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Original Article

The Effect of Postural Yinyang Correction of Temporomandibular Joint for Temporomandibular Disorder

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ABSTRACT

Background: The purpose of this study was to determine the effect of Postural Yinyang correction of the temporomandibular joint (functional cerebrospinal therapy) on temporomandibular disorder.
Methods: Medical records of 21 outpatients were reviewed who were diagnosed with temporomandibular joint disorder, unspecified (K0769) and treated at the Department of Acupuncture & Moxibustion, Dong-Eui University Korean Medicine Hospital from May 1st, 2017 to April 30th, 2018. Patients received more than 10 treatments of upper cervical manipulation and performed self-exercise therapy more than 3 times a day and wore an accurate balancing appliance in the oral cavity for more than 8 hours per day. To estimate the efficacy, visual analogue scale (VAS), numerical rating scale (NRS), maximum mouth opening (MMO), symptom intensity scale (SIS), max SIS (MSIS), symptom frequency scale (SFS), mandibular function impairment questionnaire (MFIQ) and 5-point Likert scale were used.
Results: NRS and MSIS were significantly improved during each period. VAS, MMO, SIS, and SFS were significantly improved during each period, except the period from the 8th to 10th visit. MFIQ score was significantly improved during the period from the 1st to 10th visit. In the 5-point Likert scale, the results showed a high patient satisfaction with the treatment.
Conclusion: These results showed that functional cerebrospinal therapy using an accurate balancing appliance, may be useful for reducing the symptoms of temporomandibular disorder.

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Introduction

Temporomandibular disorder (TMD) occurs in the temporomandibular joint (TMJ) and the muscles and tissues around the TMJ, and includes various clinical problems of the masticatory muscle and TMJ areas [1]. Symptoms of TMD not only include pain but also functional changes. Among them, TMJ/masticatory muscle pain, limitation of range of motion, and TMJ sound were typically referred to as the "TMD triad" [2,3]. In addition, the maximal bite force and electromyographic measurements also decreased compared to the normal group [4].

There are a variety of factors that can contribute to the TMD including neuromuscular incongruity, TMJ developmental incompatibility, mental stress, malocclusion, bad oral habits, wound, nutrition, hormonal and metabolic disorders. Clearly identifying specific factors involved in the pathogenesis of TMD is difficult and multiple factors can be involved in this complex process [5].

Various population studies have reported that the incidence of people suffering from TMD are as high as 50% to 60%, with 3% to 7% of patients requiring treatment, and there are reports that 75% of Westerners have at least 1 dysfunctional symptom, and 33% have at least 1 symptom [5].

Recently, postural Yinyang correction of the temporomandibular joint [functional cerebrospinal therapy (FCST)] which is a newly emerging area of Korean medicine treatment for TMD, corrects the position of the TMJ and aligns the upper cervicals in order to achieve the structural and physiological balance of the body, including the meridian and brain-spinal nervous system [6]. In FCST, an intraoral balancing appliance is used to find a balance by correcting the position of the TMJ and to maintain the balance point [7]. Standard intraoral balancing appliances are designed to maintain balance after locating the ideal position of the mandible in which the deviation of the TMJ disappears [8].

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Therefore, to investigate the effects of FCST on TMD, outpatients who visited the Department of Acupuncture & Moxibustion, Dong-Eui University Korean Medicine Hospital for the symptoms of TMD from May 1st, 2017 to April 30th, 2018 and who met the criteria for selection and exclusion were selected and analyzed. Retrospective chart review based on medical records was performed.

Materials and Methods

Patients

Medical records of outpatients who were diagnosed with temporomandibular joint disorder, unspecified (K0769), and treated at the Department of Acupuncture & Moxibustion, Dong-Eui University Korean Medicine Hospital from May 1st, 2017 to April 30th, 2018 were reviewed. Of 49 patients, 21 who met the criteria below, underwent upper cervical manipulation more than 10 times, performed self-exercise more than 3 times a day, and wore an accurate balancing appliance (ABA) in the oral cavity more than 8 hours a day were selected (Fig. 1).

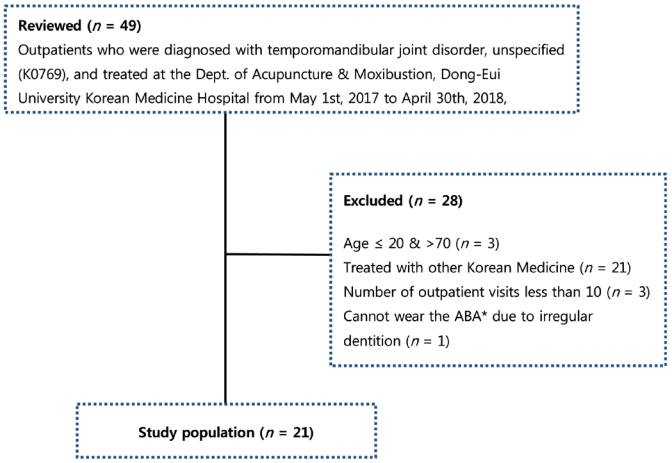

Fig. 1. Flow chart of patients selection.
ABA, accurate balancing appliance.

Inclusion criteria

(1) Patients aged 20-70 years.
(2) Patients with TMD for more than 12 weeks.
(3) Patients with at least 1 of the following symptoms: pain, TMJ sound, mouth opening limitation.
(4) Patients who were judged to have an abnormality in the TMJ using the TMJ abnormality test [9].
  ① When little fingers were placed in the ears, and the mouth opened or closed, there should be little sensation of movement in the ear. However, if there was a feeling of tightness or movement detected by the fingers, then this may be considered to be an abnormality.
  ② When index fingers were placed in front of the ears, and the mouth slightly opened and then opened and closed with a little force, there should be no pain in both ears.
  ③ If saliva cannot be swallowed more than 3 times in a row, TMD is suspected.
  ④ When the mouth is opened and closed, it should be moved in a straight line.
  ⑤ It should be possible to put the width of 3 fingers (index, middle and ring fingers) in and out of the mouth .
(5) Patients with stable vital signs and no neurological symptoms.
(6) Patients who underwent more than 10 treatments.

Exclusion criteria

(1) Patients with brain disease.
(2) Patients with mental illness.
(3) Patients who had received insulin injections for diabetes.
(4) Patients who underwent surgery due to TMD.
(5) Patients who were treated with other Korean medicine therapies such as acupuncture, moxibustion and herbal medicine with FCST
(6) Patients who had difficulty in wearing the ABA.
  ① Patients who had difficulty in wearing an ABA due to teeth defects.
  ② Patients who were expected to damage the ABA due to orthodontic treatment or uneven set of teeth.
  ③ Patients who underwent surgical operations on facial bones, such as double jaw surgery.
  ④ Patients with ulcers in the mouth, such as Behcet's disease.
(7) Patients who were contraindicated in hand therapy.
(8) Patients who were treated or needed treatment with corticosteroids or nonsteroidal anti-inflammatory drugs due to other diseases.

Treatment methods

Patients received more than 10 treatments of upper cervical manipulation and were instructed to wear ABA for at least 8 hours every day and perform self-exercise more than 3 times a day. Patients who were treated with other Korean medicine therapies such as acupuncture, moxibustion and herbal medicine were excluded.

Postural yinyang correction of temporomandibular joint, FCST

(1) Standard intraoral balancing appliance
  ABA, one of the Standard intraoral balancing appliances, varied from 1 to 10 according to the dentition and size of the oral cavity. ABA is a device that is optimized for most oral structures by statistical processing. It is used for achieving an accurate and ideal balance of the human body [10]. During the treatment, ABA was worn for more than 8 hours a day including sleeping time (Fig. 2).

Fig. 2. Accurate balancing appliance.

(2) Upper cervical manipulation

Patients were instructed to wear the ABA in the supine position. The patient's head was manipulated to about 30 degrees on the lateral side, rotated to the point of resistance, and the subluxed upper cervical vertebrae were corrected using momentary force. Upper cervical manipulation was performed once or twice a week, more than 10 times in total (Fig. 3).

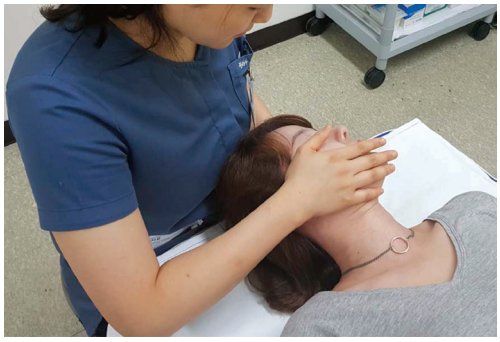

Fig. 3. Upper cervical manipulation.

(3) Self-exercise therapy

Self-exercise therapy involved TMJ and whole-body posture training exercises [11]. Patients were instructed to perform self-exercise more than 3 times a day, whilst wearing ABA. Each exercise was performed 3 to 5 times, respectively (Fig. 4).

① TMJ stretching exercise

The act of opening and closing the mouth was repeated as wide as possible.

② Neck stretching exercise

The neck was exercised in the following order: Rotation in a circle on both sides, lateral bending on both sides, flexion, extension, horizontal rotation on both sides.

③ Whole body stretching exercise

- Horizontal rotation exercise (twist exercise)

Stand up, open the feet over a shoulder width apart, and repeat the exercise to twist the waist by horizontally rotating to both sides.

- Up and down exercise (back, waist extension exercise)

Stand up, open the feet over a shoulder width apart and pull the hip back as far as possible, open the chest with the head straight up, sit down with the knees bent 90 degrees and stand up. Repeat with different foot angles.

④ Gait stretching exercise

Stand up and open the chest with both arms positioned on both sides. Hold the fist lightly and position the fist on both sides. Pull the jaw downward and walk for 20-30 seconds or more with your back straight.

(4) Patient education

All patients were educated with the following cautions.

① Take 8-10 hours of sleep, avoid excessive stress, do not overwork and take enough rest.

② Make sure to correct the bad habits that cause difficulty in TMJ such as bruxism, clenching, nail-biting, and finger sucking.

③ Avoid actions that adversely affect the TMJ balance such as unilateral chewing or resting chin on hand.

④ Do not eat hard, tough foods.

⑤ Have a positive attitude.

Fig. 4. Self-exercise therapy.

Assessment methods

Assessment tools except mandibular function impairment questionnaire (MFIQ) and patient satisfaction were measured at P0 (The 1st visit), P1 (4th visit, about 2 weeks from the 1st visit), P2 (8th visit, about 4 weeks from the 1st visit), P3 (10th visit, about 6 weeks from the 1st visit). The treatment intervals between each of these time points were defined as follows: period from P0 to P1 (below P01), period from P1 to P2 (below P12), period from P2 to P3 (below P23), period from P0 to P2 (below P02), period from P0 to P3 (below P03). MFIQ was measured at P0 and P3, and P03 was analyzed. In MFIQ, 20 cases were statistically treated due to one case of data loss. Patient satisfaction was measured at P1, P2 and P3.

Visual analog scale

Visual analog scale (VAS) is a pain assessment scale designed by Bond and Pilowsky. Patients were instructed to score the degree of pain on the 10 cm long segment from a scale of "no pain (0)" to "unbearable pain (10)" [12].

Numerical rating scale

Numerical rating scale (NRS) has a range 1-10 and the patient self-evaluated the degree of symptoms with scales from 0 (no symptoms) to 10 (severe symptoms) for TMJ sound.

Maximum mouth opening

Maximum mouth opening (MMO) is measured in this way: The patient's mandible is positioned comfortably. Even when the patients feel pain, they are encouraged to open their mouth wider. Place one end of a ruler in the incisive margin of the maxillary central incisor and the other end in the incisive margin of the mandibular incisors. The vertical distance is measured in millimeters [13].

Symptom intensity scale

Symptom intensity scale (SIS) is one of the Steigerwald/Maher TMD disability questionnaires and the higher the score, the greater the discomfort. SIS is a questionnaire that evaluates the intensity of symptoms by the patient himself. For 1 item, the usual intensity is indicated by a circle, and the intensity of the most severe case is indicated by the X-shape [14].

Symptom frequency scale

Symptom frequency scale (SFS) is one of the Steigerwald/Maher TMD disability questionnaires and the higher the score, the greater the discomfort. SFS is a questionnaire that evaluates the frequency of symptoms by the patient himself [14].

Mandibular function impairment questionnaire, function impairment rating scale, qualitative level of function impairment

Mandibular function impairment questionnaire (MFIQ) is a questionnaire for TMJ pain research, developed by Stegenga et al [15]. It is structured to assess the degree of pain associated with 11 daily activities and chewing or swallowing of 6 different types of foods [15]. The MFIQ consists of a scoring range from 0 to 68, where 0 indicates no mandibular function impairment. Using these scores, a raw component score is calculated and a function impairment rating scale (FIRS) is derived. Qualitative level of function impairment can be classified according to the FIRS (Table 1).

Patient satisfaction with 5-point Likert scale

5-point Likert scale was used for assessing satisfaction with treatment (Table 2).

Table 1. Scoring the MFIQ.

Calculation of raw component score		
Item score	i	Range 0 - 4
Numbers of items	N	
Sum item scores	S = i1 + i2 + ××××× + iN	Range 0 – 4N
Raw component score*	C = S / 4N	Range 0 - 1
Calculation of level of function impairment		
Rule for i:	Rule for C:	FIRS
All i < 2	C ≤ 0.3	0
At least one i ≥ 2	C ≤ 0.3	1
All i < 3	0.3 < C ≤ 0.6	2
At least one i ≥ 3	0.3 < C ≤ 0.6	3
All i ≠ 4	C > 0.6	4
At least one i = 4	C > 0.6	5
Qualitative level of function impairment		
I	Low	0 or 1
II	Moderate	2 or 3
III	Severe	4 or 5

*MFIQ Score.
FIRS, function impairment rating scale; MFIQ, mandibular function impairment questionnaire.

Table 2. 5-point Likert Scale.

Point	Patient satisfaction
5	I am very satisfied with this treatment
4	I am satisfied with this treatment
3	I am uninspired with this treatment
2	I am unsatisfied with this treatment
1	I am very unsatisfied with this treatment

Statistical analyses

All statistical analyses were performed with the SPSS 18.0 for Windows program (SPSS Co. USA). The level of statistical significance was set at $p < 0.05$. Results are expressed as means ± SD. A paired t test was used for data with a normal distribution, and a Wilcoxon signed rank test was used for data that did not have a normal distribution.

Results

General characteristics

The data extracted from the medical records of the 21 patients who were included in this study included age, gender, VAS, NRS, MMO, SIS, maximum symptom intensity scale (MSIS), SFS and MFIQ score at P0. In MFIQ, 20 cases were statistically treated with one case of data loss (Table 3).

The ABA size distribution was size 2 for one female patient, size 3 for one female patient, size 4 for one female patient and one male

Table 3. General Characteristics.

Characteristics	P0 (n = 21)
Age (y)	33 ± 11.22
Gender (male/female)	10/11
VAS	4.67 ± 2.90
NRS	6.74 ± 2.34
MMO (mm)	47.31 ± 8.16
SIS	24.39 ± 16.00
MSIS	43.67 ± 17.85
SFS	40.27 ± 17.01
MFIQ score	0.29 ± 0.19 (n = 20)

Data are presented as number or mean ± SD.
P0, 1st visit.
MFIQ, mandibular function impairment questionnaire; MMO, maximum mouth opening; MSIS, max symptom intensity scale; NRS, numerical rating scale; SFS, symptom frequency scale; SIS, symptom intensity scale; VAS, visual analogue scale.

Table 4. Distribution of TMJ Disorder.

TMJ Disorder	Patients
Pain	15 (71.4)
Clicking sound	21 (100)
3 knuckles test	2 (9.5)
Zigzag opening mouth	20 (95.2)
Ear-finger test	14 (66.7)
3-times swallowing test	8 (38.1)

Data are presented as n (%).
Multiple responses were allowed.
TMJ, temporomandibular joint.

Table 5. Improvements of VAS, NRS, and MMO.

Average of VAS		Improvement of VAS		
Visit	Average (mm)	Period	Z	p
P0	4.67 ± 2.90	P01	-3.239	0.001*
P1	3.10 ± 2.41	P12	-2.765	0.006*
P2	2.38 ± 2.46	P23	-1.800	0.072
P3	1.83 ± 2.39	P02	-3.640	0.000*
		P03	-3.629	0.000*
Average of NRS		Improvement of NRS		
Visit	Average (mm)	Period	t	p
P0	6.74 ± 2.34	P01	4.052	0.001†
P1	5.29 ± 2.63	P12	3.355	0.003†
P2	4.24 ± 2.55	P23	3.189	0.005†
P3	3.33 ± 2.46	P02	5.728	0.000†
		P03	6.882	0.000†
Average of MMO		Improvement of MMO		
Visit	Average (mm)	Period	t	p
P0	47.31 ± 8.16	P01	4.335	0.000†
P1	50.24 ± 8.36	P12	3.697	0.001†
P2	52.38 ± 7.72	P23	0.627	0.538
P3	52.76 ± 8.75	P02	6.335	0.000†
		P03	7.526	0.000†

Data are presented as mean ± SD.
P0, 1st visit; P1, 4th visit; P2, 8th visit; P3,10th visit; P01, period from 1st visit to 4th visit; P12, period from 4th visit to 8th visit; P23, period from 8th visit to 10th visit; P02, period from 1st visit to 8th visit; P03, period from 1st visit to 10th visit.
*$p < 0.05$ by Wilcoxon signed rank test.
†$p < 0.05$ by Paired t test..
MMO, maximum mouth opening; NRS, numerical rating scale; VAS, visual analogue scale.

patient, size 5 for seven female patients and two male patients, size 6 for one female patient and six male patients, and size 7 for one male patient.

Distribution of the TMD symptoms

The symptoms of TMD are shown in Table 4. Multiple responses were allowed. All patients experienced TMJ sound and almost 75% of the patients experienced TMJ pain (Table 4).

Comparison of VAS by treatment periods

The mean VAS at P0, P1, P2 and P3 are shown in Table 5. Significant improvements in VAS were observed in all periods except for P23 (Table 5).

Comparison of NRS by treatment periods

The mean NRS at P0, P1, P2 and P3 are shown in Table 5. Significant improvements in NRS were observed in all periods (Table 5).

Comparison of MMO by treatment periods

The mean MMO at P0, P1, P2 and P3 are shown in Table 5. Significant improvements in MMO were observed in all periods except for P23 (Table 5).

Comparison of SIS by treatment periods

The mean SIS at P0, P1, P2 and P3 are shown in Table 6. Significant improvements in SIS were observed in all periods except for P23 (Table 6).

Comparison of MSIS by treatment periods

The mean MSIS at P0, P1, P2 and P3 are shown in Table 6. Significant improvements in MSIS were observed in all periods (Table 6).

Comparison of SFS by treatment periods

The mean SFS at P0, P1, P2 and P3 are shown in Table 6. Significant improvements in SFS were observed in all periods except for P23 (Table 6).

Table 6. Improvements of SIS, MSIS, and SFS.

Average of SIS		Improvement of SIS		
Visit	Average	Period	Z	*p*
P0	24.39 ± 16.00	P01	-3.690	0.000*
P1	18.26 ± 17.36	P12	-3.251	0.001*
P2	13.61 ± 16.87	P23	-1.418	0.156
P3	12.08 ± 15.31	P02	-3.981	0.000*
		P03	-4.018	0.000*
Average of MSIS		Improvement of MSIS		
Visit	Average	Period	Z	*p*
P0	43.67 ± 17.85	P01	-3.923	0.000*
P1	30.41 ± 20.27	P12	-3.240	0.001*
P2	22.96 ± 20.08	P23	-2.136	0.033*
P3	19.36 ± 20.52	P02	-3.924	0.000*
		P03	-3.980	0.000*
Average of SFS		Improvement of SFS		
Visit	Average	Period	Z	*p*
P0	40.27 ± 17.01	P01	-3.827	0.000*
P1	29.52 ± 18.28	P12	-3.826	0.000*
P2	21.12 ± 19.17	P23	-1.713	0.087
P3	18.54 ± 17.72	P02	-3.922	0.000*
		P03	-4.016	0.000*

Data are presented as mean ± SD.
P1, 4th visit; P2, 8th visit; P3,10th visit; P01, period from 1st visit to 4th visit; P12, period from 4th visit to 8th visit; P23, period from 8th visit to 10th visit; P02, period from 1st visit to 8th visit; P03, period from 1st visit to 10th visit.
*$p < 0.05$ by Wilcoxon signed rank test.
MSIS, max symptom intensity scale; SFS, symptom frequency scale; SIS, symptom intensity scale.

Table 7. Improvement of MFIQ Score.

Average of MFIQ		Improvement of MFIQ		
Visit	Average	Period	Z	*p*
P0	0.29 ± 0.19	P03	-3.726	0.000*
P3	0.16 ± 0.18			

Data are presented as mean ± SD.
P0, 1st visit; P3, 10th visit; P03, period from 1st visit to 10th visit.
*$p < 0.05$ by Wilcoxon signed rank test.
MFIQ, mandibular function impairment questionnaire.

Comparison of MFIQ score

The mean MFIQ score at P0 and P3 are shown in Table 7. 20 cases were analyzed statistically due to one case of data loss. Significant improvements in MFIQ score were observed in the analysis period (Table 7). Table 8 represents the number of people for FIRS and Qualitative Function Impairment Level.

Table 8. Distribution of FIRS and Qualitative Function Impairment Level.

FIRS	P0 (%)	P3 (%)
0	0 (0)	8 (40)
1	12 (60)	9 (45)
2	0 (0)	1 (5)
3	6 (30)	1 (5)
4	0 (0)	0 (0)
5	2 (10)	1 (5)
Level	P0 (%)	P3 (%)
Low	12 (60)	17 (85)
Moderate	6 (30)	2 (10)
Severe	2 (10)	1 (5)

Data are presented as *n* (%).
P0, 1st visit; P3, 10th visit.
FIRS, function impairment rating scale.

Table 9. 5-point Likert Scale After Treatment.

Result	P1 (%)	P2 (%)	P3 (%)
5	6 (28.57)	9 (42.86)	10 (47.62)
4	13 (61.90)	12 (57.14)	11 (52.38)
3	2 (9.52)	0	0
2	0	0	0
1	0	0	0
Total (%)	21 (100)	21 (100)	21 (100)
Mean score	4.19	4.43	4.48

Data are presented as *n* (%).
P1, 4th visit; P2, 8th visit; P3, 10th visit.

Patient satisfaction with 5-point Likert scale

Patient satisfaction in P1 was highest at 4 points with 13 people (61.90%), 5 points with 6 people (28.57%), and 3 points with 2 people (9.52%), in order, with an average of 4.19 points. In P2, patient satisfaction was highest at 4 points with 12 people (57.14%), and 5 points with 9 people (42.86%), in order, with an average of 4.43 points. In P3, patient satisfaction was highest at 4 points with 11 people (52.38%), and 5 points with 10 people (47.62%), in order, with an average of 4.48 points (Table 9).

Discussion

TMJ is a joint associated with surrounding tissues and related to mouth opening, closing, chewing, swallowing and pronunciation [16]. It is a complicated joint composed of mandible, discs, skull, ligaments, and surrounding muscles [16]. Various disorders that can occur in the TMJ and related structures are termed TMD [17]. TMD includes various symptoms such as tender joint, surrounding tissue tenderness, pain during chewing, pain at mouth opening, limitation of mouth opening, TMJ sound, facial asymmetry, headache, ear pain and toothache [18]. TMD is prone to chronicization because people often fail to recognize the TMD as

a lesion at a specific site and do not perform systematic evaluation and treatment [19].

In classical Korean medical literature, the mandible is represented by Hyeobgeogol, Haasanggol, and Ajo, and TMD is represented by Hamtong, Hyeobtong, Gugeumbulgae [20]. The mechanism of damage for the TMJ can be classified into trauma such as bruising or an external cause such as a wind-cold-dampness pathogen or an internal cause such as deficiency of Qi and the blood [20]. In addition, the prototype of the intraoral appliance can be observed in classical Korean medical literature of the 12th-19th century. Various kinds of materials such as chopsticks, bamboo boxes, and coins were used to control the TMJ position [21]. Moreover, a previous study reported that standard and quantitative TMJ control was attempted using a coin. It was temporarily applied based on the response of the human body and was applied to various pathologies as well as pain [21].

According to a web-based survey for assessment of Korean medical treatment and clinical practice patterns for temporomandibular disorders [22], the most commonly used treatments were acupuncture, electro-acupuncture and chuna. In the Korean medicine doctor group that actually treated the TMD patients, the ratio of using chuna and intraoral appliance was higher than the group that did not. This indicates that manipulation and hand therapy are widely used in clinic. Acupuncture treatment with adjacent points and circumferential meridian is used for masticatory tension relief and unblocking Qi. In Korea, Moon et al [23] reported that in patients with TMD, there was easing of symptoms when motion style treatment was applied, and Kim et al [24] reported that significant improvements were observed with Sa-Am acupuncture treatment (a treatment using distant acupuncture points), and Cho et al [5] reported that, in 194 patients with TMD, acupuncture (including electro-acupuncture), and correction of iliac, lumbar, and cervical vertebrae were all effective. Chang et al [25] reported clinical case studies on TMD with upper cervical manipulation. Herbal medicine is also a commonly used treatment for TMD. A study comparing the efficacy of non-steroidal anti-inflammatory drugs with Huoluo Powder for TMD by measuring Friction's Craniomandibular Index (an index related to TMD symptoms), showed that herbal medicine was more effective than NSAIDs [26].

In Western medical treatment, the treatment for TMD includes self-care, counseling, physical therapy, medication, appliance therapy, physiotherapy, occlusion therapy, behavior therapy, and surgical management [27]. Most of the TMDs (about 85% to 90%) can be treated by reversible, noninvasive, and non-surgical methods [28]. Where 3-6 months of non-surgical treatment does not alleviate the limitation of movement and pain with daily activities, surgical management may be considered [28]. Most patients receive conservative therapy prior to surgery, and the most representative of conservative therapies is occlusal stabilization appliance therapy [29]. This therapy aimed to remove the instability that caused TMD, by relieving all formal instability between the occlusal location and joint positions [30]. This allowed a therapeutic effect such as a reduction of pain through neuromuscular balance and reducing abnormal muscle activity [31]. An extensive literature review of occlusal appliance therapy has shown a therapeutic efficacy of between 70% to 90%, but the mechanism still remains controversial [30].

Recently, FCST, a whole-body control treatment through TMJ stimulation, has been used as a Korean medical treatment. In Korean medicine, the TMJ and surrounding tissues are places where all the meridians of the human body gather, and the brain and kinesthetic nerve are directly linked [32]. Therefore, TMJ can be utilized to evaluate and derive the whole-body balance [32]. The TMJs on both sides move around the odontoid process of the axis, and the TMJ is set as an indicator and a tool to reflect and adjust the systemic balance of the brain and spinal nervous system through the 2nd cervical vertebra [32]. In the FCST, the whole-body imbalance is assessed through 7 aspects, including the assessment of 4 imbalances in the TMJ itself and the assessment of changes in 3 components of spinal posture [33]. FCST precisely controls the TMJ by determining the direction and amount of appropriate stimulation with these assessments [34]. The balance position found in this way is maintained by wearing an intraoral balancing appliance [35].

FCST and occlusal appliance therapy are similar in that they use oral appliances for treatment. However, FCST is not limited to TMD but is a physiological therapy that regulates the balance of the whole-body meridian by balancing the TMJ [36]. Therefore, FCST differs from dental occlusal appliance treatment in principle and effect [36]. In clinical practice, FCST is not limited to TMD and is used for a wide range of diseases such as spasmodic torticollis [35], tic disorder [37] and dizziness [38].

There are some studies using FCST for TMD itself: recurrent or habitual type TMJ dislocation [39], and sleep bruxism-induced TMJ pain [40]. However, it may be difficult to provide meaningful interpretation from these studies as only one case of treatment was reported, with a lack of various evaluation tools, and a failure to observe effects of FCST alone. In addition, treatment was limited to certain symptoms such as dislocation or pain.

In this current study, to investigate the effects of FCST on the improvement of TMD, medical records were reviewed from 21 outpatients who visited the Department of Acupuncture & Moxibustion, Dong-Eui University Korean Medicine Hospital, from May 1st 2017 to April 30th 2018 and who were diagnosed with temporomandibular joint disorder, unspecified (K0769) and who wore an ABA, received upper cervical manipulation and performed self-exercise.

Based on VAS, NRS, MMO, SIS, MSIS, SFS, measured at P0 (1st visit), P1 (4th visit, about 2 weeks from the 1st visit), P2 (8th visit, about 4 weeks from the 1st visit), and P3 (10th visit, about 6 weeks from the 1st visit), the period from P0 to P1 (below P01), P1 to P2 (below P12), P2 to P3 (below P23), P0 to P2 (below P02), and the period from P0 to P3 (below P03) were analyzed. MFIQ was measured at P0 and P3, and P03 was analyzed. Patient satisfaction was measured at P1, P2 and P3. Patients visited twice a week during P0-P2, then once a week thereafter, which seemed to be due to symptom relief, resulting in an increase in the interval between visits from twice a week to once a week.

NRS and MSIS were significantly improved during each period. VAS, MMO, SIS, and SFS were significantly improved during each period except P23. VAS, MMO, SIS and SFS assessments showed improvements in the average value but no significant improvements were shown at P23, which is thought to be related to the interval between visits. Unlike P0-P2, where patients visited twice a week, the interval between visits increased in P23. In addition, since the symptoms were already alleviated from P0 to P2, it was thought that the improvements in P23 were not meaningful. In the case of MMO, there was a limit to the mouth opening range, so it was thought that no significant increase was observed at P23. MFIQ was measured at P0 and P3, where statistics were applied to 20 cases (with 1 case of data loss). Statistically significant improvements in MFIQ scores were observed in the period, and positive changes in the FIRS and Qualitative Function Impairment Level were also observed. The mean satisfaction of patients was 4.19 in P1, 4.43 in P2, and 4.48 in P3 showing a high satisfaction with treatment.

These results showed that FCST using ABA may be useful for

reducing the various symptoms of TMD. In addition, after the treatment there was a decrease in not only TMJ symptoms, but also headache, neck and shoulder pain.

It is presumed that the standard intraoral balancing appliance, relaxes excessive tension in the muscles and ligaments involved in the TMJ movement by securing a narrowed space of the TMJ and inducing a minimum horizontal, up and down, left and right balance of the TMJ [6]. The pain felt in the deep tissue is mostly in the muscles, and is caused by an abnormality of the fascia. Such pain leads to muscular rigidity, blood circulation disturbance, and limitation of joint motion [41]. Therefore, TMJ stretching with the intraoral appliance can alleviate symptoms. In addition, imbalance in the TMJ causes subluxation of C2 [34], the central axis of the TMJ movement, and so upper cervical manipulation may be beneficial for treatment of TMD and related symptoms [25]. Furthermore, neck and gait stretching exercises with wearing the intraoral appliance may help to improve the TMJ and whole-body imbalance, by maintaining the overall posture of the body.

In this study, a control group was not possible since this was a retrospective study, and the research period was limited, so posttreatment progress or complications were not investigated. In addition, it was difficult to determine frequency and consistency of the time period whilst wearing ABA and exercising. Nevertheless, the positive effects of FCST on the symptoms such as pain, TMJ sound, and mouth opening disorder in the patients with TMD were observed. Further studies need to use objective measurement methods such as electrovibratography in evaluating TMJ sound. Furthermore, a systematic randomized controlled trial with long-term patient monitoring and sufficient sample size need to be conducted in the future. And use of a customized yinyang balancing appliance which gives a more accurate TMJ balance would provide a useful additional assessment.

Conclusion

Of the patients who were diagnosed with temporomandibular joint disorder, unspecified (K0769) in the Department of Acupuncture & Moxibustion, Dong-Eui University Korean Medicine Hospital, and underwent outpatient treatment between May 1st, 2017 to April 30th, 2018, 21 patients who wore ABA, received upper cervical manipulation and performed self-exercise were retrospectively analyzed and the following conclusions were obtained.

NRS, MSIS were significantly improved during each period.

VAS, MMO, SIS, SFS were significantly improved during each period except P23.

MFIQ was measured at P0 and P3 and the MFIQ scores were significantly improved.

In the 5-point Likert scale, the results showed high satisfaction with the treatment.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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