were recruited over 4 months and 2 were excluded. One exclusion was related to recent cervical manipulation by another provider, and the other for concerns related to manipulation safety (Ehlers Danlos Syndrome, uncontrolled blood pressure, and lip paresthesia). This case series was approved by the Institutional Review Board at Bradley University, in Peoria, Illinois (BU 39-16). All participants agreed to participate and provided informed consent.

Examination

At baseline, a detailed and standardized history and physical exam was performed, and participants completed a number of self-report questionnaires. A screen for TMD confirmed pain location, and provocation tests looked for familiar pain or headache.[37] This screen has demonstrated high specificity (.97) and sensitivity (.99) in identification of those with and without TMD, supporting the need for treatment.[38,39] All participants had myalgia as confirmed by Diagnostic Criteria for Temporomandibular Disorders (DC/TMD): pain located in a masticatory muscle, pain with palpation of the masseter and/or temporalis, pain with opening, and the patient's symptoms of pain or primary complaint were reproduced with palpation or opening of the mouth.[40] TMDs are heterogeneous, and while myalgia is the most common category of TMDs, evidence supporting the diagnostic accuracy in distinguishing between the categories of myogenic, arthrogenic, and disc displacements is not as strong.[41] The difficulty differentiating various categories of TMD may relate to difficulty classifying all patients in only one category and findings of some patients fitting into no category.[1] Patients may frequently have both myalgia and arthralgia diagnoses.[40] Therefore, while all participants in this study had myalgia, additional diagnoses beyond myalgia (DC/TMD) were not a reason for exclusion.

Physical examination included vital signs, cranial nerve function, vertebral artery screen, upper cervical ligament stability, myelopathy screen, cervical nerve function (sensation, reflexes, myotomes), and a manipulative hold position. Participants with a positive TMD screen and no exclusions were enrolled in the study.

Outcome Measures

All outcomes were measured at baseline, 1 week, and 4 weeks. Primary outcome measures included maximal mouth opening (MMO), Numeric Pain Rating Scale (NPRS), Jaw Functional Limitation Scale (JFLS), and Global Rating of Change (GROC) scores. Secondary outcomes included cervical range of motion (ROM), pain pressure threshold (PPT), Neck Disability Index (NDI), and TMD Disability Index.

Mouth opening is an essential function of chewing and speech and often a limitation in those with jaw or neck pain.[3,23] Maximal mouth opening (MMO) of 40-50 mm is generally accepted as normal; measurement was taken with a disposable Therabite™ tool from tip to tip at central incisors.[3,42] Excellent interrater reliability has been reported in the literature (ICC .90-.96).[43,44] Minimal detectable change (MDC) is 1.73-1.91 mm [45] There is no reported minimal clinically important difference (MCID).

NPRS allows patients to quantify pain intensity on an 11-point scale. Pain is given a number from 0 (representing no pain) to 10 (representing the worst pain imaginable).[46] Participants in this case series rated their best, worst, and current 24-hour pain intensity for the jaw, neck, and headache. Psychometric properties relevant to the TMD population were not found. However, sum scores for 24-hour behavior have been suggested to improve reliability in other populations.[47]

The JFLS is a 20-item self-report scale assessing three constructs (mastication, vertical jaw movement, emotional/verbal expression) to quantify functional limitation.[48] Each item is scored by the patient from 0 (no limitation) to 10 (severe limitation). Lower scores represent less dysfunction. Excellent internal reliability (Alpha .95), and temporal stability (alpha = .87) have been reported in dental literature.[49,50] While no MCID has been established, moderate to large effect sizes have been documented for TMD treatment in dental and PT intervention studies (.41-.92).[22,50]

The GROC scale asks patients to rate their perception of overall change. While not specific to the TMD population, face validity (high) and test-retest reliability (ICC .90) have been reported in the literature.[51,52] A 3 point change from baseline on GROC has been used to define MCID, and ≥ +4 has been used to dichotomize a successful outcome.[47,53,54] Challenges to construct validity of GROC for long term follow-up are acknowledged.[55,56]

Cervical ROM was measured with a bubble inclinometer. Good interrater reliability (ICC .84) is noted in healthy subjects and those with neck pain.[57] Fletcher et al report the standard error of measurement for cervical spine ROM is between 2.5° and 4.1°; these authors also report at least 5° is necessary for MDC to demonstrate true change.[58]

A digital algometer was used for PPT; anatomical locations (see Figure 1) were modelled after previous research using 2 points on the masseter and 1 on the anterior temporalis.[35,59] Adequate to excellent intrarater reliability (ICC 0.69-0.92) has been reported for PPT of the temple and parietal region in healthy adults.[60] Increases in PPT have been seen in masticatory muscles in intervention studies for TMD, myofascial facial pain, and neck pain.[34-36,61] While no specific MCID has been established for PPT in the TMD population, moderate to large effect sizes have been seen with cervical mobilization for TMD pain.[34-36] In their systematic review, Voogt et al state PPT changes of ≥15% were reported by the majority of authors as a MCID.[62]

FIGURE 1. Anatomical Locations for Pain Pressure Threshold**.** ***(1A)*** *Temporalis location is 3 centimeters (cm) above a line between the lateral edge of the eye and anterior fibers of the temporalis muscle.* ***(1B)*** *Masseter 1 location is 2.5 cm anterior to the tragus and 1.5 cm inferior.* ***(1C)*** *Masseter 2 location is 1 cm superior and 2 cm anterior from the mandibular angle*.

NDI is a 10 question self-report scale assessing levels of neck pain and related disability. NDI is highly responsive and has previously shown test-retest reliability, as well as content and construct validity in a neck pain population.[63,64] Each item is scored from 0-5 with a maximum score of 50 points. A systematic review published in 2009 reported a change of 5 (10%) was needed for MDC and 7 (14%) for MCID.[65]

The TMD Disability Index is a 10-question self-report scale.[66] Each item is scored 1-5 with a minimum score of 10 and a maximum score of 50. Higher scores are representative of higher levels of disability. While this scale has been used in clinical practice and published studies of intervention effectiveness, there are no reports of psychometric property analysis in the literature.[66-68]

Procedures
A total of 5 participants (4 female, mean age 27, median age 21) with a primary complaint of TMD with myalgia were enrolled in the study. The mean duration of symptoms was 2.2 years (range 1-4 years). All participants were seen for 3 sessions over 4 weeks. Baseline assessment of pain, function, ROM, and PPT were recorded. See table 1 for baseline history details for each participant.

Immediate changes in pain, ROM, and PPT were recorded on the first visit following cervical spine TJM. All outcome measurements were repeated at 1 and 4 weeks. Cervical spine TJM was performed after baseline evaluation and at 1 week while the education and exercise were issued at baseline and reviewed at both 1-week and 4-week visits. Further intervention options were discussed with participants at the final visit if indicated.

Interventions
Manual intervention included supine cervical spine TJM techniques for atlantooccipital (AO) distraction and C2-3 upslope manipulation; procedures are described in Figure 2.[69] These levels were chosen based on known convergence of upper cervical nerve roots (C1-3) and the trigeminal nerve in the trigeminocervical nucleus. Cervical spine thrust joint manipulations were performed at AO and C2-3 on both the right and left sides following common research practice for high-velocity, low amplitude (HVLA) thrust.[70] If cavitation occurred on the first trial, the therapist moved to the next location. If there was no cavitation, the participant was repositioned and the procedure performed a second time. A maximum of 2 trials at each location was performed. A manual therapy fellowship trained physical therapist with 16 years of clinical orthopaedic experience performed cervical safety screening and delivered all cervical spine TJMs.

All participants were given verbal and written education for behavioral modification, avoidance of parafunctional habits, and Rocabado 6x6 home exercise program (HEP).[21,22] Participants were asked to track compliance with HEP using a standardized form.

Table 1. Baseline History Details

Criteria	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5
Age	21	55	21	19	19
Gender	Female	Female	Female	Female	Male
BMI	24.5	20.8	22.4	27.2	19.4
Duration Symptoms (years)	1	2	4	2	2
Additional Medical History	Herniated lumbar disc with no current pain	Hysterectomy over a year ago	Scoliosis and on an acne medication	Braces off and tooth removed 2 years ago, takes Iron and birth control pills; unknown ear surgery 8 years ago	Episodic tension headaches
Prior Treatments	Chiropractic treatment (to jaw only) more than 2 months ago	Exercises from chiropractor	None	None	None
Aggravating Factors	Opening mouth too far	Long car rides, sleep, stress	Eating, sleeping on painful side	Eating, yawning, opening the mouth	Clenching during the day or night
JFLS Most Limiting Activity (score ≥ 7)	Opening wide for apple or sandwich	Chewing tough food, hard bread, opening wide for apple or sandwich	Chewing tough food, hard bread	Chewing tough food, hard bread, opening wide for apple or sandwich, yawn	Chewing tough food, opening wide for apple or sandwich
Relieving Factors	Massage, heat	Self-massage provider massage with pressure point work	Ice, Tylenol	Ice	Self-massage of jaw muscles

Abbreviations: BMI, body mass index; JFLS, Jaw Functional Limitation Scale

RESULTS

There were no reported adverse events and no participants lost to follow-up. One participant was interested in continued intervention and was assisted in setting up physical therapy off-site after completion. All participants but one were compliant with HEP (compliance was noted if at least 70% of the program was completed over 4 weeks). The participant with poor compliance with HEP actually had the greatest change on the NPRS, JFLS, and GROC. Results of clinically meaningful change are noted below.

Maximal Mouth Opening

Overall median scores for mouth opening improved from 36 mm (less than normal) to 45 mm (normal). MCID has not been established; however, the improvement to normal motion suggests some meaningful change may have occurred. Four of five participants met or exceeded the MDC for improvement of 6 mm in mouth opening and finished with normal ROM of the jaw (≥40 mm).[3,42,43] See table 2.

NPRS

Median sum scores of jaw pain improved at each visit. Two of five participants exceed the MCID of a 2-point change from baseline to final measurement.[71] The 2 participants with the greatest reduction in jaw pain also met the MCID in HA pain and had the highest GROC scores. Only 1 participant met MCID for neck pain. See table 2.

FIGURE 2. Cervical spine thrust joint manipulation. ***(A)*** *Participant positioned supine and therapist passively sidebends the head and neck to the left then rotates the head to the left. The first MCP of the opposite hand contacts the ipsilateral mastoid process. The therapist passively moves the occiput into slight extension while maintaining left rotation. Delivery of TJM to R OA is then performed in a cranial direction, perpendicular to the surface of the right OA joint with a gentle rotatory force. The procedure is repeated to the other side.* ***(B)*** *Participant positioned supine in a cradle hold with therapist contacting the posterior right articular pillar of C2 with the lateral border of the proximal or middle phalanx. The therapist passively moves the head and neck into right side-bending and left rotation with no significant flexion or extension. The right hand directs the force of TJM in a direction upward toward the patient's left eye. The procedure is repeated to the other side.*

JFLS

Four of five participants had lower levels of functional limitation (lower scores) at 4 weeks. Participant 3 improved initially but returned to baseline at the final visit. This participant reported an incident hitting her head on her bedrail before the final session, noting aggravation of symptoms. While reliability and validity of JFLS have been supported, there is no established MDC or MCID for this outcome tool in a dental or PT population.[49] In this case series, the 2 participants (2 and 5) with the highest self-reported improvement (GROC scores) had a change of 33 and 54 points respectively. Interestingly, participant 4 had improved function on JFLS (43 points) and a GROC score of 3, while participant 3 was unchanged on JFLS and had a GROC of 4. See table 2 and figure 3.

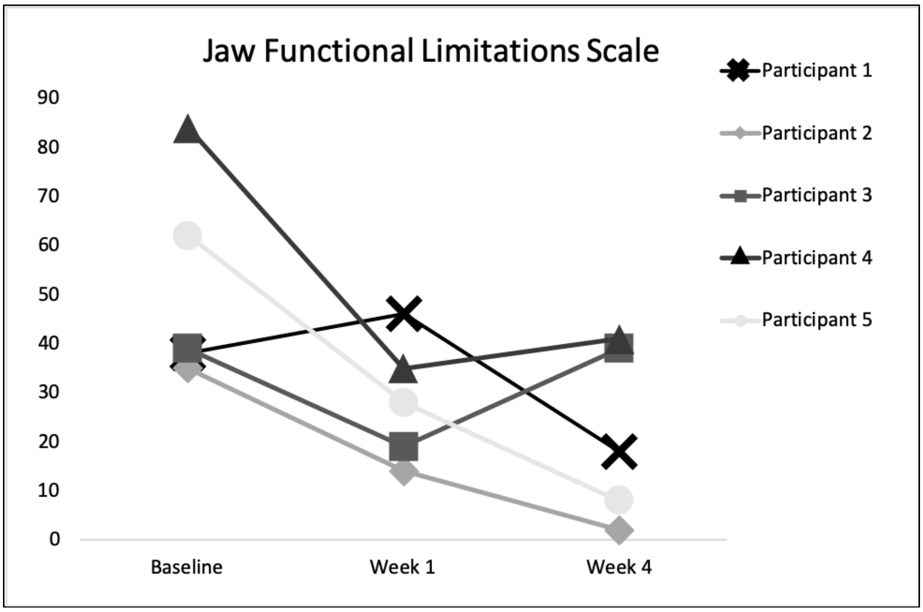

Figure 3. Jaw Functional Limitation Scale. *Lower scores represent less dysfunction.*

Table 2. Outcome Measures and Change at 4-Weeks

Scale	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5
MMO (mm)					
Baseline	34	36	39	35	41
4-week	40	45	51	31	48
Change	+6.0*	+9.0*	+12.0*	-4.0	+7.0*
NPRS Jaw					
Baseline	2	3.67	2	5	5.67
4-week	3	0	1.33	4.67	1.67
Change	+1.0	-3.7**	-0.67	-0.23	-4.0**
NPRS Neck					
Baseline	0.67	4.67	0.67	0	6.67
4-week	1.33	3	2.33	4.67	2.33
Change	+0.66	-1.67	+1.66	+4.67	-4.34**
NPRS HA					
Baseline	0.33	2.34	0	0.33	5
4-week	2.0	0	0	0.33	1.33
Change	+1.67	-2.34**	0	0	-3.67**
JFLS					
Baseline	38	35	39	84	62
4-week	18	2	39	41	8
Change	-20.0	-33.0	0	-43.0	-54.0
NDI					
Baseline	5	19	10	9	17
4-week	5	11	10	6	7
Change	0	-8.0**	0	-3.0	-10.0**
TMD-DI					
Baseline	20	17	17	19	20
4-week	13	14	18	20	16
Change	-7.0	-3.0	+1.0	+1.0	-4.0
GROC	3**	5**	4**	3**	6**

Abbreviations: MMO, maximal mouth opening; mm, millimeters; NPRS (24-hour behavior), numeric pain rating scale; JFLS, Jaw Functional Limitation Scale; NDI, Neck Disability Index; TMD-DI, Temporomandibular Disorder Disability Index; GROC, Global Rating of Change at final visit.
** change score meets minimal detectable change (MDC)*
*** change score meets minimal clinically important difference (MCID)*

Pain Pressure Threshold
Participants 2 and 4 had increased PPT meeting MCID for 3 of the 6 locations tested. Only participant 5 saw an increase in all PPT measurements, meeting MCID for each region tested. See table 3.

NDI
Participant 2 and 5 met the MCID. See table 2.

TMD Disability Index
Changes in this outcome measure were inconsistent with changes in other measured outcomes and participant perception of change (GROC). Participants with the greatest perception of change (GROC score 5-6), only improved 3-4 points on TMDI Disability Index. See table 2.

GROC
All 5 participants met the MCID of a 3 point change[54] on GROC at 4 weeks. Three of five participants (60%) reported symptoms at least "moderately better" (≥ 4) and were therefore considered a success. See table 2

Cervical ROM
Median scores for cervical ROM improved in all measured planes. See Figure 4.

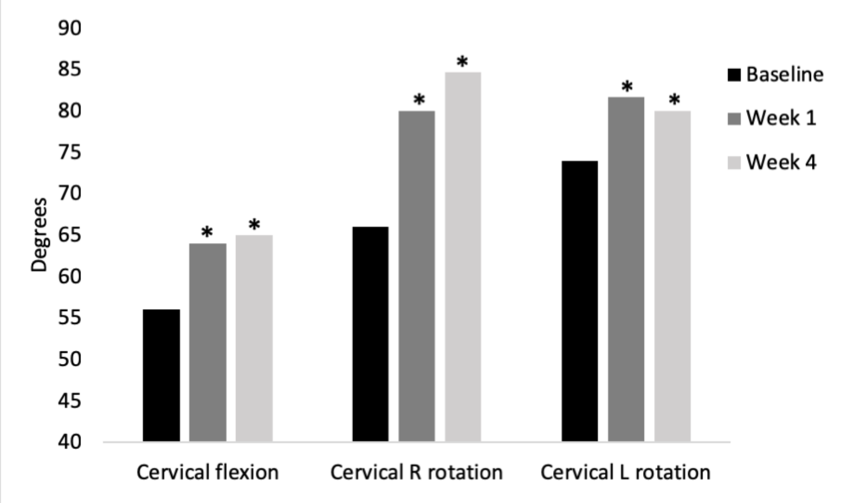

Figure 4. Cervical range of motion. *R: Right, L: Left.*
**Change from baseline meets or exceeds the minimal detectable change*

Table 3. Pain Pressure Threshold and Change at 4-weeks

Scale	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5
Temporalis R					
Baseline	0.62	4.02	4.46	3.88	3.02
4-week	1.2	6.72	5.16	5.58	4.48
Change	+0.58	+2.7**	+0.70**	+1.70**	+1.46**
Temporalis L					
Baseline	0.78	2.18	3.76	4.88	2.78
4-week	0.96	6.52	3.32	5.16	4.22
Change	+0.18**	+4.34**	-0.44	+0.28	+1.44**
Masseter-1 R					
Baseline	1.18	5.54	2.84	2.44	2.12
4-week	0.62	5.34	3.14	3.76	5.38
Change	-0.56	-0.20	+0.30	+1.32**	+3.26**
Masseter-1 L					
Baseline	0.9	2.82	4.88	4.02	2.20
4-week	0.66	4.04	2.26	2.74	4.42
Change	-0.24	+1.22**	-2.26	-1.28	+2.22**
Masseter-2 R					
Baseline	0.78	3.72	1.84	1.76	2.14
4-week	0.60	3.54	1.68	2.96	4.36
Change	-0.18	-0.18	-0.16	+1.20**	+2.22**
Masseter-2 L					
Baseline	0.64	4.62	2.50	3.36	2.16
4-week	0.56	4.08	2.34	2.0	3.34
Change	-0.08	-0.54	-0.16	-1.36	+1.18**

** change score meets minimal detectable change (MDC)*
*** change score meets minimal clinically important difference (MCID)*

DISCUSSION

The current case series utilized a multimodal intervention consisting of cervical spine TJM added to standard education and HEP prescription. Five participants with at least one-year history of TMD were treated 3 times in 4 weeks. Multimodal intervention combinations may produce greater and longer lasting improvement in pain, function, and quality of life than isolated interventions.[72] While current evidence is not sufficient in clarifying relationships, manual therapy, exercise, and education have demonstrated effectiveness in the treatment of TMD.[13,15,30,34,35,67,73] A systematic review by Brantingham et al in 2013 reports fair evidence supporting multimodal intervention for TMD.[74] All participants in this case series demonstrated some improvement; 4 of 5 participants were pleased with their progress and did not see a need to continue with another provider at study completion.

Successful treatment can be defined by return to normal function and reduction in pain.[75] While all participants had some degree of improvement, consistent improvement across outcome measures was noted in only 2 of the 5 participants. Sixty percent (60%) of participants in this study reported symptoms at least moderately better on GROC (≥4), and this score was used to define success. Furto et al utilized manual therapy to the neck and jaw with soft tissue mobilization techniques in a case series published in 2006.[66] These authors reported 73% of participants noted symptoms at least somewhat better (GROC ≥3).[66] In this case series, 100% of participants reported symptoms at least somewhat better, or ≥3 on GROC.

The TMD Disability Index provided inconsistent results in this case series with improvements ranging from 17.5-35%. Furto et al also utilized this outcome measure with only 13.9% improvement despite improvements across other measures.[66] Gonzalez-Iglesias et al reported 43.4% overall improvement in this outcome, however, authors acknowledged inability to draw conclusions based on lack of psychometric property analysis.[76] Further study of this and other functional outcome measures in the TMD population is recommended.

Manual therapy intervention and exercise addressed both the jaw and the cervical spine. Regional interdependence refers to the biomechanical and neurophysiological relationship between various joints and pain responses attempting to explain why impairments at one region may contribute to pain in another region.[77-79] The convergence of afferent input from the trigeminal nerve and the upper cervical nerves describe a neurophysiological relationship between the cervical spine and TMD. The trigeminal nucleus projects inferiorly converging with grey matter and nerve cell bodies of the upper cervical spine (C1-3) in what is known as the trigeminocervical nucleus.[24,25]

Cervical spine non-thrust mobilization demonstrated large effect sizes for decreasing pain, increasing MMO, and increasing PPT. This effect was noted at a 48-hour assessment and maintained at a 12-week follow-up.[34] A subsequent study revealed the cervical spine non-thrust mobilization was superior to sham mobilization in reduction of pain and increase in PPT.[35] Cervical manipulation relative to TMD has been examined as part of a multi-modal treatment package or on individuals with a diagnosis of neck pain or presence of latent trigger points.[23,32,80] Growing support exists for a neurophysiological effect of thrust joint spinal manipulation with changes seen in pain inhibition, muscle recruitment, and/or function.[34] It is possible that thrust joint manipulation of the cervical spine may result in changes in pain, PPT, ROM, or function in structures innervated by the trigeminal nerve such as muscles of mastication and the temporomandibular joint.[32] Participants in this case series received cervical spine TJM as well as cervical exercise; results demonstrate reduction in pain, increased PPT, and improvements in function. Future examination of the specific impact of TJM for TMD with larger sample sizes and a randomized design is warranted.

Limitations

Limitations of this study are acknowledged. Outcomes cannot be attributed to any single intervention due to the multimodal treatment combination. Lack of psychometric analysis of measurement tools and functional outcome scales used for the TMD population must be considered in interpreting results. Inherent in case study analysis, the lack of blinding, randomization, or a control group prohibit discussion of cause and effect relationships. External validity is limited by the use of standardization of treatment procedures and the characteristics of the sample.

CONCLUSION

The outcomes from the study indicate cervical spine thrust joint manipulation, behavioral education, and a home exercise program may be effective in the chronic TMD population. All participants had pain at least 1 year in duration indicating spontaneous recovery was unlikely, however, a control group would be necessary to confirm this statement. Three participants experienced success as measured by GROC, and 2 of the 5 participants experienced meaningful change across multiple outcome measures. The specific impact of each intervention in this study is unknown. Prior evidence does support behavioral modification and exercises can be enough to show meaningful change.[14,16,17,81]

Individuals with TMD may not seek treatment or know what treatment options exist. Evidence to support effective interventions may lead to earlier access to care, improved interdisciplinary collaboration, or reduction in prevalence and progression to chronicity. Future study with randomization is feasible and necessary to determine the specific effect of cervical TJM on individuals with TMD.

Implications for Practice and Research

Five individuals with TMD with myalgia received 3 treatments over 4 weeks. The multimodal approach including cervical spine TJM, behavioral education, and a home exercise program was well tolerated and resulted in clinically meaningful changes in some outcomes. All participants reported improvement in GROC. Gaps in the literature still exist and further evidence is necessary to guide best practice. Future randomized clinical trials examining specific manual interventions including cervical TJM with larger samples are necessary to draw specific conclusions. Based on this case series, authors believe a randomized design is indicated and feasible.

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