Original Article

Efficacy of Oral Habit Amendment in Neck Pain Treatment

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Abstract

Background and Aim: Temporomandibular disorders (TMDs) can be associated with pain in other areas such as the neck. Multiple causes have been suggested for TMDs; parafunctional habits such as bruxism and clenching are among the most commonly suggested etiologies. This study aimed to assess the efficacy of the amendment of oral parafunctional habits in the improvement of TMDs and neck pain.

Materials and Methods: This before-and-after interventional study was conducted on 136 patients with TMDs, parafunctional habits, and neck pain. The patients were instructed on how to quit their parafunctional habits and were followed up for two months. The neck pain disability index (NPDI), anamnestic dysfunction index (Ai), and clinical dysfunction index (Di) of TMD were evaluated before and after the modification of parafunctional habits. Data were analyzed using paired Student's t-test, Wilcoxon, Mann-U-Whitney, Kruskal-Wallis, and Spearman tests. $P<0.05$ was considered significant.

Results: Most TMD patients were women (74.5%). The patients' scores significantly decreased from 4 to 1 in the Ai, from 8 to 1 in the Di, and from 49 to 25 in the NPDI two months after the intervention ($P<0.05$). There were no significant differences in the NPDI, Ai, and Di scores following the amendment of oral parafunctional habits between males and females or among different age ranges. Age did not significantly correlate with the changes in the NPDI, Ai, and Di scores after the improvement of oral parafunctional habits. The NPDI significantly correlated with the Ai score.

Conclusion: It seems that parafunctional habit modification improves TMDs and neck pain.

Key Words: Neck Pain, Bruxism, Temporomandibular Joint Disorders

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Introduction

Pain can be a symptom of a serious problem. Patients complaining of maxillofacial pains comprise a large portion of individuals presenting to oral medicine departments. These pains mostly have a dental origin. Among non-odontogenic pains, the pain of the temporomandibular joint (TMJ) is common. Temporomandibular disorders (TMDs) refer to all the disorders related to the masticatory system, and they are often associated with pain [1-3].

Half to one-third of adults report at least one symptom of TMDs, and more than half of them manifest one clinical symptom, which is often muscle tenderness [4-6]. Coordination of the central nervous system (CNS) with the musculoskeletal system is necessary for natural movements, the ability to bear loads, and protect the system from injury or trauma. Any factor that disrupts this coordination can impair the function of the neurosensory and motor systems and can result in poor articular control and abnormal movements [4-6].

Many studies have evaluated the etiology of TMJ diseases and mainly believe that TMDs are multifactorial [7]. TMDs may be related to malocclusion, parafunctional habits, stress, or trauma; however, the share of each of these factors in the development of TMDs has yet to be determined [8-12].

Evidence shows that psychological stress can increase parafunctional habits or non-physiological activities such as clenching and bruxism [4,5]. Parafunctional habits are the activities of the masticatory system that have no functional goal and play no role in mastication, deglutition, or speech. Parafunctional habits apply an excessive load to the masticatory system and consequently damage it. In stressful conditions, energy is generated in the body, which must be released in some way. Thus, stress not only causes TMD but also aggravates it via triggering parafunctional habits [4,5]. Each component of the masticatory system can bear the excess load to a certain extent due to the increased activity of the muscles. When these loads exceed the critical threshold, damage and destruction occur. When the weakest components of the masticatory system are the muscles of mastication, patients commonly complain of pain and tenderness of these muscles during jaw movements. This manifests as a limitation in mandibular movements due to pain. When the TMJs are the weakest components, pain and tenderness of these joints will occur. It has been shown that 89.3% of the patients had anxiety disorders associated with high muscle tone and pain [11-14].

Most epidemiologic studies on TMDs are descriptive, while longitudinal studies on TMDs are scarce. Thus, the incidence rate of TMDs has been often underestimated. Different percentages of TMD prevalence with variable clinical and non-clinical symptoms have been reported worldwide [15-17].

The first study on TMDs and their association with neck pain was conducted in 1976; this association has been confirmed in numerous studies [18,19]. In 2014, Walczyńska-Dragon et al [20] also confirmed the relationship of TMDs with body imbalance and neck pain.

Spinal cord pain is also common and is mainly due to musculoskeletal disorders. Most individuals have experienced this pain at least once in their lifetime and thus, it is considered as a normal part of the human life cycle [21]. In general, the spinal cord is a dynamic and unstable structure that is subjected to numerous stresses as well as internal and external pressures on a daily basis. Thus, it can be easily subjected to injury resulting in neck pain. According to the Panjabi's stability mode, this stabilizing system has three parts, ensuring segmental and global stability: (I) a passive part including the vertebrae, intervertebral disc, ligaments, and articular capsule; (II) an active part, which includes local muscles and global muscles, and (III) a neural control system [21].

In most cases, the main pathophysiological mechanism responsible for neck pain remains unrecognized. However, it is believed that neck pain is multifactorial [22]. Any problem in the biomechanics of muscles and joints can result in improper adaptive responses of the CNS. Also, studies show that neck pain mainly originates from the vertebrae, articular surfaces, muscles, ligaments, and intervertebral discs [23].

The prevalence of neck pain is increasing worldwide. This condition has numerous effects on the patients and their family, health system, and occupation. The mean prevalence of neck pain is 23.1% in the community, and it is more common among females [24]. Evidence shows that the type of occupation, a sedentary lifestyle with head in a flexed position, jobs with unsuitable physical conditions, unsuitable psychological conditions, job dissatisfaction, and cigarette smoking can all result in neck pain [24]. Also, TMDs have been reported to be among the causes of neck pain [18-20].

Since most patients presenting to oral medicine departments complain of TMDs, parafunctional habits, and sometimes neck pain due to muscle spasm, this study aimed to assess the efficacy of the amendment of parafunctional habits in the improvement of TMDs and neck pain.

Materials and Methods

The present study was a before-and-after clinical trial (IRCT201410091559). During 2012-2014, 320 patients presenting to the Oral Medicine Department of the School of Dentistry of Tehran University of Medical Sciences with maxillofacial pains (other than odontogenic pain) were examined, out of which, 275 were diagnosed with TMDs together with parafunctional habits according to the Helkimo's index [25]. Also, the patients and their companions were questioned about parafunctional habits such as bruxism and clenching. Of 275 patients, 226 also had neck pain according to the neck pain disability index (NPDI) [26]. Patients were asked about the history of using analgesics. Those with a history of neck trauma or under regular pharmaceutical therapy were excluded. Subjects with TMDs, parafunctional habits, and neck pain were chosen. The study protocol was thoroughly explained to the patients, and those willing to participate signed a written informed consent form.

Patients should quit their parafunctional habits in order for their maxillofacial pains to resolve. Thus, the patients were instructed to place their tongue behind their maxillary central incisors such that the tongue applied no pressure to oral and dental tissues (as when the letter N is pronounced). In this position, the distance between the upper and lower teeth must be a few millimeters, and the lips must be closed with minimal pressure. In this position, the freeway space is maintained. To naturalize this position, the patients were requested to set an alarm on their cell phones to remind them every five minutes to keep this position. Moreover, two text messages were sent to the patients weekly to remind them to maintain the freeway space.

The patients were examined again after one and two months, and the level of improvement of TMDs and the intensity and frequency of neck pain were assessed. During the study period, patients starting a new treatment other than the current one, those not receiving the reminders, and patients developing conditions affecting the intensity of their neck pain were excluded.

A total of 136 patients (90 females and 46 males) in the age range of 18 to 60 years remained in the study until the end of the intervention.

The TMDs affecting the patients were assessed through clinical examination and using the Helkimo's index [25] by taking medical and dental history as well as the occupational and social status of the patients along with the patient's age and clinical TMJ and muscle examinations.

The TMJ status was assessed by asking eight subjective questions (the anamnestic dysfunction index, Ai) regarding joint stiffness when waking up or during mandibular movements, joint noises just anterior to the ear, fatigue in the TMJs, discomfort when opening the mouth, history of jaw locking, pain in the TMJs or the muscles of mastication, pain when moving the mandible, and history of dislocation.

In objective examinations (the clinical dysfunction index, Di), the followings were assessed:

Assessment of the range of mandibular movements in the below-mentioned positions:

- The maximum mouth opening was measured from the incisal edge of the upper to that of the lower incisors using a graded tongue blade. In patients with deep-bite (overbite of more than 2 mm), the excess amount was added to the measured value. If the patient had an open bite (overbite less than 2 mm), this value was subtracted from the obtained number.
- Patients with a maximum opening more than 40 mm were scored zero, those with 30 to 39 mm maximum opening were scored one, and those with a maximum opening less than 30 mm were scored five.
- Measuring the maximum lateral (right and left) movements: For this purpose, the distance between the upper and lower midlines was measured using a graded tongue blade (before the measurement, the coincidence of the upper and lower midlines was evaluated). Maximum lateral movement over 7 mm was scored zero, lateral movement between 4 to 6 mm was scored one, and lateral movement between 0 to 3 mm was scored five.
- Measurement of the maximum protrusion: A graded tongue blade was used to measure the distance between the incisal edge of the maxillary incisors and that of the mandibular incisors in the horizontal dimension and in the maximum

protrusion. In class III patients, the amount of the primary protrusion was subtracted from the amount measured during the maximum protrusion. In class II patients, the amount of retrusion was added to the amount measured during the maximum protrusion. Maximum protrusion over 7 mm was scored zero, protrusion between 4 to 6 mm was scored one, and protrusion between 0 to 3 mm was scored five.

Assessment of mouth opening pattern:

The straight pattern was allocated a score of zero, jaw deviation to the right or left without returning to its normal position was given a score of one, and jaw deviation to the right or left with returning to the straight position was given a score of five.

Assessment of joint function:

The function of the joint was considered normal if the movements of the mandible were noise-free with smaller than 2 mm of deviation; this was scored zero. Moderate TMD was diagnosed based on mandibular movements with noises as well as more than 2 mm of deviation (score one). Patients were diagnosed with severe TMD in case of the presence of locking and luxation (score five).

Assessment of muscle tenderness:

- "No pain" was scored zero, "pain in one to three muscles" was scored one, and "pain in four muscles or more" was scored five.
- Muscles were palpated by fingertips with a gradually increasing pressure. The patients were requested to express whether they felt any difference in sensation between the two sides. The reaction of the muscles upon irritation was also assessed. The masseter, temporalis, medial and lateral pterygoids, digastric, mylohyoid, sternocleidomastoid (SCM), and trapezius muscles were examined.

Assessment of TMJ tenderness:

- The patients were assigned to three groups of no pain (score zero), pain during lateral palpation (score one), and pain during posterior palpation (score five).
- Lateral palpation was started anterior to the tragus, while posterior palpation of the joint was performed from inside the ear. The pain during lateral palpation has a muscular origin, while the pain during posterior palpation probably originates from the articular tissues.

Articular pain during mandibular movements:

The patients were divided into three groups of no pain in any movement (score zero), pain in one movement (score one), and pain in two or more movements (score five).

The assessment of neck pain was subjective, and the presence of neck pain (muscle spasm) was determined using the NPDI and following counseling with a neurologist [26]. The frequency of pain and the aggravating or relieving factors were also asked. The NPDI questionnaire contains 20 questions on factors affecting neck pain [26]. The patients answered each question based on a 0-10 scale. The patient selected one score depending on his/her status. Higher scores indicated worsening of the questioned condition.

Participants with the following exclusion criteria during the two-month period were excluded: Changes in regular pharmaceutical regimen and initiation of a new treatment regimen other than the protocol, and patients who did not receive the text messages and did not adhere to the self-management instructions for any reason.

Data collection tools:

The Ai included questions regarding the subjective symptoms of articular disorders.

The Di included clinical examination and the measurement of mandibular movements as well as palpation of the muscles and joints.

The occlusal index (OI) included the assessment of the teeth and occlusion. In this method, a score was allocated to each sign/symptom of TMD. Accordingly, TMD was classified as normal, mild, moderate, or severe. Also, to determine the severity of neck pain, the NPDI questionnaire was used, and the site of neck pain, its frequency, time of onset, aggravating factors, history of trauma, the dosage of analgesics, and the frequency of taking over-the-counter (OTC) pain medications were asked.

Sample size calculation:

Based on the results of a pilot study on 24 patients, in 20 cases, the numerical scale decreased by more than 2 units after the intervention. Thus, considering α=5% and d=7%, the minimum required sample size was calculated to be 135 using the Minitab sample size calculation software (version 15, Minitab Inc., State College, PA, USA). It should be noted that the required sample size to detect statistically significant differences after the intervention was slightly lower than this rate.

Statistical analysis:

Statistical analysis was done using SPSS software (version 16; SPSS Inc., Chicago, IL, USA). Data were statistically analyzed using paired Student's t-test (pre- and post-intervention mandibular mobility ranges), Wilcoxon test (pre- and post-intervention NPDI, Ai, and Di scores), Mann-U-Whitney test (comparison of changes in the NPDI, Ai, and Di scores between males and females), Kruskal-Wallis test (comparison of changes in the NPDI, Ai and Di scores among different age ranges), and Spearman test (the correlation between the parameters). P<0.05 was considered significant.

Results

The effect of the amendment of oral parafunctional habits on the NPDI, Ai, and Di scores is presented in Table 1. The NPDI, Ai, and Di scores significantly decreased following oral parafunctional habit modification (P<0.05).

Table 2 shows the efficacy of the amendment of oral parafunctional habits in terms of the mandibular mobility ranges; they significantly increased after the amendment (P<0.05).

There were no significant differences in the changes of the NPDI, Ai, and Di scores following oral parafunctional habit modification between males and females (Table 3) or among different age ranges (Table 4).

Age did not significantly correlate with the changes in the NPDI and Ai scores following the amendment of oral parafunctional habits. The NPDI score significantly correlated with the Ai score (Table 5).

Table 1. Comparison of neck pain disability index (NPDI), anamnestic dysfunction index (Ai), and clinical dysfunction index (Di) before and after oral parafunctional habit modification (intervention)

Parameter	Pre-intervention N(%)	Post-intervention N(%)	P-value
NPDI	49 (22)	25 (33)	0.0001*
Ai	4 (2)	1 (1)	0.0001*
Di	8 (10)	1 (1)	0.0001*

Data are expressed as median (interquartile range); *=Significant according to Wilcoxon test (P<0.05).

Table 2. Comparison of the mandibular mobility range (mm) before and after oral parafunctional habit modification (intervention)

Parameter	Pre-intervention	Post-intervention	P-value
Maximum mouth opening	34.49±0.54	38.99±0.42	0.0001*
Maximum right lateral movement	6.82±0.12	7.33±0.09	0.0001*
Maximum left lateral movement	6.71±0.13	7.36±0.09	0.0001*
Maximum protrusion	6.75±0.11	7.26±0.08	0.0001*

Data are expressed as mean±standard error of the mean (SEM); *=Significant according to paired Student's t-test (P<0.05).

Table 3. Comparison of neck pain disability index (NPDI), anamnestic dysfunction index (Ai), and clinical dysfunction index (Di) changes after oral parafunctional habit modification (intervention) between males and females; Wilcoxon test (P<0.05)

Parameter	Female N(%)	Male N(%)	P-value
NPDI	25 (33)	26 (31)	0.459
Ai	3 (2)	3 (2)	0.269
Di	6 (9.25)	5 (9)	0.364

Data are expressed as median (interquartile range)

Table 4. Comparison of neck pain disability index (NPDI), anamnestic dysfunction index (Ai), and clinical dysfunction index (Di) changes according to age after oral parafunctional habit modification (intervention); Kruskal-Wallis test (P<0.05)

Age range (year) / Parameter	10-19 N(%)	20-29 N(%)	30-39 N(%)	40-49 N(%)	50-59 N(%)	60-69 N(%)	P-value
NPDI	4 (35)	27 (31)	26 (20)	23 (30)	36 (16)	21 (46)	0.055
Ai	2 (1)	3 (2)	3 (1)	3 (1)	4 (4)	2 (1)	0.469
Di	3 (11)	6 (10)	7 (8)	5 (9)	7 (20)	7 (10)	0.941

Data are expressed as median (interquartile range)

Table 5. Correlation between age, neck pain disability index (NPDI), anamnestic dysfunction index (Ai), and clinical dysfunction index (Di) changes after oral parafunctional habit modification (intervention)

	NPDI	Ai	Di
Age	r=0.03; P=0.726	r=- 0.006; P=0.94	r=0.024; P=0.782
NPDI		r=0.221; P=0.01*	r=0.13; P=0.132
Ai			r=0.501; P=0.0001*

***=Significant**

Discussion

TMDs include a wide range of clinical problems with variable etiologies, history, and prognoses, affecting the muscles of mastication, TMJs, or both [2,3]. TMDs are often associated with pain, which may manifest as acute pain during the function of the jaws. The main symptoms of TMDs include pain and tenderness of the TMJs or the muscles of mastication, limited jaw movements, jaw deviation when opening or closing the mouth, and TMJ noises during jaw movements [27].

Back pain (neck, shoulder, and back) and TMDs affect motor systems; however, a correlation between the two has not yet been identified.

Nevertheless, several studies have reported the correlation between TMDs and neck pain in different populations [28]. In 2014, Silveira et al [28] used a questionnaire to assess TMDs and neck muscle tenderness. They reported that the prevalence of TMDs was significantly higher in craniofacial patients and those with neck pain [28]. Another study was conducted in 2014 on 60 TMD patients with cervical spinal pain using an occlusal splint with a three-month follow-up [20]; a significant association was found between the resolution of TMDs and decreased pain in the cervical spinal area as well as improved function [20].

Plesh et al [29] evaluated a number of personal complaints of neck trauma and its effect on TMD and muscle pain in a national health interview survey (NHIS). They reported that the incidence of TMDs increased with age, irrespective of gender, and had the greatest association with other common pains; they added that this condition is rarely seen alone [29]. In 2009, Wiesinger et al [30] assessed 616 patients using a questionnaire and reported that TMD and spinal pains may have the same risk factors and mutual effects.

Rantala et al [31] assessed the prevalence of TMDs and their correlation with neck pain in a Finnish population using a questionnaire. They reported a strong association between neck pain and TMDs. Also, it seemed that symptoms of TMD and pain in the TMJs were significantly associated with psychosocial occupational factors rather than the type of occupation [31].

The mechanism explaining the results of the above-mentioned studies may be as follows: Inside the muscles, muscle spindles exist in addition to muscle fibers (extrafusal muscle fibers). The extrafusal muscle fibers are innervated by the alpha (α) motor neurons, while the muscle spindle and intrafusal muscle fibers are innervated by the gamma motor neurons. Muscle spindle receptors play a role in movement control. These receptors send signals to the spine, cerebellum, brain cortex, and other parts of the nervous system for motor control. The responses of muscle spindles can be phasic or tonic. Fast tensions of the muscle spindle result in a phasic response, which leads to the contraction of the respective muscle via the action of the alpha (α) motor neurons. However, in static positions, stimulation of the secondary receptors occurs more frequently, which results in a tonic response. The secondary receptors are stimulated by static gamma motor neurons. Thus, it can be assumed that in subjects who constantly maintain their facial muscles in a contracted position, muscle spindle receptors are stimulated, resulting in the stimulation of motor centers in the face, neck, and spinal cord, leading to muscle contraction in these areas. In the long term, this process decreases the blood supply and results in muscle spasm and pain [32].

In a study by Soylu et al [14], 89.3% of the patients had anxiety disorders associated with an increase in muscle tone and pain.

Lim et al [19] have reported that painful and stressful conditions increase the risk of TMDs by four times.

Plesh et al [29] showed that the cumulative effect of stress causes TMJ and muscle pain. The conditions that cause stress are referred to as stressors. Stressors affect the body in different ways. They activate the hypothalamus, which increases the activity of the gamma efferent neurons, resulting in the contraction of the skeletal muscle fibers inside the muscle spindles; following this, the muscle spindle becomes sensitized to the level that even the slightest tension results in muscle contraction. Most stressful activities may result in increased activity of the muscles of mastication [9].

Evidence indicates a higher prevalence of TMDs in females. Some studies have reported that TMDs are 2-3.5 times more common in females than in males [6]. Several reasons have been proposed for the higher prevalence of TMDs among women such as more stressful conditions in women's lives and their sensitivity to problems, resulting in the development of parafunctional habits such as bruxism and clenching [6,7].

In the current study, 320 patients presenting to the Oral Medicine Department of the School of Dentistry of Tehran University of Medical Sciences were evaluated for the presence of TMDs, out of which, 275 were found to have TMDs; of which, 205 (74.5%) were females. This also indicates a higher prevalence of TMDs among females.

The assessment of the scores acquired by males and females in both questionnaires revealed that elimination of parafunctional habits (if done correctly) can efficiently improve TMDs, irrespective of gender.

It has been shown that parafunctional habit modification attenuates headaches and TMDs [33], which is in agreement with the findings of our study. Okeson [34] believes that parafunctional habits increase the intra-articular pressure, which increases muscle activity and applies a tensile load in an anterior and medial direction to the disc, resulting in thinning of the posterior segment of the disc and elongation of the posterior and inferior ligaments of the disc; disc displacement may eventually occur [34]. Also, during parafunctional movements, muscles remain in spasm for long; this isometric activity prevents adequate blood supply to the muscles and results in increased levels of carbon dioxide and metabolic products adjacent to muscle cells, leading to pain, fatigue, and muscle spasm [34].

Accordingly, we aimed to eliminate parafunctional habits to resolve TMDs and neck pain. It was explained to the patients that in order to resolve maxillofacial pains, parafunctional habits must be eliminated; these habits include clenching, bruxism, unilateral chewing, and gum chewing.

One major advantage of this treatment was its acceptance by the patients since it was free of charge and included no medication intake. It had no side effect and was therefore well accepted by the patients.

Patients of different ages participated in this study. Most TMD patients were in the age range of 20-29 years; thus, it seems that the prevalence of parafunctional habits is higher in this age range. The comparison of age groups yielded P>0.05, which indicated that the treatment and age were not significantly correlated. This finding shows that treatment will be effective in all age groups if performed correctly.

TMDs and neck pain were evaluated before and after the intervention at three time points using the Helkimo's index [25] and the NPDI [26]. At the final follow-up session, in the TMD questionnaire, patient scores decreased from 4 to 1 in the Ai section and from 8 to 1 in the Di section. This indicates that the intervention significantly improved TMDs; this treatment modality was based on education and self-care of patients and imposed no cost on them.

Considering the importance of the range of jaw movements compared to other symptoms of TMD in chewing, speech, deglutition, etc., this factor was separately evaluated quantitatively. The comparison of the mean values before and after the intervention revealed that the greatest change occurred in the maximum mouth opening. This is due to the fact that elimination of parafunctional habits prevents the contraction of the muscles of mastication and consequently increases the range of mandibular movements. Observing optimal clinical outcomes further motivated the patients to continue the treatment.

In the assessment of neck pain using the questionnaire, the pain score of the patients decreased from 49 to 25; this indicates the significant association of neck pain with parafunctional habits, which is justified by the muscle spindle theory described earlier [32]. By this treatment, non-physiological muscle contractions decreased; consequently, muscle spasm in other areas such as the neck was resolved. Stress is equal to energy. In stressful conditions, the energy generated in the body must be released in some way; thus, it may cause TMDs and even neck pain in some patients, according to the spindle theory described earlier [32].

In this study, we significantly improved TMDs and neck pain through the amendment of parafunctional habits. Also, a significant association was found between the improvement of TMDs and the resolution of neck pain.

Conclusion

It seems that the amendment of parafunctional habits improves TMDs and neck pain.

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