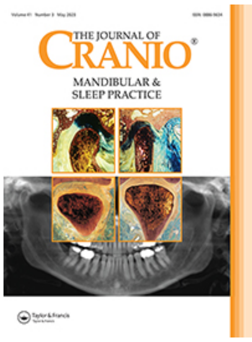

Taylor & Francis
Taylor & Francis Group

CRANIO®

The Journal of Craniomandibular & Sleep Practice

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/ycra20

The efficacy of orofacial myofunctional therapy in oral dysphagia accompanying temporomandibular dysfunction

Hazel Çelik Güzel & Aysenur Tuncer

To cite this article: Hazel Çelik Güzel & Aysenur Tuncer (2023): The efficacy of orofacial myofunctional therapy in oral dysphagia accompanying temporomandibular dysfunction, CRANIO®, DOI: 10.1080/08869634.2023.2226832

To link to this article: https://doi.org/10.1080/08869634.2023.2226832

Published online: 21 Jun 2023.

CRANIO®: THE JOURNAL OF CRANIOMANDIBULAR & SLEEP PRACTICE
https://doi.org/10.1080/08869634.2023.2226832

The efficacy of orofacial myofunctional therapy in oral dysphagia accompanying temporomandibular dysfunction

Hazel Çelik Güzel PT, PhD [a] and Aysenur Tuncer PT, PhD [b]

[a]Faculty of Vocational School of Health Services, Department of Physiotherapy and Rehabilitation, Bandırma Onyedi Eylül University, Balıkesir, Turkey; [b]Department of Physiotherapy and Rehabilitation, Hasan Kalyoncu University, Gaziantep, Turkey

ABSTRACT

Objective: Patients with temporomandibular dysfunction (TMD) may develop oral-stage dysphagia (OD) in the chronic phase.

Methods: This study investigated the effect of orofacial myofunctional therapy (OMT) in individuals with TMD-related OD. Fifty-one patients aged 18–65 years with TMD-related OD were separated into three groups using a simple randomization method: the control group ($n = 12$) underwent patient education and a home-exercise program; additionally, to an exercise program the manual therapy (MT) group ($n = 19$) received MT; and the OMT group ($n = 20$) received the OMT program. MT and OMT were applied in two sessions per week for 10 weeks. The patients were re-evaluated after treatment and at 3 months.

Results: The OMT group showed the most improvement in jaw functionality, swallowing-related quality of life, pain, and dysphagia ($p < .05$).

Discussion: OMT was superior to MT and exercises alone in reducing dysphagia and improving the swallowing-related quality of life.

KEYWORDS
Temporomandibular dysfunction; oral dysphagia; orofacial myofunctional therapy; manual therapy; swallowing quality of life

Introduction

Irregularities in the temporomandibular joint (TMJ) and related musculoskeletal structures that result in functional disorders are defined as temporomandibular dysfunction (TMD). The main complaints of TMD are joint and muscle pain, limited joint movement, and abnormal joint sounds [1]. The coronavirus disease 2019 (COVID-19) pandemic has recently created severe limitations in global healthcare systems, particularly in providing oral dental care services. During periods of social isolation, permission was granted only for dental procedures defined as emergencies by the World Health Organization (WHO) and the American Dentists Association, and many patients with TMD were not able to receive treatments at the time when they were most needed [2]. Pandemic-related stress, anxiety, and depression have also been reported to increase the prevalence of TMD in the general population [3,4].

Oral dysphagia (OD) is a swallowing disorder that includes oropharyngeal dysphagia and a swallowing difficulty experienced at the stage of transferring food from the mouth to the oropharynx and esophagus for the start of the involuntary swallowing process [5,6]. Shaker reported the symptoms of OD to include difficulty gathering the bolus behind onto the tongue, hesitation, or inability to start swallowing, frequently repeated gulping, frequent throat clearing, and coughing during or after swallowing [5].

OD can be caused by chewing impairment, decreased mandibular range of movement, and changes in joint movements due to delayed TMD treatment or failure of treatment [7,8]. Pain and fatigue during chewing and impaired chewing associated with joint or muscle dysfunction are often reported in these patients [9]. The authors assumed that swallowing problems are formed secondary to chewing impairments in patients with TMD [10], and in a meta-analysis that examined the prevalence of OD in patients with TMD, 9.3% of patients had swallowing problems [11]. It has also been reported that a series of additional dysphagia signs and symptoms are commonly seen, primarily pain on chewing at a rate of 87.4% and muscle fatigue at 62% [12–14].

In a previous study by the current authors [8], which aimed to reveal the clinical differences between patients with TMD, it was determined that the jaw functionality, the presence and severity of dysphagia symptoms, and swallowing-related quality of life were worse in patients with TMD-related OD, compared to those without OD. Moreover, the tongue strength and endurance of all

CONTACT Hazel Çelik Güzel hguzel@bandirma.edu.tr Department of Physiotherapy and Rehabilitation, Faculty Vocational School of Health Services, Bandırma Onyedi Eylül University, Balıkesir, Turkey

TMD patients, with and without OD, were significantly lower than those of the healthy control group. The tongue is of great importance in swallowing and provides normal swallowing function. At the oral stage of swallowing, impairments in tongue shaping, coordination, and range of movement have negative effects [5,15]. Exercise and manual treatment methods combined with other therapeutic agents are widely used in TMD rehabilitation [16,17]. However, few studies have investigated accompanying problems [14,18,19] and treatment approaches [20] in TMD cases with coexistent oral stage swallowing problems. It has been emphasized that there is a need for effective approaches to swallowing problems in treating TMD [20,21].

In light of the current literature, this study aimed to reduce or eliminate pain and swallowing disorders using orofacial myofunctional therapy (OMT), targeting motor coordination of the tongue, lips, cheek, and surrounding structures in the presence of OD in patients with TMD, thereby improving patients' quality of life. The study hypothesis was that the OMT protocol would be more effective than exercise and manual therapy (MT) alone in reducing pain, developing jaw functionality, and improving swallowing-related quality of life in patients with TMD-related OD.

Materials and methods

Study design and participants

This randomized controlled study was conducted on patients aged 18–65 years diagnosed with TMD-related OD at Sanliurfa Viranşehir State Hospital between October 2019 and April 2021. This research was supported by the Hasan Kalyoncu University Scientific Research Project (no. SBF.003). This study was approved by the Human Research Ethics Committee of Hasan Kalyoncu University (decision no: 2019–131). All the study procedures conformed to the provisions of the World Medical Association Declaration of Helsinki. Written informed consent was obtained from all the participants. This study was registered in the WHO International Clinical Trials Registry Platform (NCT04636606).

The patients included were aged between 18–65 years, had scores of ≥ 4 on a visual analog scale (VAS), ≥3 points on the Eat Assessment Tool-10 (EAT-10), and verbally reported pain and difficulty in chewing and swallowing. All included patients had at least 28 permanent teeth and were examined according to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) [22]. Patients were excluded from the study if they had histories of surgery in the cervical region or related to TMJ problems, had trauma that could affect this region, had cancer, neurological problems, congenital anomalies, musculoskeletal or systemic problems, were receiving any treatment for problems involving the cervical region or TMJ during the evaluation or had any swallowing difficulty associated with a neurological disorder.

The severity of pain in the jaw region was evaluated using a VAS. The patients were instructed to mark the level of pain felt on a 10-cm line ranging from 0 (no pain) to 10 (intolerable pain) [23]. Each patient's maximum mouth opening (MMO) measurement was performed using a 15 cm ruler [24]. Head posture was evaluated using the craniovertebral angle and the angle in the horizontal plane between the earhole and the seventh cervical vertebra using a goniometer. A craniovertebral angle (CVA) <48° was considered a forward head posture (FHP) [25].

Tongue strength and endurance were evaluated using the Iowa Oral Performance Instrument in the anterior and posterior parts of the tongue [26]. To measure the pressure of the anterior tongue region, the ampoule was placed on the anterior hard palate, which is a midline suture of the hard palate located behind the central incisor teeth. Patients were instructed to press the ampoule with the tongue as hard as possible towards the hard palate for 2 seconds. For the posterior tongue region, the ampoule was placed on the anterior side of the posterior hard palate, a midline suture of the hard palate located in between the right and left first molars, and the patients were instructed to press the ampoule upwards without frowning or using their teeth and keeping their cheek and lip muscles relaxed. The highest value obtained from three trials was recorded as the maximum power (P_{max}). In the normal population, P_{max} falls in the 40–80 kPa range, with an average of ~ 63 kPa. Tongue endurance measurement was calculated as 50% of the maximum tongue pressure previously measured, and the patients were instructed to press at this value until they could hold the ampoule with the tongue toward the hard palate. With visual feedback, they were instructed to maintain a specified pressure to activate the device's green light, and the time for which this could be maintained was recorded using a chronometer.

To measure the functionality of jaw movements, the Jaw Function Limitation Scale-20 was used, the reliability and validity of which have been proven. This scale, designed to measure the degree of limitation of jaw function during different activities, consists of 20 items in areas of chewing, vertical jaw movements, and verbal and emotional expressions. The restrictions related to each item were evaluated on a scale numbered from 0–

10, where 0 = no restriction and 10 = severe restriction [27].

The EAT-10 scale was used to evaluate the symptoms and severity of dysphagia, which has proven validity and reliability [28,29]. This functional scale consists of 10 items, scored from 0 (no problem) to 4 points (severe problem). The total score can range from 0–40, with a total score ≥ 3 indicating a swallowing problem.

Patients' swallowing-related quality of life was evaluated using the Swallowing Quality of Life (Swal-QoL) Questionnaire [30]. The questionnaire included 10 concepts: general burden, food choice, eating duration, appetite, fear of eating, sleep, fatigue, communication, mental health, and social function. Higher scores indicate better quality of life. Since the creation of the Swal-QoL questionnaire, it has been used as a valid and reliable test for evaluating patients' quality of life in studies related to swallowing disorders [31].

A total of 51 patients who met the study inclusion criteria and were diagnosed with TMD-related OD were separated into three groups using a simple randomization method. The groups included 12 patients in the control group, 19 in the MT group, and 20 in the OMT group. The control group received patient education and a home-based exercise program. The MT group received MT in addition to patient education and a home exercise program. The OMT group received patient education, a home exercise program, MT, and an OMT program. MT and OMT were applied in two weekly sessions for 10 weeks (20 sessions in total) by a physiotherapist (HCG) with at least 7 years of clinical experience. Patients who completed 20 sessions were evaluated and followed up, then re-evaluated 3 months after treatment (Figure 1).

Instructions regarding the at-home exercises were given as a brochure, and the patients were instructed to perform these exercises 3 days a week for 10 weeks, with follow-up provided by weekly telephone calls. The home exercise program included tongue and mandibular resting position, chin tuck exercise, diaphragmatic breathing, relaxation and strengthening of chewing and cervical and back muscles, and posture exercises. The MT treatment program included friction massage to trigger points, the muscle-energy technique for the chewing and suboccipital muscles, mandibular fascia loosening, TMJ traction and gliding under traction, and manual mobilization of the cervical joint and soft tissues. In addition to the control group exercises and MT applications, OMT approaches were applied to the OMT group. The OMT program included education on difficult swallowing and tongue and mandibular resting positions, nasal breathing exercises, stretching of the tongue muscles and rotation exercises, strengthening exercises with palate pressure of the anterior and posterior regions of the tongue, strengthening of resistant tongue protrusion, and strengthening of the hyoid muscles with resistant chin-tuck exercises. A total of 20 sessions, each lasting 30–45 mins, were applied in two weekly sessions for 10 weeks to the MT and OMT groups.

Statistical analysis

The study sample size was calculated using G-Power software [32]. A sample size of 30 individuals was required to provide an effect size of 1.00 in the evaluation of the primary outcome of changes from pre- to post-treatment tongue strength, evaluated in a 95% confidence interval to give a study power of 80% with 5% Type 1 and 20% Type 2 margins of error. Allowing a dropout rate of 15%, 36 participants (12 in each group) were recruited for this study. Data obtained in the study were statistically analyzed using the IBM-SPSS version 25.0 for MacOS software. Variables determined by measurements were expressed as mean ± standard deviation (X±SD) and categorical variables as number (n) and percentage (%). The level of statistical significance was set at $p < .05$. Measurements obtained from the three groups were assessed using the Shapiro – Wilk test to determine conformity to a normal distribution, and the data were not normally distributed. In the comparisons of the changes over time from pre-treatment to post-treatment and three months post-treatment for the three groups, the non-parametric Friedman test was used. Wilcoxon paired tests were applied with Bonferroni correction (with statistical significance defined as $p < .017$) to determine the time points that created significant differences. The Kruskal – Wallis test was applied to determine the changes between the groups at the three time points. The chi-squared test was used in the cross-table analyses of the qualitative measurements of the three groups.

Results

The mean age of the study participants was 35.58 ± 6.35 years in the control group, 30.53 ± 7.56 years in the MT group, and 35.64 ± 8.87 years in the OMT group. The three groups were homogenous regarding age ($p = .092$), body mass index ($p = .310$), pain history ($p = .712$), sex ($p = .448$), marital status ($p = .184$), and RDC/TMD classification ($p = .450$). The demographic and clinical characteristics of the study groups are shown in Table 1.

Between-group comparisons of the respective VAS, MMO, and CVA values are shown in Table 2. In each of the three groups, the level of pain was reduced, and

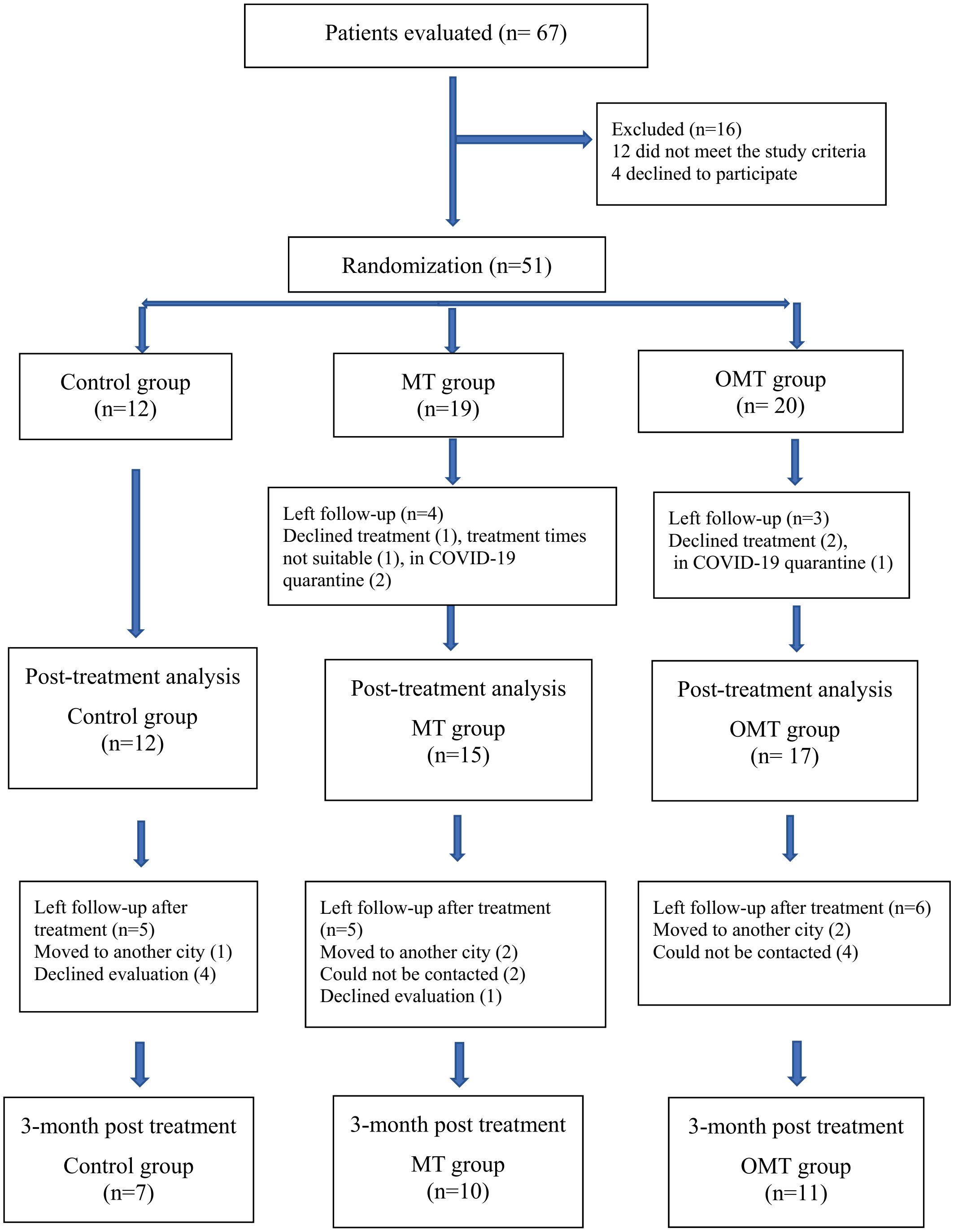

Figure 1. Flow chart.

the MMO and CVA increased after treatment and at the 3-month evaluation compared to the pre-treatment values ($p < .05$). After 10 weeks of treatment, the most significant reduction in pain was observed in the MT group, followed by that in the OMT group. At the 3-month follow-up evaluation, the pain levels decreased in the MT and OMT groups, and those in the OMT group were maintained at the lowest level ($p = .000$). A significant increase in MMO levels was observed after treatment in all groups ($p < .05$). The most significant increase in MMO was observed in the OMT group, followed by the MT group, and the difference was statistically significant at 3 months ($p = .029$). A statistically significant increase was observed in the craniovertebral angles after treatment in all three groups ($p < .05$). In comparisons between the groups, the difference in the craniovertebral angle values of the OMT group was statistically significant both after treatment ($p = .000$) and at 3 months post-treatment ($p = .001$).

Table 1. Sociodemographic and clinical data of the study participants.

Variables	Control Group n = 12 X±SD	MT Group n = 15 X±SD	OMT Group n = 17 X±SD	H	p^1
Age (years)	35.58 ± 6.35	30.53 ± 7.56	35.64 ± 8.87	4.768	0.092
BMI (kg/m^2)	23.51 ± 2.44	26.40 ± 5.45	24.87 ± 4.45	2.344	0.310
Duration of pain (years)	1.66 ± 1.35	2.42 ± 2.12	2.54 ± 2.32	0.679	0.712
N (%)				x^2	p^2
Sex					
Female	10 (83.3%)	12 (80%)	11 (65%)	1.605	0.448
Male	2 (16.7%)	3 (20%)	6 (35%)		
Marital Status					
Married	7 (58.3%)	5 (34%)	11 (65%)	3.387	0.184
Single	5 (41.7%)	10 (66%)	6 (35%)		
TMD Classification					
Group 1: Myofascial	6 (50%)	5 (33%)	3 (18%)	3.688	0.450
Group 2: Disc	3 (25%)	6 (40%)	7 (41%)		
Group 3: joint	3 (25%)	4 (27%)	7 (41%)		

p^1 : Kruskal Wallis Test, p^2 : Chi-Square Test, X: Mean, SD: Standard Deviation, TMD/DC: Temporomandibular dysfunction diagnosis criteria, MT: Manual Treatment, OMT: Orofacial Myofunctional Treatment, BMI: Body Mass Index.

Table 2. Comparisons of the pain, maximum mouth opening and craniovertebral angle values of the study groups.

		Control Group n = 12 X±SD	MT Group n = 15 X±SD	OMT Group n = 17 X±SD	H	p^1
VAS	PreT	5.42 ± 0.78	5.20 ± 1.22	5.36 ± 1.02	0.471	0.790
(cm)	PostT	1.85 ± 0.69	0.40 ± 0.51	0.54 ± 0.82	15.500	0.000*
	3 months	3.00 ± 0.81	0.90 ± 0.73	0.63 ± 0.80	15.382	0.000*
	p^2 (x^2)	0.001*(13.231)	0.000*(18.571)	0.000*(20.222)		
MMO	PreT	34.42 ± 4.61	33.50 ± 5.64	34.81 ± 4.51	1.496	0.473
(mm)	PostT	38.00 ± 3.21	40.80 ± 2.93	41.90 ± 3.47	5.152	0.076
	3 months	37.57 ± 2.93	40.50 ± 2.95	41.63 ± 3.44	7.052	0.029*
	p^2 (x^2)	0.004*(11.200)	0.000*(17.882)	0.000*(19.000)		
CVA	PreT	43.71 ± 1.88	45.30 ± 4.83	41.63 ± 8.39	1.291	0.524
(degree)	PostT	45.85 ± 2.54	51.60 ± 3.72	52.00 ± 2.48	16.230	0.000*
	3 months	44.85 ± 1.67	50.30 ± 2.49	50.90 ± 1.64	14.941	0.001*
	p^2 (x^2)	0.009*(9.333)	0.000*(18.865)	0.000*(18.667)		

**$p < .05$, p^1 : Kruskal Wallis Test, p^2 : Friedman Test, X: Mean, SD: Standard Deviation, PreT: Pre-treatment, PostT: Post-treatment; MT: Manual Treatment, OMT: Orofacial Myofunctional Treatment, VAS: Visual Analog Scale, MMO: Maximum Mouth Opening; CVA: Craniovertebral Angle.*

Table 3. Comparisons of tongue strength and endurance values of the study groups.

		Control Group n = 12 X±SD	MT Group n = 15 X±SD	OMT Group n = 17 X±SD	H	p^1
Anterior	PreT	41.00 ± 5.32	43.60 ± 10.29	42.63 ± 8.62	0.843	0.656
Tongue Strength	PostT	42.42 ± 5.09	45.90 ± 11.21	57.36 ± 9.16	16.955	0.000*
(kg/m^2)	3 months	41.57 ± 5.02	44.70 ± 9.18	55.18 ± 7.75	10.787	0.005*
	p^2 (x^2)	0.054(5.600)	0.152 (3.769)	0.000*(20.600)		
Posterior	PreT	36.14 ± 6.30	40.20 ± 11.43	35.36 ± 8.33	1.317	0.518
Tongue Strength	PostT	36.28 ± 6.12	40.90 ± 11.16	51.54 ± 8.91	16.354	0.000*
(kg/m^2)	3 months	33.42 ± 8.36	40.70 ± 10.19	49.54 ± 7.89	9.587	0.008*
	p^2 (x^2)	0.607(1.000)	0.692(1.797)	0.000*(20.600)		
Tongue Endurance (seconds)	PreT	21.00 ± 2.70	22.30 ± 5.88	18.90 ± 4.92	1.857	0.395
	PostT	21.57 ± 2.37	23.60 ± 7.13	26.81 ± 4.33	14.382	0.001*
	3 months	21.28 ± 2.42	22.80 ± 6.05	25.45 ± 4.88	4.022	0.134
	p^2 (x^2)	0.082(5.000)	0.074(5.200)	0.000*(20.486)		

**$p < .05$, p^1: Kruskal Wallis Test, p^2: Friedman Test, X: Mean, SD: Standard Deviation, PreT: Pre-treatment, PostT: Post-treatment; MT: Manual Treatment, OMT: Orofacial Myofunctional Treatment.*

Compared to the pre-treatment values, a statistically significant increase was observed in the OMT group's anterior tongue strength, posterior tongue strength, and tongue endurance values immediately and at 3 months post-treatment ($p < .05$). No significant changes were observed in the control and MT groups ($p > .05$; Table 3).

The JFLS, EAT-10, and Swal-QoL scores are presented in Table 4. Compared to the pre-treatment values, a significant decrease was observed in the JFLS

Table 4. Comparisons of the jaw function limitation, eating assessment, and swallowing-related quality of life values of the study groups.

		Control Group n = 12 X±SD	MT Group n = 15 X±SD	OMT Group n = 17 X±SD	H	p[1]
JFLS-20	PreT	37.28 ± 12.37	43.00 ± 17.65	47.45 ± 17.29	0.443	0.801
	PostT	22.71 ± 13.82	12.60 ± 4.47	7.72 ± 3.77	23.056	0.000*
	3 months	25.28 ± 11.68	14.60 ± 5.75	8.00 ± 3.74	16.166	0.000*
	p^2 (x^2)	0.002*(13.000)	0.000*(18.571)	0.000*(21.412)		
EAT-10	PreT	8.71 ± 2.05	11.20 ± 2.65	11.72 ± 7.00	1.053	0.591
	PostT	8.28 ± 1.60	8.20 ± 2.48	2.45 ± 2.50	24.800	0.000*
	3 months	8.42 ± 1.39	9.00 ± 2.26	2.90 ± 2.54	15.411	0.000*
	p^2 (x^2)	0.223(3.000)	0.000*(15.800)	0.000* (20.667)		
Swal-QoL	PreT	86.33 ± 8.74	82.82 ± 9.79	78.59 ± 13.06	0.433	0.805
	PostT	87.96 ± 7.57	86.61 ± 8.98	91.87 ± 5.87	8.660	0.013*
	3 months	87.33 ± 8.33	84.10 ± 9.54	91.49 ± 5.77	3.439	0.179
	p^2 (x^2)	0.050(6.000)	0.368(2.000)	0.000*(17.568)		

**p* < .05, p^1 : Kruskal Wallis Test, p^2 : Friedman Test, X: Mean, SD: Standard Deviation, PreT: Pre-treatment, PostT: Post-treatment; JFLS-20: Jaw Function Limitation Scale-20, EAT-10: Eating Assessment Tool-10, Swal-QoL: Swallowing-related Quality of Life questionnaire, MT: Manual Treatment, OMT: Orofacial Myofunctional Treatment.*

values after treatment and at 3 months post-treatment in all three groups, with the greatest improvement observed in the OMT group, followed by the MT group ($p = .000$). A significant decrease was observed in the EAT-10 values from pre-treatment to post-treatment and 3-month evaluations, with the greatest reduction in the OMT group, followed by the MT group ($p = .000$). No significant changes were observed in the control group ($p = .223$). Regarding the Swal-QoL values, a significant increase after treatment was observed only in the OMT group ($p = .000$).

In the control group, the decrease in pain, increased MMO and craniovertebral angle, and improved JFLS values were significant between the pre- and post-treatment conditions. In addition to these values in the MT group, a statistically significant difference was observed from pre-treatment to post-treatment concerning anterior tongue strength and EAT-10 scores ($p < .017$). Tongue strength gain could not be maintained at the 3-month evaluation in the MT group, and no gains were maintained in the control group ($p > .017$). In the OMT group, all improvements from pre- to post-treatment were statistically significant, and these improvements were maintained at the 3-month evaluation ($p < .017$; Table 5).

Table 5. Comparisons of the differences in the values of the groups between pre-treatment, post-treatment, and 3-month post-treatment.

		Control Group		MT Group		OMT Group	
		z	p	z	p	z	p
VAS	PreT- PostT	−3.176	0.001*	−3.434	0.001*	−3.741	0.000*
	PreT- 3 months	−2.388	0.017	−2.816	0.005*	−3.002	0.003*
MMO	PreT- PostT	−3.020	0.003*	−3.413	0.001*	−3.539	0.000*
	PreT- 3 months	−2.264	0.024	−2.829	0.005*	−2.812	0.005*
CVA	PreT- PostT	−2.913	0.004*	−3.416	0.001*	−3.521	0.000*
	PreT- 3 months	−2.000	0.046	−2.848	0.004*	−2.805	0.005*
Anterior Tongue Strength	PreT- PostT	−2.232	0.026	−2.536	0.011*	−3.627	0.000*
	PreT- 3 months	−1,633	0.102	−0.423	0.673	−2.938	0.003*
Posterior Tongue Strength	PreT- PostT	−1.414	0.157	−2.032	0.042	−3.625	0.000*
	PreT- 3 months	−0.447	0.655	−0.314	0.753	−2.936	0.003*
Tongue Endurance (seconds)	PreT- PostT	−1.633	0.102	−0.412	0.681	−3.626	0.000*
	PreT- 3 months	−1.414	0.157	−0.957	0.339	−2.943	0.003*
JFLS-20	PreT- PostT	−3.062	0.002*	−3.411	0.001*	−3.622	0.000*
	PreT- 3 months	−2.371	0.018	−2.805	0.005*	−2.934	0.003*
EAT-10	PreT- PostT	−1.826	0.068	−3.327	0.001*	−3.626	0.000*
	PreT- 3 months	−1.000	0.317	−2.546	0.011*	−2.941	0.003*
Swal-QoL	PreT- PostT	−1.604	0.109	−1.067	0.286	−3.623	0.000*
	PreT- 3 months	−1.342	0.180	−0.170	0.865	−2.845	0.004*

**p* <.05(Bonferroni Correction), p: Wilcoxon Test, PreT: Pre-treatment, PostT: Post-treatment, VAS: Visual Analog Scale, JFLS-20: Jaw Function Limitation Scale-20, EAT-10: Eating Assessment Tool-10, Swal-QoL: Swallowing-related Quality of Life questionnaire, MT: Manual Treatment, OMT: Orofacial Myofunctional Treatment.*

Discussion

This study aimed to investigate the effects of OMT exercises on individuals with TMD-related OD. The study results confirmed the hypothesis established before the study that OMT protocols would reduce pain in these patients, develop jaw functionality, and improve swallowing-related quality of life. After treatment, a decrease in pain severity, improvement in FHP, increased movement capacity of the mandible, and an improvement in jaw functionality was observed in all groups. Although improvements in swallowing disorders were observed in the group treated with MT and home exercises, the most effective improvement was seen in those treated with OMT in addition to home exercises and MT. The study results demonstrated that OMT was superior to MT and exercises alone in reducing swallowing difficulties.

The individuals in this study's three groups had similar characteristics concerning the pre-treatment parameters of age, sex, TMD classification, sociodemographic data, and evaluation parameters. Thus, homogeneity was provided in evaluating the results of the treatments applied to the three groups.

In a review that included studies published between 2006 and 2016 on rehabilitation strategies for TMD related to muscle exercises and MT to investigate the efficacy of muscle and oral motor rehabilitation for TMD, most treatments showed positive results in TMD patients [21]. However, these studies showed significant variability in the treatment recommendations and methodologies used to confirm the treatments' efficacy, and very few studies included control groups. Combined techniques (exercises related to the use of equipment to reduce pain) produced better treatment effects with a greater decrease in pain and improved mandibular movement. Consequently, despite the increasing number of studies related to TMD rehabilitation, there is still uncertainty regarding the best treatment technique and its real benefits.

In a systematic review of the efficacy of OMT in patients with TMD, OMT alone or in combination with other therapies was found to be effective in TMD treatment, and compared with other conservative treatments or a control group with no treatment applied, there was a significant decrease in pain severity [20]. Mulet et al. provided patient education to the control group and tongue, neck, jaw, and shoulder exercises to the study group. At the end of the study, a clinically and statistically significant decrease was observed in pain symptoms, with no difference between the groups and a clinically insignificant change in head posture [33]. In a study by De Felicio et al. of 20 patients with articular TMD, treatment was applied with an OMT program to 10 subjects and not to the other 10 as the control group. At the end of the study, the OMT group showed a decrease in odontological and orofacial symptoms and sensitivity to palpation of the chewing muscles; OMT was reported to reduce TMD symptoms by providing muscular coordination [34]. In another study, OMT's efficacy was compared to that of a stabilization splint in patients with TMD. Significantly better results were obtained in patients treated with OMT regarding the severity of muscle pain, frequency of headaches, and stomatognathic functions than in the group treated with a stabilization splint [35]. Machado et al. evaluated the efficacy of different treatments in 102 patients with chronic TMD and found that OMT combined with low-level laser treatment was more effective than low-level laser treatment alone in reducing TMD symptoms and rehabilitating orofacial functions [36]. The common finding of these studies is that although the scientific evidence is weak, OMT is effective in treating TMD with acceptable cost-benefit and risk-benefit rates [20]. Unlike previous studies, the OMT approach used in this study was applied together with patient education and MT. Thus, the results of this study can be considered important in showing the contribution of the OMT program to other treatment approaches.

In this study, a significant decrease in pain severity was observed in all three groups after treatment compared with the pre-treatment values. It has been previously reported that symptoms can increase in patients with chronic painful TMD [8,9]. The pain history in the three groups in the current study was homogenous. After treatment, the greatest improvement was observed in the OMT group. Thus, this study showed that OMT combined with MT was more effective in reducing pain than the application of exercises alone or with MT. In the 3-month follow-up evaluation, the greatest pain return was seen in the control group. In contrast, the OMT group maintained low pain levels immediately after treatment. The long-term inhibition of pain with the OMT protocol, including head-neck, jaw, tongue, lips, and swallowing exercises, in addition to MT and home exercises, suggested that the OMT treatment protocol was the most effective treatment for reducing pain severity in this patient group.

Forward head posture (FHP) is the most frequently observed form of deviation from the ideal posture. Several studies showing a relationship between FHP and TMD have emphasized the neurophysiological and biomechanical relationship between head posture and TMJ. It is thought that FHP pulls the mandible into retraction by causing tension in the suprahyoid muscles and thus causes TMJ dysfunction [37,38]. The suprahyoid muscles allow effective and correct movement of the hyolaryngeal complex during the oropharyngeal and pharyngeal phases of swallowing. FHP can negatively affect chewing and swallowing by disrupting the alignment and kinematics of these muscles [39]. This study found an anterior head tilt in the craniovertebral angle in all three groups before treatment. After treatment, all three groups showed improved anterior head posture and increased craniovertebral angle. The greatest increases were observed in the MT and OMT groups.

Moreover, while this improvement in head posture was maintained in the MT and OMT groups, it was not maintained in the control group. Both MT and OMT treatments were superior to the control group regarding the correction of FHP, which was attributed to the MT approach applied to the mandibular and cervical regions. It is thought that TMJ disc-condyle positioning improved FHP with loosening of the cervical fascia and mobilization of the cervical segments, together with stretching of the joint capsule and elimination of muscle spasm in the chewing region, which was maintained in the long term.

The tongue and TMJ are components of the stomatognathic system. Sufficient tongue strength and endurance are determining factors for safe and effective swallowing. Previous studies have reported tongue strength in the range of 40–80 kPa, with a mean of 63 kPa in the normal population [27]. Tongue strength values have been shown to have a Pmax value of > 34 kPa in 95% of the general population, including older adults [40]. Posterior tongue strength is generally 5–10% lower than anterior tongue strength [27]. It has been reported that there are still insufficient data on the normal distributions of tongue endurance in the normal population. Published studies show a mean endurance of approximately 30–35 seconds for the tongue [40,41]. An endurance of 10 seconds or shorter may signify that the patient has low endurance. It is reported in such cases, orofacial and tongue muscle fatigue causes oromotor motor problems in the patient [27,40–42].

It has been assumed that patients with chronic TMD may have irregular or weak tongue function [11–13,18]. In a recent study by the current authors, the tongue strength and endurance of all TMD patients with and without OD were significantly lower than those of a healthy control group [8]. In the current study, the pre-treatment tongue strength was measured as 41.00 ± 5.32 kPa in the control group, 43.60 ± 10.29 kPa in the MT group, and 42.63 ± 8.62 kPa in the OMT group, and these were below the average mean value. Following treatment, a significant increase in the anterior tongue strength was observed in the OMT group. In parallel with anterior tongue strength, an increase in posterior tongue strength and an improvement in tongue endurance were observed only in the OMT group. The increase in tongue strength in the OMT group was attributed to this group having the greatest pain inhibition as much as the effect of tongue strengthening and swallowing exercises.

Impaired chewing and associated pain and fatigue in chewing have been determined in adults with TMD [10,14]. Although previous research has determined chewing function disorders to be expected in this group, Huckabee et al. produced new findings in a 2018 study regarding the specific nature of these problems [10]. It was reported that chewing difficulties affected typical oral intake in up to 89% of participants; one in four participants experienced difficulties chewing food that usually required little or no effort. In addition, 90% of the study subjects reported pain while chewing, and 78% reported fatigue, which caused longer eating durations (72%) and decreased meal endurance (60%). Objectively, this study found that patients with TMD required a greater chewing cycle per bite than healthy individuals. This is potentially related to restricted mandibular movement in patients with TMD, and it has been hypothesized that bite strength and chewing could be affected. In addition, the need for a greater chewing cycle per bite could be related to the high levels of pain and fatigue experienced by this group because greater exerted effort could cause a greater level of discomfort.

In the current study, an improvement was observed in jaw functionality measured using the JFLS, with the greatest improvement observed in the OMT group, followed by the MT group. In the post-treatment 3-month follow-up evaluation, this gain was maintained in the MT and OMT groups but not in the control group. The greatest improvement was observed in the OMT group, which was interpreted as an effective improvement in chewing function with suprahyoid muscle activation and an increase in tongue pressure. The superiority of the MT and OMT approaches over exercise was demonstrated by the improvement in jaw functionality. In addition to functionality, although a significant increase was observed in all groups' MMO values after treatment compared to the pre-treatment values, the greatest increase was observed in the OMT group, followed by the MT group.

A previous study reported that 53% of adults with TMD had some degree of swallowing difficulty [14]. Despite severe difficulties reported by half of the study participants, the mean swallowing difficulty was moderate. The most frequently reported swallowing problems were oral remains (68%) and multiple swallows secondary to complications in the oropharyngeal passage (58%). In addition, the feeling of choking while swallowing was reported by 48% of subjects, coughing when swallowing by 31%, and difficulty eating hard solid food by 41% [14]. In another study, which supported these findings, the results showed that, on average, adults with TMD felt the need for more swallows per bite and showed less time per swallow compared to healthy normative values [10]. It has been suggested that swallowing at a high frequency could be related to weak chewing and the formation and cohesion of the bolus, leading to fragmented swallowing and difficulties in the oropharyngeal passage. This emphasizes the symbiotic nature of chewing and swallowing processes and reveals the need to consider all factors potentially contributing to eating and swallowing disorders in adults with TMD.

Total scores ≥ 3 obtained on the EAT-10 scale evaluating OD symptoms and severity showed the presence of a swallowing problem. Although a decrease was observed in the OD symptoms and severity in the MT and OMT groups after treatment, the greatest reduction was observed in the OMT group. These results were expected as the OMT group received education about strengthening the tongue and suprahyoid muscles. It was also thought that the decrease in dysphagia symptoms in the MT group may have been due to the increase in chewing functionality and decrease in restricted mandibular movement associated with the changes thought to have occurred in the suprahyoid muscles and hyoidal bone's position with the improvement in FHP and a reduced level of pain.

In a review published by Bitiniene et al., chronic pain, the most frequently observed symptom of TMD, could lead to psychological problems such as stress, anxiety, social isolation, and depression. Due to chronic pain, quality of life has been reported to diminish in patients with TMD [43]. It has been reported that psychosocial problems, eating, and swallowing problems associated with TMD diminish the quality of life [44]. In the current study, the swallowing-related quality of life of patients with TMD was evaluated using the Swal-QoL questionnaire. The analysis was performed with the total points of all subparameters. An improvement in Swal-QoL values (general burden, food choice, eating duration, appetite, fear of eating, sleep, fatigue, communication, mental health, and social function) was observed only in the OMT group.

The current study participants stated that they did not have sufficient information about which healthcare professionals they could consult to treat TMD problems and what should be done for a referral. Therefore, it can be considered that providing the necessary training on this subject to relevant healthcare professionals is essential for TMD patients to be informed and could be effective for them to access the necessary treatment.

There were some limitations to this study. First, video fluoroscopy or fiberoptic endoscopy for evaluation of the swallowing problems was not used. The fact that an objective measurement was not performed while evaluating the swallowing function can also be considered a limitation of the study. However, Logeman stated that instrumental evaluations were not necessary for swallowing oral origin issues and suggested that they were only required if the swallowing problems were of pharyngeal or laryngeal origin [45]. Moreover, we did not check for ankyloglossia, which might be a risk factor for OD [46]. Finally, there was a loss of data in the long-term follow-up due to the COVID-19 pandemic.

This study aimed to create a different perspective on the treatment approach for patients with TMD. Considering that OD symptoms can be seen, especially in the chronic period of TMD, an evaluation and treatment protocol can be developed. We consider that surveys or questionnaires that evaluate OD symptoms in TMD patients may be necessary. Thus, a more effective rehabilitation service can be presented to improve these patients' pain, disability, and functional status.

It may be recommended that future studies examining the effects of ankyloglossia on swallowing function, include a greater number of patients and investigating the results of long-term follow-up. There is a need for further randomized studies to strengthen the data obtained in this study under the COVID-19 pandemic restrictions. With this, a future study may be conducted on chewing training be used as a variable to see if oral dysphagia improves by targeting chewing. Training protocols being developed and studied may be beneficial to improve the quality of life of those having TMD with OD. As the results of this study demonstrated that OMT appears superior to MT and exercise alone in reducing OD and improving swallowing-related quality of life.

Acknowledgments

The authors would like to thank their patients who participated in the study.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the Bilimsel Araştırmalar Projesi (BAP, Turkey).

ORCID

Hazel Çelik Güzel PT, PhD http://orcid.org/0000-0001-6510-5012
Aysenur Tuncer PT, PhD http://orcid.org/0000-0002-5660-1134

Author contributors

All listed authors made valuable contributions to the development of this manuscript. Conception and Design: AT, HCG. Collection and assembly of data: HCG; Analysis and interpretation of the data: AT, HCG; Drafting of the article: AT, HCG, Critical revision of the article for important intellectual content and final edition of the manuscript: AT.

References

[1] Komiyama O, Kawara M, Arai M, et al. Posture correction as part of behavioural therapy in treatment of myofascial pain with limited opening. J Oral Rehabil. 1999;26(5):42835. doi: 10.1046/j.1365-2842.1999.00412.x.
[2] Bao Y, Sun Y, Meng S, et al. 2019-nCov epidemic: address mental health care to empower society. Lancet. 2020 22;395(10224):e37–e38. doi: 10.1016/S0140-6736(20)30309-3.
[3] Gaş S, Ekşi Özsoy H, Cesur Aydın K. The association between sleep quality, depression, anxiety and stress levels, and temporomandibular joint disorders among Turkish dental students during the COVID-19 pandemic. Cranio. 2021;5:1–6. doi: 10.1080/08869634.2021.1883364
[4] Qu X, Zhou XD. Psychological intervention for patients with oral disease during the pandemic period of COVID-19. Zhonghua Kou Qiang Yi Xue Za Zhi. 2020;55(4):235–240. doi: 10.3760/cma.j.cn112144-20200213-00053.
[5] Shaker R. Oropharyngeal dysphagia. Gastroenterol Hepatol (N Y). 2006;2(9):633–634.
[6] Shapiro J. Evaluation and treatment of swallowing disorders. Compr Ther. 2000;26(3):203–209. doi: 10.1007/s12019-000-0010-0.
[7] Bag AK, Gaddikeri S, Singhal A, et al. Imaging of the temporomandibular joint: an update. World J Radiol. 2014;6(8):567–582. doi: 10.4329/wjr.v6.i8.567.
[8] Celik Guzel H, Tuncer A. Evaluation of tongue strength and symptoms of oral dysphagia in patients accompanying temporomandibular disorder. Adv Rehab. 2021;35(4):9–16. doi: 10.5114/areh.2021.108004.
[9] Poveda Roda R, Bagan JV, Díaz Fernández JM, et al. Review of temporomandibular joint pathology. Part I: classification, epidemiology and risk factors. Med Oral Patol Oral Cir Bucal. 2007;12(4):E292–E298.
[10] Huckabee ML, McIntosh T, Fuller L, et al. The Test of Masticating and Swallowing Solids (TOMASS): reliability, validity and international normative data. Int J Lang Commun Disord. 2018;53(1):144–156. DOI:10.1111/1460-6984.12332
[11] Gilheaney Ó, Béchet S, Kerr P, et al. The prevalence of oral stage dysphagia in adults presenting with temporomandibular disorders: a systematic review and meta-analysis. Acta Odontol Scand. 2018;76(6):448–458. doi: 10.1080/00016357.2018.1424936
[12] de Felício CM, Medeiros AP, de Oliveira Melchior M, et al. Validity of the 'protocol of oro-facial myofunctional evaluation with scores' for young and adult subjects. J Oral Rehabil. 2012;39(10):744–753. doi: 10.1111/j.1365-2842.2012.02336.x.
[13] Weber P, Corrêa EC, Bolzan Gde P, et al. Chewing and swallowing in young women with temporomandibular disorder. Codas. 2013;25(4):375–380. doi: 10.1590/S2317-17822013005000005.
[14] Rosa RR, Bueno MDRS, Migliorucci RR, et al. Tongue function and swallowing in individuals with temporomandibular disorders. J Appl Oral Sci. 2020;28:e20190355. doi: 10.1590/1678-7757-2019-0355
[15] Logemann JA. Evaluation and treatment of swallowing disorders. 2nd ed. Austin, TX: Pro-Ed; 1998.
[16] Armijo-Olivo S, Pitance L, Singh V, et al. Effectiveness of manual therapy and therapeutic exercise for temporomandibular disorders: systematic review and meta-analysis. Phys Ther. 2016;96(1):9–25. doi: 10.2522/ptj.20140548.
[17] Tuncer AB, Ergun N, Tuncer AH, et al. Effectiveness of manual therapy and home physical therapy in patients with temporomandibular disorders: a randomized controlled trial. J Bodyw Mov Ther. 2013;17(3):302–308. doi: 10.1016/j.jbmt.2012.10.006.
[18] Marim GC, Machado BCZ, Trawitzki LVV, et al. Tongue strength, masticatory and swallowing dysfunction in patients with chronic temporomandibular disorder. Physiol Behav. 2019;210:112616. doi: 10.1016/j.physbeh.2019.112616
[19] Fassicollo CE, Machado BCZ, Garcia DM, et al. Swallowing changes related to chronic temporomandibular disorders. Clin Oral Investig. 2019;23(8):3287–3296. doi: 10.1007/s00784-018-2760-z.
[20] Melis M, Di Giosia M, Zawawi KH. Oral myofunctional therapy for the treatment of temporomandibular disorders: a systematic review. Cranio. 2022;40(1):41–47. doi: 10.1080/08869634.2019.1668996.
[21] Sassi FC, Silva AP, Santos RKS, et al. Oral motor rehabilitation for temporomandibular joint disorders: a systematic review. Audiol Commun Res. 2018;23:e1871. doi: 10.1590/2317-6431-2017-1871.
[22] Dworkin SF, Le Resche L. Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. J Craniomandib Disord. 1992;6(4):301–355.
[23] Bijur PE, Silver W, Gallagher EJ. Reliability of the visual analog scale for measurement of acute pain. Acad Emerg Med. 2001;8(12):1153–1157. doi: 10.1111/j.1553-2712.2001.tb01132.x.
[24] Okeson JP. Management of temporomandibular disorders and occlusion-E-Book. 8th ed. St. Louis, Missouri: Elsevier Health Sciences; 2019. pp. 26–52.
[25] Shaghayegh Fard B, Ahmadi A, Maroufi N, et al. Evaluation of forward head posture in sitting and standing positions. Eur Spine J. 2016;25(11):3577–3582. doi: 10.1007/s00586-015-4254-x.
[26] Solomon NP, Munson B. The effect of jaw position on measures of tongue strength and endurance. J Speech

Lang Hear Res. 2004;47(3):584–594. doi: 10.1044/1092-4388(2004/045).
[27] Ohrbach R, Larsson P, List T. The jaw functional limitation scale: development, reliability, and validity of 8-item and 20-item versions. J Orofac Pain. 2008;22(3):219–230.
[28] Belafsky PC, Mouadeb DA, Rees CJ, et al. Validity and reliability of the Eating Assessment Tool (EAT-10). Ann Otol Rhinol Laryngol. 2008;117(12):919–924. doi: 10.1177/000348940811701210
[29] Demir N, Serel Arslan S, İnal Ö, et al. Reliability and validity of the Turkish eating assessment tool (T-EAT-10). Dysphagia. 2016;31(5):644–649. doi: 10.1007/s00455-016-9723-9.
[30] Demir N, Serel Arslan S, İnal Ö, et al. Turkish version of swallow quality of life questionnaire: validity and reliability in Turkish population. Turk J Physiother Rehabil. 2015;27(1):19–24. doi: 10.21653/tfrd.271061.
[31] Roe JW, Leslie P, Drinnan MJ. Oropharyngeal dysphagia: the experience of patients with non-head and neck cancers receiving specialist palliative care. Palliat Med. 2007;21(7):567–574. doi: 10.1177/0269216307082656.
[32] Faul F, Erdfelder E, Lang AG, et al. G* Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods. 2007;39(2):175–191. doi: 10.3758/BF03193146
[33] Mulet M, Decker KL, Look JO, et al. A randomized clinical trial assessing the efficacy of adding 6 x 6 exercises to self-care for the treatment of masticatory myofascial pain. J Orofac Pain. 2007;21(4):318–328.
[34] de Felício CM, Melchior Mde O, Ferreira CL, et al. Otologic symptoms of temporomandibular disorder and effect of orofacial myofunctional therapy. Cranio. 2008;26(2):118–125. doi: 10.1179/crn.2008.016.
[35] de Felício CM, Melchior MD, da Silva MA, et al. Effects of orofacial myofunctional therapy on temporomandibular disorders. CRANIO®. 2010;28(4):249–259. doi: 10.1179/crn.2010.033.
[36] Machado BC, Mazzetto MO, Da Silva MA, et al. Effects of oral motor exercises and laser therapy on chronic temporomandibular disorders: a randomized study with follow-up. Lasers Med Sci. 2016;31(5):945–954. doi: 10.1007/s10103-016-1935-6.
[37] La Touche R, París-Alemany A, von Piekartz H, et al. The influence of cranio-cervical posture on maximal mouth opening and pressure pain threshold in patients with myofascial temporomandibular pain disorders. Clin J Pain. 2011;27(1):48–55.
[38] Ballenberger N, von Piekartz H, Paris-Alemany A, et al. Influence of different upper cervical positions on electromyography activity of the masticatory muscles. J Manipulative Physiol Ther. 2012;35(4):308–318.
[39] Winnberg A. Suprahyoid biomechanics and head posture. An electromyographic, videofluorographic and dynamographic study of hyo-mandibular function in man. Swed Dent J Suppl. 1987;46:1–173.
[40] Youmans SR, Youmans GL, Stierwalt JA. Differences in tongue strength across age and gender: is there a diminished strength reserve? Dysphagia. 2009;24(1):57–65.
[41] Stierwalt JA, Youmans SR. Tongue measures in individuals with normal and impaired swallowing. Am J Speech Lang Pathol. 2007;16(2):148–156.
[42] Youmans SR, Stierwalt JA. Measures of tongue function related to normal swallowing. Dysphagia. 2006;21(2):102–111.
[43] Bitiniene D, Zamaliauskiene R, Kubilius R, et al. Quality of life in patients with temporomandibular disorders. A systematic review. Stomatologija. 2018;20(1):3–9.
[44] Ferreira CLP, Sforza C, Rusconi FME, et al. Masticatory behaviour and chewing difficulties in young adults with temporomandibular disorders. J Oral Rehabil. 2019;46(6):533–540. doi: 10.1111/joor.12779.
[45] Logemann JA. Swallowing disorders. Best Pract Res Clin Gastroenterol. 2007;21(4):563–573. doi: 10.1016/j.bpg.2007.03.006.
[46] Moulton K, Seikel JA, Loftin JG. Examining the effects of ankyloglossia on swallowing function. Int J Orofl Myol. 2018;44(1):5–21. doi: 10.52010/ijom.2018.44.1.1.