A Randomized Clinical Trial Assessing the Efficacy of Adding 6 × 6 Exercises to Self-care for the Treatment of Masticatory Myofascial Pain

Mariona Mulet, DDS, MS
Graduate Program Director

Karen L. Decker, PT
Assistant Education Specialist

John O. Look, DDS, MPH, PhD
Senior Research Associate

Patricia A. Lenton, GDH, MA
Research Fellow

Eric L. Schiffman, DDS, MS
Associate Professor

TMD and Orofacial Pain Division
University of Minnesota School of Dentistry
Minneapolis, Minnesota

Correspondence to:
Dr Mariona Mulet
TMD and Orofacial Pain Division
University of Minnesota School of Dentistry
6-320 Moos Tower
515 Delaware Street SE
Minneapolis, MN 55455

Aims: *To determine whether Rocabado's 6 × 6 exercise program has an added benefit to self-care alone in reducing myofascial jaw pain and improving forward head posture (FHP) in subjects with myofascial pain and FHP at the end of 4 weeks.* ***Methods:*** *In this double-blinded trial, 45 subjects (43 female and 2 male, mean age 24 years) were randomly assigned to self-care or self-care + 6 × 6 exercises. The primary outcome measure was intensity of jaw pain on a numerical graphic rating scale (NGRS). Secondary outcome measures were jaw pain on a verbal rating scale (VRS), neck pain (NGRS and VRS), and change in head posture. Twenty-one subjects per group resulted in 80% power to detect a difference of 2 in the NGRS for intensity of jaw pain. Alpha was set at .05 for statistical significance.* ***Results:*** *Both groups showed significant statistical (*P = .001*) and clinical (> 2 on NGRS) improvement in jaw pain intensity. Jaw pain and neck pain improved significantly (*P < .01*) in both groups. There were no differences between groups for any of the measures. A significant change in head posture was not detected in either group.* ***Conclusion:*** *The 6 × 6 exercises were not significantly more beneficial in reducing the intensity of jaw and neck pain than self-care alone. Furthermore, they were not beneficial in improving head posture within the 4-week duration of this study.* J OROFAC PAIN 2007:21:318–328

Key words: exercises, myofascial pain, posture, randomized clinical trial, self-care, temporomandibular disorders

Myofascial pain (MFP) is the most common disorder causing chronic pain in the head.[1] Fifty-five percent of patients complaining of head and neck pain have a primary diagnosis of MFP.[2] Clinically, MFP of the masticatory muscles is characterized by a complaint of localized pain in the jaw muscles that is replicated upon palpation of the painful area. The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD)[3] define MFP as a complaint of pain in the masticatory muscles at rest or during function as well as pain in the muscle associated with localized areas of tenderness to palpation. Pain is reported by the subject in response to palpation in at least 3 of 20 muscle sites.

It has been postulated that forward head posture (FHP) with rounded shoulders is 1 of the factors involved in the development and perpetuation of TMD and MFP.[4–7] In theory, FHP alters the normal anatomic relationships, creating tension and fatigue of the anterior suprahyoid muscles and tightening the posterior extensor muscles. In addition, FHP has been hypothesized to translate the mandible posteriorly and superiorly, which can result in intrusion of the condyle upward and backward into the glenoid fossa and may contribute to dislocation of the articular disc, create more tension in the masticatory muscles, and become a potential source of facial pain and TMD.[5,8,9]

Treatment goals for reduction of MFP symptoms are to address contributing factors, decrease pain, and restore normal muscle length, strength, function, and coordination. Different treatment modalities have been proposed for treating masticatory MFP; these include self-care (SC), medications, exercises, cognitive-behavioral interventions, trigger-point injections, intraoral splints, massage, physical therapy modalities, and alternative medicine techniques.[10–12]

Guidelines for the treatment of TMD support inexpensive and simple initial therapy of SC and education about the condition.[10–12] Rocabado proposes a 6 × 6 home exercise program to be implemented in combination with the SC program to decrease pain, improve function of the masticatory muscles, and correct FHP.[13] The objectives of the program are to learn a new postural position and to restore original muscle length and normal joint mobility and body balance. Although the 6 × 6 program is used clinically and is presented in the TMD literature, both as a group[14,15] and as individual exercises,[4,16–19] the group of exercises has never been tested for its effectiveness. Several clinical trials have been conducted to evaluate the effect of postural training on TMD and/or posture,[18,20,21] but evidence is still lacking to support the efficacy of postural changes and exercises for the relief of MFP and to correct FHP.

The purpose of the present study was to determine if Rocabado's 6 × 6 exercise program has an added benefit to SC alone in reducing myofascial jaw pain and improving FHP in subjects with MFP and FHP at the end of 4 weeks. The primary null hypothesis was that there would be no difference between SC and SC plus Rocabado's 6 × 6 exercises for reduction of pain in the masticatory muscles as measured by a numerical graphic rating scale (NGRS) for pain intensity at the end of 4 weeks.

Materials and Methods

Study Design and Subjects

This was a double-blinded, randomized, controlled clinical trial with an intervention period of 4 weeks. Forty-five consenting adults (43 female and 2 male, mean age 24 years) who met the inclusion criteria were recruited through advertisements in the University of Minnesota daily newspaper (n = 24) and flyers posted at the University of Minnesota (n = 19) and from patients presenting for treatment at the University of Minnesota TMJ and Orofacial Pain Clinic (n = 2). Subjects were randomly assigned to 1 of 2 experimental treatment groups: *(1)* self-care (SC) and *(2)* self-care + 6 × 6 exercises (SC+). A stratified randomization scheme using randomization tables matched treatment groups for gender distribution and medication use (intake of 0 to 1 days of nonsteroidal anti-inflammatory drugs [NSAIDs] per week versus 2 to 3 days per week).

Qualifying subjects were required to have a primary diagnosis of myofascial pain of the masticatory muscles according to the RDC/TMD,[3] and their pain had to be duplicated by palpation of the masticatory muscles. If active mouth opening was limited, passive interincisal opening had to be at least 40 mm. The examiner who determined eligibility (PAL) had been previously calibrated to perform the RDC/TMD examination protocol. The Temporomandibular Index (TMI), which has acceptable reliability and validity, was the data collection instrument used to complete the clinical examination.[22] The examiner's reliability for the TMI relative to the gold standard examiner (ELS), showed an intraclass correlation coefficient (ICC) greater than 0.85. Coexistent diagnoses of temporomandibular joint (TMJ) arthralgia and disc displacement with reduction were allowed. The average pain intensity in the masticatory muscles during the previous month needed to be rated equal or greater than 4 on a 0-to-10 numerical graphic rating scale (NGRS). Total pain duration needed to be greater than 6 months, with pain frequency equal to or greater than 3 days per week. FHP, as defined by Kendall[6] (the external meatus of the ear had to be anterior to the lateral malleolus in the sagittal plane) was another inclusion criterion; its presence was confirmed with a plumb line by the primary investigator (MM). Subjects needed to be between 18 and 65 years old.

The exclusion criteria for all subjects included

- Systemic rheumatic disease and fibromyalgia
- Dental pathology
- Orofacial pain disorders
- TMJ disc displacement without reduction or osteoarthritis as determined by history and clinical examination
- Cervical structural pathology as determined by history and physical examination using a Cervical Range of Motion (CROM) goniometer device[23–25] and performed by an experienced physical therapist (KLD)
- Current intake of over-the-counter analgesics more than 3 days per week
- Current use of narcotics, hypnotic drugs, sedatives, or muscle relaxants

If subjects took antidepressant or antianxiety medications, they were required to have been on a stable dose for the preceding 2 months. Subjects with a concurrent major psychiatric disease assessed by history or subjects unwilling to accept allocation to the treatment groups were excluded from the study.

The primary outcome measure was self-assessment of pain intensity in the masticatory muscles, as measured by an NGRS of 10 cm, with 0 labeled "no pain" and 10 labeled "the worst pain imaginable." Secondary assessment measures collected included *(1)* pain intensity in the masticatory and cervical muscles, which was rated on a previously validated[26,27] verbal rating scale (VRS) with the categories no pain, mild, moderate, severe, and very severe pain; *(2)* pain intensity in the cervical muscles, which was rated on a previously validated 10-cm NGRS[26,27]; *(3)* change in head posture in the sagittal plane while standing, as measured by the horizontal distance from the tragus of the ear to the acromion of the shoulder; and *(4)* overall change in symptoms at the end of treatment measured on a 5-point scale (symptom-free, better, unchanged, worse, and much worse).

Each participant was evaluated at 3 different appointments: baseline, week 1, and week 4. Jaw and neck pain levels were recorded at baseline, week 1, and week 4; postural measurements were taken at baseline and week 4, and overall change of symptoms was documented at week 4. The primary investigator, who was blinded to the treatments received, collected these data. Treatment compliance was recorded daily by subjects in a diary. Subjects were provided a chart to document which specific SC recommendations and which exercises they had completed each day of treatment. There were 5 possible levels of compliance depending on the percentage of time the subject utilized the recommended treatments: level 0, < 20%; level 1, 20% to 40%; level 2, 40% to 60%; level 3, 60% to 80%; and level 4, > 80%. Compliance was evaluated during the first and last weeks of the study.

Postural Measurements

The presence of FHP was determined with a plumb line by the primary investigator as defined by Kendall.[6] Subjects were instructed to stand comfortably, without shoes and with their feet slightly apart, looking toward the horizon, and focused on the reflection of their eyes in a hypothetical mirror located in front of them.

To record the subjects' baseline and posttreatment head posture in the sagittal plane, and quantify forward head posture, 3SPACE-FASTRAK equipment was used.[28,29] This system uses electromagnetic fields to determine the position and orientation of a remote object. Magnetic field vectors are generated by a transmitter and detected by a receiver. The received signals are converted to a mathematical algorithm that computes the receiver's position and orientation relative to the transmitter. The system includes the hardware and software necessary to generate and sense the magnetic fields, compute position and orientation, and interface with the host computer. A pencil-like device (stylus) is used for digitizing the desired landmarks. The following anatomic landmarks were marked on the subject's left side with a pen: *(1)* angle of the acromion of the shoulder, *(2)* tip of the spinous process of C7, *(3)* most posterior aspect of the tragus of the ear, and *(4)* lateral corner of the eye. Two sensors were positioned in the trunk and in the back of the head to detect anterior-posterior sway. A chair was positioned next to the subject, and the subject was allowed to rest his or her right arm on it to increase his or her stability.

Prior to recruitment of subjects, the primary investigator was calibrated by taking 2 series of measurements on 9 individuals 1 week apart. This calibration exercise was designed to estimate the reliability of measurements and the consistency of landmark placement. The coefficient of variation (CV) was used to estimate the reliability of these measurements.

Four consecutive series of postural measurements were made for each subject at baseline and the end of treatment, and the means of these series were calculated. From the landmarks recorded, the values calculated were *(1)* head-shoulder difference: distance in centimeters from the tragus of the ear to the acromion of the shoulder in a horizontal plane parallel to the floor; *(2)* neck inclination: the angle (in degrees) formed by a line connecting C7 and the tragus of the ear with a horizontal line parallel to the floor; and *(3)* cranial rotation: angle (in degrees) formed by the line connecting the tragus of the ear and the corner of the eye with a horizontal line parallel to the floor (Fig 1).

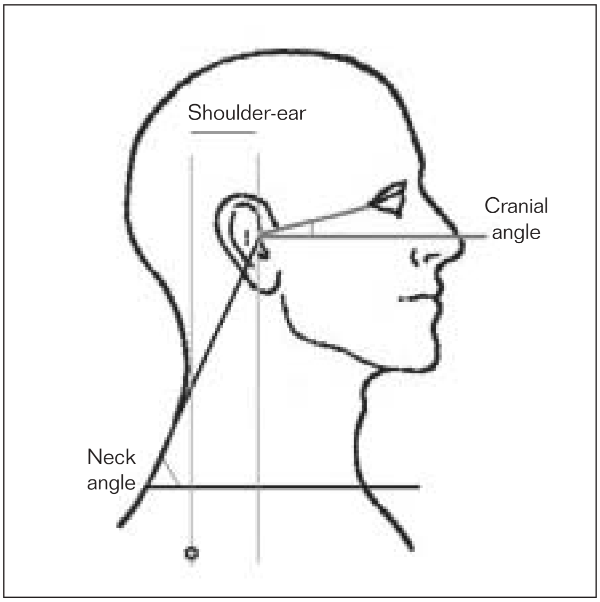

Fig 1 Postural measurements.

Treatments

Treatment was initiated by a physical therapist (KLD) at baseline after all measurements were completed. She was familiar with the interventions and had expertise in managing TMD. Subjects returned to the clinic for review of their assigned treatments after 1 week.

SC. A well-designed program[18,30–32] that included optimistic counseling, patient education, reassurance about TMD symptoms, and encouragement to rest the masticatory muscles was used. It included application of heat and ice; control of maladaptive behaviors such as tooth clenching and grinding, caffeine, gum chewing, stomach sleeping, resting the jaw on the hand, and wide opening of the mouth; and implementation of a pain-free diet, bilateral chewing, and calcium intake.

Rocabado's 6 × 6 Exercises (6 × 6). This program included 6 exercises to be performed 6 times a day and repeated 6 times each (Fig 2).

1. Rest position of the tongue: Rests the tongue and jaw and promotes diaphragmatic breathing to decrease activity of the accessory muscles.
2. Shoulder posture: Correction of abnormal scapular protraction through shoulder girdle retraction.
3. Stabilized head flexion: Distraction of the upper cervical spine and alleviation of mechanical compressions; this allows the posterior cervical muscles to elongate.
4. Axial extension of the neck: Distraction of the cervical vertebrae, allowing tension reduction in the supra- and infrahyoid muscles and enhancing the ability of the masticatory muscles to relax. With this exercise, the sternocleidomastoid muscle takes a more normal posterior angulation, which reduces further unnecessary muscle activity to maintain that position.
5. Control of TMJ rotation: Reduction of initiating jaw movements with translatory component (ie, protrusive movement in opening, talking or chewing), therefore reducing masticatory muscle activity and joint overload.
6. Rhythmic stabilization technique: Induction of muscle relaxation through the principle of reciprocal inhibition. When a muscle is actively contracted, its antagonists are consequently relaxed. Rhythmic stabilization also promotes the proper jaw rest position through proprioception.

The physical therapist educated the subjects regarding their jaw muscle condition. She also explained the SC and 6 × 6 exercise program and how to complete a diary of compliance, report NSAID use, and report any adverse events. Both groups received verbal and written explanations and instructions in an identical standardized manner. Effort was made to keep time spent with subjects constant and equal for both groups. Subjects were told that 2 exercise programs were being tested for their effectiveness in relieving their jaw pain. They were not told that their posture was being evaluated. Following completion of the experimental phase, all participants were informed of their group assignment and offered further treatment.

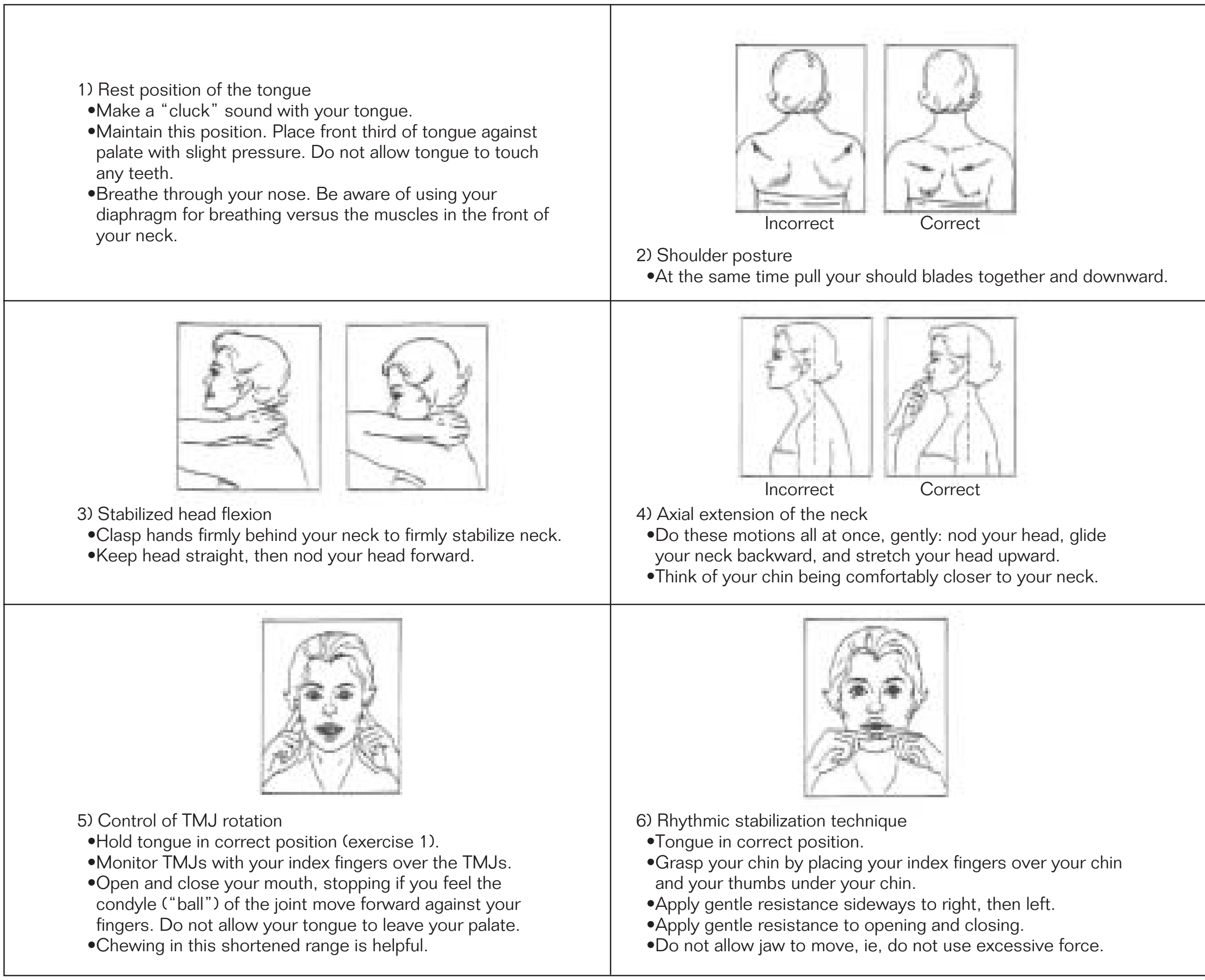

Fig 2 Rocabado's 6 × 6 exercises.

Ethics

This project was approved by the institutional review board for the Protection of Human Subjects of the University of Minnesota. After discussing all aspects of the study, and prior to initiation of the study, all subjects gave their written consent. They received $50 compensation for their time and participation.

Statistical Methods

The primary outcome measure, intensity of jaw pain rated on an NGRS, was analyzed using repeated-measures analysis of variance (ANOVA). The alpha level for statistical significance was set at .05 (2-sided test). The secondary outcome measures—jaw pain intensity rated on a VRS and neck pain intensity rated on an NGRS—were also analyzed using repeated-measures ANOVA. Postural measurements were analyzed using a *t* test comparing the 2 treatment groups according to their measurements at week 4, and a *t* test comparing the treatment groups according to their change from baseline to week 4. An adjusted analysis using multiple linear regression models was performed to test all primary and secondary hypotheses. It controlled for baseline group differences (age, sex, socioeconomic level, baseline jaw and neck pain intensity, and baseline posture measurement). To compare groups at baseline, a Fisher exact test or Pearson's chi-square test was used for categorical data items and a 2-sample *t* test for continuous data.

Table 1 Demographic Characteristics of Groups

	SC (n = 22)	SC+ (n = 20)	Total (n = 42)	*P*
Age (mean ± SD)	23.4 ± 2.1	25.1 ± 2.3	24.2 ± 10.0	.59
Gender (% females)	95.45% (21)	95.00% (19)	95.20% (40)	> .99
Race				
White	90.90% (20)	95.00% (19)	92.86% (39)	.49
Asian	9.09% (2)	5.00% (1)	7.14% (3)	
Education				
Some college	50.00% (11)	50.00% (10)	50.00% (21)	
College graduate	31.82% (7)	20.00% (4)	26.19% (11)	.64
Postgraduate work	18.18% (4)	30.00% (6)	23.80% (10)	

Number of subjects shown in parentheses.

Table 2 Baseline Characteristics of Groups

	SC	SC+	Total	*P*
Duration of pain in years (mean ± SE)	5.65 ± 0.83	5.20 ± 0.87	5.4 ± 3.9	.71
Concurrent TMJ arthralgia	68.18% (15)	75.00% (15)	71.4% (30)	.74
Concurrent TMJ sounds	50.00% (11)	65.00% (13)	57.1% (24)	.37
MFP group Ia vs Ib	86.36% (19)	90.00% (18)	88.1% (37)	> .99
Mean days of NSAID/wk	1.30	1.07	1.19	.55
Intake of SSRIs	22.73% (5)	15.00% (3)	19.00% (8)	.67

Number of subjects shown in parentheses.

Table 3 Baseline Measures for Outcome Variables

	SC	SC+	Total	*P*
Jaw pain (NGRS) (mean ± SE)	5.16 ± 0.29	5.60 ± 0.31	5.4 ± 1.4	.30
Jaw pain (VRS)				
None	0	0	0	
Mild	18.2% (4)	10% (2)	14.3% (6)	.50
Moderate	72.7% (16)	70% (14)	71.4% (30)	
Severe	9.1% (2)	20% (4)	14.3% (6)	
Neck pain (NGRS) (mean ± SE)	3.32 ± 0.52	4.88 ± 0.55	4.1 ± 2.6	.047
Neck pain (VRS)				
None	13.6% (3)	15% (3)	14.3% (6)	
Mild	40.9% (9)	15% (3)	28.6% (12)	.046
Moderate	45.4% (10)	45% (9)	45.2% (19)	
Severe	0	25% (5)	11.9% (5)	
Postural measures				
Distance shoulder-ear (cm)	4.2 ± 0.4	3.9 ± 0.4	4.0 ± 1.8	.51
Neck angle (horizon-C7-ear)	50.4 ± 1.2	51.7 ± 1.2	51.1 ± 5.5	.45
Cranial angle (horizon-ear-eye)	20.9 ± 1.2	19.2 ± 1.3	20.1 ± 5.7	.33

Number of subjects shown in parentheses.

A mean group difference of 2 on the NGRS for intensity of jaw pain has been reported to be the minimum difference that is clinically significant.[33] When the alpha for statistical significance was set at .05, statistical power was set at 80%, and detection of a between-group difference was as small as 2, the sample size estimate per group was 21. Recruitment was planned to continue until 21 subjects per group completed the study to ensure that the sample-size requirements for statistical power were met.

Results

Baseline demographic characteristics did not differ between study groups for age, gender distribution, race, or education (Table 1, $P \geq .49$). There were no differences between groups in duration of jaw pain, TMD diagnoses, or intake of selective serotonin reuptake inhibitors (SSRIs) or NSAIDs (Table 2, $P \geq .37$). There were no differences between groups in baseline values of jaw pain intensity or postural measurements. The SC+

Table 4 Mean Change ± SE in Jaw Pain Intensity—NGRS

	SC	SC+	*P*
Baseline	5.16 ± 0.29	5.60 ± 0.31	.30
Week 4	3.05 ± 0.26	3.40 ± 0.27	.35
Change	-2.11 ± 0.26	-2.20 ± 0.27	.82
P	< .001	< .001	

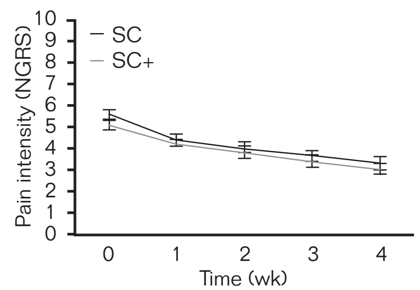

Fig 4 Change in jaw pain intensity (NGRS).

group reported significantly higher scores of baseline neck pain as measured in a NGRS ($P < .047$), and there was a statistically significant difference in the number of subjects with severe neck pain measured on a VRS (Table 3).

The primary investigator's reliability for taking postural measurements as expressed by CV was 0.066 for measurement of the neck angle, 0.17 for measurement of the cranial angle, and 0.26 for measurement of the linear measure shoulder to ear. Forty-two subjects completed the study, 22 SC subjects and 20 SC+ subjects. Three subjects withdrew from the study: 1 from the SC group and 2 from the SC+ group.

Pain Measures

Both groups improved significantly in jaw pain intensity as measured in a NGRS after 4 weeks ($P < .001$), and the change in pain intensity was similar for both groups ($P = .82$; Table 4, Fig 3). Decrease in jaw pain intensity as measured in a VRS was statistically significant for both groups (SC: –0.73; SC+: –0.65; $P = .006$); there was no significant difference between the groups ($P = .68$). Both treatment groups improved significantly in neck pain as measured by a NGRS (SC: –1.18; SC+: –1.60; $P = .002$), and there was no difference between treatment groups ($P = .69$). Even though groups differed at baseline with respect to neck pain (NGRS; $P = .047$), they did not differ in amount of change from baseline; ie, the SC+ group started with higher scores at baseline and finished with higher scores at week 4 as well. When neck pain was measured on a VRS, all subjects improved significantly (SC: –0.50; SC+: –0.40; $P = .01$) without differences between groups ($P = .62$; data not presented).

Postural Measures

The only statistically significant difference between groups was the change in cranial angle from baseline to week 4 (SC: –1.49 degrees; SC+: +1.76 degrees; $P < .01$). Changes in neck angle were –0.78 degrees for the SC group and –0.65 degrees for the SC+ group ($P = .89$). Changes in the linear measurement of the head-shoulder difference were +0.56 cm for the SC group and +0.50 cm for the SC+ group ($P = .89$).

Analysis of Sway

The values of sway were calculated by obtaining the range of the 4 repeated sets of measurements for each subject. For all subjects, the baseline average sway of the trunk was 0.95 cm, and the average sway of the head was 0.74 cm. Groups did not differ significantly at either baseline or week 4 for either trunk sway ($P > .10$) or head sway ($P = .20$). There was no difference between groups in the change of trunk sway ($P = .08$) from baseline to week 4. However, groups did differ significantly in change of head sway ($P = .01$). The amount of sway remained the same for the SC group but decreased from baseline to week 4 for the SC+ group.

Overall Change of Symptoms

The vast majority (90.9%) of subjects in the SC group reported improvement of their symptoms, 4.5% reported no change, and 4.5% reported feeling worse. In the SC+ group, 85% of subjects reported improvement of their symptoms, 10% reported no change, and 5% reported feeling worse. There were no statistically significant differences between the 2 groups ($P = .79$).

Compliance with Treatment

During the first week of treatment, most subjects in the SC group were distributed in higher levels of compliance (levels 3 and 4); in the last week, there was a slight improvement—100% of subjects had levels of compliance 3 and 4. For the SC+ group, compliance in the first week was equally distributed over levels 2, 3, and 4; at the last week, 70% of subjects were at levels 3 and 4 and 30% at levels 1 and 2. Compliance with the 6 × 6 exercises was mainly at levels 3 and 4: 90% and 85% of subjects for weeks 1 and 4, respectively. At week 4, the SC group had significantly greater compliance than the SC+ group ($P < .05$).

Subsequent Treatment

After the end of the study, 1 subject requested and received further TMD care.

Adverse Events

No adverse events were noted by the clinicians or reported by any of the subjects.

Post-hoc Power Analysis

Based on post-hoc power analysis with 21 subjects per group and with a between-subject standard deviation of 1.37, there was 80% power to detect a between-group difference of 1.19 on the NGRS and 90% power to detect a difference of 1.38. Regarding differences between groups for change from baseline, post-hoc power analysis revealed that, with 21 subjects per group and with an average within-group variation of 1.56 for change from baseline, there was 80% power to detect a difference between groups of 1.35 and 90% power to detect a difference of 1.56.

Discussion

A statistically and clinically significant decrease in the intensity of jaw pain was observed for both groups, regardless of the treatment received. Improvement of neck pain was statistically significant but not clinically significant. In the present study, the combination of Rocabado's 6 × 6 exercises and SC was not demonstrated to be superior to SC alone for reduction of jaw pain intensity. Furthermore, there was no treatment benefit associated with the secondary outcome measures, neck pain, and FHP.

These results differ from those of Wright et al[18] who reported a significant reduction of TMD symptoms with posture exercises and SC (37%) versus SC alone (5%; $P < .001$). Differences in methodology between Wright's study and the present one could account for the different findings. While in the present study the 2 treatment groups were regarded equally in terms of attention given, number of visits, and information supplied, in Wright's study the 2 groups were treated differently relative to these parameters. In addition, Wright et al used a different strategy to recruit subjects.

Two other randomized clinical trials have been carried out to study the same SC treatment as the present study. One study[32] compared SC with cyclobenzaprine, clonazepam, or placebo for the treatment of MFP. The group on placebo and self-care reported a reduction in pain of 40.2%, similar to the reduction in the present study (40.9%). Another study[31] evaluated splints versus SC instructions and no treatment. Subjects receiving SC experienced a 19% reduction in pain intensity between baseline and the end of the study; this change was not statistically significant.

Another study has shown exercises with SC to be no different than SC in decreasing jaw pain intensity.[34] Exercises included diaphragmatic breathing, self-massage, heat, stretching, and coordination exercises. The lack of statistically significant differences may have resulted from the limited power, the high dropout rate, and the low baseline pain intensity values.

Previous case series have demonstrated the benefit of exercises based on jaw movements for the treatment of TMD pain, which demonstrates the importance of conducting randomized clinical trials. For the present study, it was decided to examine the benefit of the 6 × 6 exercises recommended by Rocabado, a defined group of exercises commonly used in the TMD clinical practice but never rigorously tested in a clinical trial as a group. The main difficulty in comparing results between studies is that most studies, including the present study, use combinations of exercises, making it impossible to assess the efficacy of each of the techniques individually. The use of different exercises is theoretically appropriate given that masticatory MFP typically involves more than 1 muscle. Also, if MFP has a multifactorial etiology, this theoretically suggests the need for the use of multiple treatments concurrently, which may yield a synergistic effect.

Jaw pain intensity was selected as the primary outcome measure in the present study. Pain is the most common reason for seeking TMD treatment.[35] Although frequency and duration of pain are important to determine pain impact, pain intensity is a widely used outcome to measure pain, allowing for comparison of results between studies. An NGRS was used as the scale for the main outcome measure because it has been recommended as an appropriate instrument to measure pain; it is easy and reliable to use.[36] It has also been shown to have a higher precision in measuring pain intensity than other pain scales, and it has good sensitivity to detect changes in pain intensity.[37] Lastly, change in pain score as measured by an 11-point pain intensity scale and patient global impression of improvement are significantly correlated.[33] It was determined a priori that a change of 2 on the NGRS would be required for clinical significance, as suggested by the literature. This would suggest that, on average, both groups in the present study experienced meaningful improvement. This was corroborated by the subjects' responses when asked about their impression of the overall change of their symptoms: 90.9% of the SC group and 85% of the SC+ group responded that they were "better."

Upon evaluation of the secondary outcome measures, the only difference between groups that was statistically significant was the change in cranial angle. A decrease in cranial angle for the SC group indicated improvement in FHP; an increase indicated worsening. However, the within-group changes by themselves were not statistically significant for either group. It can be hypothesized that if the observed change in cranial angle had been significant, a significant change in neck angle and/or in head-shoulder difference would also have been observed. Thus, in the present study, it was not possible to assess whether a change in head posture was correlated with a change in jaw pain.

It has been estimated that posture measured in the standing position while the subject is trying to maintain equilibrium has an associated anterior-posterior body sway of 1 to 3 cm.[38] This can be a source of inherent error. In the present study, the mean values for all subjects' head and trunk sway were relatively small—0.74 cm and 0.95 cm, respectively.

The head-shoulder difference has been used previously as a postural measure.[38,39] Values of this measure have been determined to be 2.1 to 2.8 cm[38–41] in a normal population. In 2 separate studies of a TMD population, these values have been found to be 1.49 cm[18] and 3.2 cm.[39] There are no studies in the literature that show the typical values in an FHP population. The population in the present study had a baseline value of 4.0 cm for the head-shoulder difference. Compared to the previous values, it can be suggested that the population included in the present study had FHP.

Several reasons could account for the lack of postural changes. Four weeks might have been insufficient time for posture changes to occur. Assessment of subjects for a longer period of time after completion of treatment would have enabled potential observation of the long-term benefits of the treatments provided.

Also, if subjects had known that their posture and change in posture were being evaluated, results might have been different. In addition, the exercises could have been ineffective in changing head posture. Finally, focusing treatment only on the cervical areas may have been insufficient to result in an improvement, especially if subjects still maintained a poor posture in the rest of the body.

The levels of compliance with self-care were higher for the SC group than for the SC+ group at week 4. It is possible that the complexity of any given therapy is inversely correlated with compliance. It could also be that some subjects satisfactorily eased their symptoms relatively quickly and thus felt less need to comply. Also, multiple treatment options were available to the SC+ group, and they may have self-selected to do only those treatments that were easiest to do, made the most sense to them, or appeared effective in addressing their pain complaints. Measuring compliance of subjects doing SC is difficult. A diary of compliance provides only an approximate guide as to what therapies subjects used, and it acts as a reminder for patients to do their treatments. However, the validity of self-reported compliance could be questioned.

The lack of differences in jaw pain reduction between groups could also be explained by the optimistic counseling and education about TMD leading to subjects' realization of the benign nature of the condition and having a positive effect on subjects' pain reports. Also, biobehavioral treatments based on simple self-regulation programs that rely heavily on a self-management approach could be as effective as traditional therapies.[34,42]

Future research studies examining the relative efficacy of the 6×6 exercises could be improved by adding a baseline period of no-treatment for all subjects prior to enrollment in 1 of the 2 treatment groups. This would minimize the regression to the mean phenomenon. Adding a placebo group would allow isolation of nonspecific treatment effects, and adding a no-treatment study group would allow evaluation of the natural progression of the symptoms. Recruiting more subjects from a patient population would better extrapolate results to a care-seeking patient population. Increasing the duration of therapy would increase the time for greater changes to occur. Finally, using postural exercises that address not only the jaw and the neck but also the overall body might improve the likelihood that the exercises could cause a measurable change in body posture.

Conclusions

The observed results indicate that SC alone is as beneficial as SC plus 6 × 6 exercises for decreasing the intensity of myofascial pain of the jaw and neck over a 4-week study period. Using the present study's methodology, Rocabado's 6 × 6 exercises did not demonstrate an improvement in FHP. As a consequence, the question of whether improvement of FHP would impact TMD symptoms could not be answered. While presenting evidence of the benefit of these 2 therapeutic protocols for the treatment of MFP, this study did not evaluate the specific therapeutic effect of either of the techniques used. Additional research studies are needed to clarify the net benefit of specific physical therapy exercises for the treatment of jaw pain and FHP over other forms of treatment.

Acknowledgments

This research was supported by grants from the American Academy of Orofacial Pain and the TMD and Orofacial Pain Division at the University of Minnesota School of Dentistry. The authors would like to thank Dr Paula Ludewig, Dr Jim Hodges, and Dr Edward Wright for their contributions to this study and manuscript.

References

1. Simons DG, Travell JG. Myofascial Pain and Dysfunction: The Trigger Point Manual, ed 2, vol 1. Baltimore: Williams and Wilkins, 1992.
2. Fricton JR, Kroening R, Haley D, Siegert R. Myofascial pain syndrome of the head and neck: A review of clinical characteristics of 164 patients. Oral Surg Oral Med Oral Pathol 1985;60:615–623.
3. Dworkin SF, LeResche L. Research diagnostic criteria for temporomandibular disorders: Review, criteria, examinations and specifications, critique. J Craniomandib Disord Facial Oral Pain 1992;6:327–334.
4. Sahrmann SA. Adult posturing. In: Kraus SL (ed). TMJ Disorders: Management of the Craniomandibular Complex. New York: Churchill Livingstone, 1998: 295–360.
5. Mannheimer JS, Rosenthal RM. Acute and chronic postural abnormalities as related to craniofacial pain and temporomandibular disorders. Dent Clin North Am 1991;35: 185–208.
6. Kendall FP. Posture and Pain. Huntington, NY: Robert Kreiger, 1970.
7. Gonzalez HE, Manns A. Forward head posture: Its structural and functional influence on the stomatognathic system, a conceptual study. Cranio 1996;14:71–80.
8. Rocabado M. Physical therapy and dentistry: An overview. J Craniomandib Pract 1983;1:46–49.
9. Kritsineli M, Shim YS. Malocclusion, body posture, and temporomandibular disorder in children with primary and mixed dentition. J Clin Pediatr Dent 1992;16:86–93.
10. Clark GT, Seligman DA, Solberg WK, Pullinger AG. Guidelines for the treatment of temporomandibular disorders. J Craniomandib Disord 1990;4:80–88.
11. Okeson JP, Adler RC, Anderson G, et al. Differential diagnosis and management considerations of temporomandibular disorders. In: Okeson JP (ed). Orofacial Pain. Guidelines for Assessment, Diagnosis, and Management. Chicago: Quintessence, 1996:141–158.
12. Management of temporomandibular disorders. National Institutes of Health Technology Assessment Conference Statement. J Am Dent Assoc 1996;127:1595–1606.
13. Rocabado M, Iglarsh ZA. Physical modalities and manual techniques used in the treatment of maxillofacial pain. In: Musculoskeletal Approach to Maxillofacial Pain. Philadelphia: JB Lippincott, 1991:187–192.
14. Fricton JR. Interdisciplinary management of patients with temporomandibular disorders and craniofacial pain: Characteristics and outcome. J Craniomandib Disord 1987;1:115–122.
15. Mannheimer JS. Overview of physical therapy modalities and procedures. In: Pertes RA, Gross SG (eds). Clinical Management of Temporomandibular Disorders and Orofacial Pain. Quintessence, 1995:227–244.
16. Zeno E, Griffin J, Boyd C, Oladehin A, Kasser R. The effects of a home exercise program on pain and perceived dysfunction in a woman with TMD: A case study. Cranio 2001;19:279–288.
17. Darling DW, Kraus S, Glasheen-Wray MB. Relationship of head posture and the rest position of the mandible. J Prosthet Dent 1984;52:111–115.
18. Wright EF, Domenech MA, Fischer JR. Usefulness of posture training for patients with temporomandibular disorders. J Am Dent Assoc 2000;131:202–210.
19. Magnuson T, Syren M. Therapeutic jaw exercises and interocclusal appliance therapy. Swed Dent J 1999;23:27–37.
20. Komiyama O, Kawara M, Arai M, Asano T, Kobayashi K. Posture correction as part of behavioural therapy in treatment of myofascial pain with limited opening. J Oral Rehab 1999;26:428–435.
21. Huggare JA, Raustia AM. Head posture and cervicovertebral and craniofacial morphology in patients with craniomandibular dysfunction. J Craniomandib Pract 1992;10:173–179.
22. Pehling J, Schiffman EL, Look JO, Shaefer J, Lenton PA, Fricton JR. Interexaminer reliability and clinical validity of the temporomandibular index: A new outcome measure for temporomandibular disorders. J Orofac Pain 2002;16:296–304.

23. Tousignant M, Bellefeuille L, O'Donoughue BS, Grahovac S. Criterion validity of the cervical range of motion (CROM) goniometer for cervical flexion and extension. Spine 2000;25:324–330.
24. Rheault W, Albright B, Byers C. Intertester reliability of the cervical range of motion device. J Orthop Sports Phys Ther 1992;15:147–150.
25. Youdas JW, Carey JR, Carret TR. Reliability of measurements of cervical spine range of motion: Comparison of three methods. Phys Ther 1991;71:98.
26. Jensen MP, Karoly P, Braver S. The measurement of clinical pain intensity: A comparison of six methods. Pain 1986;27:117–126.
27. Jensen M, Karoly P, O'Riordan E, Bland FJ, Burns R. The subjective experience of acute pain. An assessment of the utility of 10 indices. Clin J Pain 1989;5:153–159.
28. Polhemus. 3SPACE FASTRAK User's Manual, Revision F. Colchester, VT: Polhemus, 1993.
29. An KN, Jacobsen MC, Berglund LJ, Chao EYS. Application of a magnetic tracking device to kinesiologic studies. J Biomech 1988;21:613–620.
30. Fricton JR, Schiffman EL. Management of masticatory myalgia and arthralgia. In: Lund JP, Lavigne GJ, Dubner R, Sessle BJ (eds). Orofacial Pain: From Basic Science to Clinical Management. Chicago: Quintessence, 2001:240.
31. Wright EF, Anderson G, Schulte J. A randomized clinical trial of intraoral soft splints and palliative treatment for masticatory muscle pain. J Orofac Pain 1995;9:192–199.
32. Herman CR, Schiffman EL, Look JO, Rindal DB. The effectiveness of adding pharmacologic treatment with clonazepam or cyclobenzaprine to patient education and self-care for the treatment of jaw pain upon awakening: A randomized clinical trial. J Orofac Pain 2002;16:64–70.
33. Farrar JT, Young JPJ, LaMoreaux L, Werth JL, Poole RM. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. Pain 2001;94:149–158.
34. Michelotti A, Steenks MH, Farella M, Parisini F, Cimino R, Martina R. The additional value of a home physical therapy regimen versus patient education only for the treatment of myofascial pain of the jaw muscles: Short-term results of a randomized clinical trial. J Orofac Pain 2004;18:114–125.
35. Dworkin S, Huggins K, Wilson L, et al. A randomized clinical trial using Research Diagnostic Criteria for Temporomandibular Disorders-Axis II to target clinic cases for a tailored self-care TMD treatment program. J Orofac Pain 2002;16:48–63.
36. Dworkin RH, Turk DC, Farrar JT, et al. Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. Pain 2005;113:9–19.
37. Conti PC, de Azevedo LR, de Souza NV, Ferreira FV. Pain measurement in TMD patients: Evaluation of precision and sensitivity of different scales. J Oral Rehabil 2001;28:534–539.
38. Harrison AL, Barry-Greb T, Wojtowicz G. Clinical measurement of head and shoulder posture variables. J Orthop Sports Phys Ther 1996;23:353–361.
39. Lee WY, Okeson JP, Lindroth J. The relationship between forward head posture and temporomandibular disorders. J Orofac Pain 1995;9:161–167.
40. Woodhull AM, Maltrud K, Mello BL. Alignment of the human body in standing. Eur J Appl Physiol 1985; 54:109–115.
41. Barry-Greb T. Measurement of Normal and Forward Head Posture. University of Kentucky: Lexington, 1990.
42. Carlson CR, Bertrand PM, Ehrlich AD, Maxwell AW, Burton RG. Physical self-regulation training for the management of temporomandibular disorders. J Orofac Pain 2001;15:47–55.