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Treating Parafunctional Habits for Alleviating Temporomandibular Disorder and Lower Back Pain: A Phase II Clinical Trial

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ABSTRACT

Objectives: Temporomandibular disorders (TMDs) include a series of signs and symptoms in the temporomandibular joints (TMJ) and muscles of mastication, which are associated with or caused by parafunctional habits. Many of these patients also suffer from lumbar pains. This study aimed to evaluate the effectiveness of treating parafunctional habits in alleviating symptoms of TMD and lower back pain.

Materials and Methods: This phase II clinical trial was conducted on 136 patients suffering from TMDs and lumbar pain, who consented to participate in this study. They were provided with instructions on how to discontinue their parafunctional habits including clenching and bruxism. The Helkimo and Rolland Morris questionnaires were used to assess TMD and lower back pain, respectively. Data were statistically analyzed using paired Student's t-test, Wilcoxon, Mann-Whitney, and Spearman correlation tests, with the significance level set at P<0.05.

Results: The mean severity score of TMD significantly decreased after the intervention. Following treatment of TMD, the mean severity score of lumbar pain decreased from 8 to 2 (P=0.0001).

Conclusion: Based on our findings, it appears that the elimination of parafunctional habits improves TMD and lumbar pain.

Keywords: Temporomandibular joint; Bruxism; Self Care; Lumbosacral Region; Pain

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INTRODUCTION

Pain is a significant concern in medicine and dentistry, often being a symptom or complication of a specific condition [1]. While dental pain typically originates from teeth, patients often seek oral and maxillofacial department (OMFD) care for temporo-mandibular joint (TMJ) pain or limited jaw movement. Temporomandibular disorder (TMD) includes a series of signs and symptoms in the TMJ or the muscles of mastication causing discomfort and concerns for the patients. These symptoms include muscle or TMJ pain, either spontaneously or upon palpation (tenderness), articular sounds, and jaw movement limitations in different directions. A diagnosis of TMD is often based on the presence of one or more of these symptoms [2,3].

Researchers have suggested several causes for TMD but mostly believe it to be multi-factorial [3]. TMJ disorders typically develop due to factors that affect muscle function (psychological factors, stress and, inflammatory conditions), increased functional loads (parafunction and bruxism), trauma, and systemic conditions [3-5].

Prior to 2002, malocclusion was believed to be the primary cause of TMD [6-8]. However, recent studies suggest that stress and psychological factors play a significant role in the development of TMD. [6-8]. Stress is a form of energy (psychophysiological theory) and in stressful conditions, energy is generated in the body and needs to be released which can cause or worsen TMD by triggering parafunctional habits [9,10]. The structures involved in mastication can only tolerate loads from increased muscle activity to a certain extent. If the applied loads exceed a critical threshold known as ‘structural tolerance’, destruction occurs. The first signs of destruction appear in components of the mastication system with the lowest structural tolerance; therefore, the site of injury varies from person to person [11,12]. Given that the muscles of mastication are the weakest components in this system, patients commonly complain of pain and tenderness of the muscles during jaw movements. This often manifests as mandibular movement limitation due to pain. Nail biting, chewing gum and, bruxism are among the harmful parafunctional habits that apply excessive loads to the dentition, jaws, and muscles of mastication [10].

Bruxism is a term used to describe the grinding or clenching of teeth, and although the cause of bruxism is unknown, stress and emotional pressure are considered to be important causes, especially considering its higher prevalence in young individuals compared to the elderly [13].

Clenching refers to bruxism semi-consciously while awake, which is often silent. Bruxism during sleep is characterized by involuntary grinding of teeth, which causes a sound and is referred to as grinding. Estimating the prevalence of bruxism when asleep is difficult because most patients do it unconsciously. Some have reported that bruxism occurs during all stages of sleep, while others believe that it only occurs during the REM (rapid eye movement) stage [13].

The vertebral column tolerates significant internal and external mechanical pressures during daily activities, making it susceptible to damage, especially in the lumbar region [14]. Lumbar pain, commonly referred to as backache, is a significant musculoskeletal disorder that affects individuals in developed and developing countries, causing disability, absence from work, and decreased efficiency. Evidence suggests that more than half of all individuals experience backache at least once in their lifetime [15].

Several factors are responsible for backache including anatomical, biomechanical, occupational and, psychological factors. According to Panjabi et al [16], the stability of the vertebral column is maintained by three main elements: the passive system, the active system, and the neural system. Dysfunction of any of these systems impairs the stability of the vertebral column and results in the subsequent development of backache. Several treatments have been proposed for backache including resting, physiotherapy, pharmaceutical therapy and, surgical procedures. However, no specific treatment has been recommended for backache and researchers often recommend a combination of available treatment strategies [17]. The first study on the correlation between TMD and backache was conducted in 2005 and its association has been confirmed in some recent studies [14,18-22]. Most patients presenting to OMFD with non-odontogenic pain are those suffering from TMD [23]. On clinical examination, these patients often have parafunctional habits and complain of pain in other body parts such as backache [21].

Considering all the above, this study aimed to assess the effectiveness of eliminating parafunctional habits, such as clenching and bruxism, in treating TMD and alleviating lower back pain.

MATERIALS AND METHODS

The ethics committee of the Tehran University of Medical Sciences approved the current study (IR.TUMS.REC.1394.1395). This phase II clinical trial (IRCTID: IRCT201410091559N5) was conducted on 300 patients presenting to the OMFD complaining of non-odontogenic pain. Patients aged 15 - 75 years, who had TMD according to the Helkimo's index [24], parafunctional habits (clenching and bruxism) along with TMD, and lumbar pains according to the criteria described by Rolland Morris [25] were included, and subjects with a history of trauma to their waist or TMJ, who were under regular pharmaceutical therapy for TMD and backache were excluded.

The Helkimo questionnaire is a commonly used tool for assessing TMD, consisting of two parts: Ai (Anamnestic Dysfunction Index) and Di (Clinical Dysfunction Index). The index evaluates TMD severity based on clinical criteria, such as muscle and joint pain, jaw movements, and pain during jaw movements. The Ai portion consists of eight yes/no questions, with a positive response scoring 1 and a negative response scoring 0. The Ai score is calculated by adding all scores and can range from 0 to 8. The Di portion of the Helkimo questionnaire includes nine items with scores ranging from 0-5, and seeks objective information about the range of mandibular movements, pattern of mouth opening, TMJ function, mastication muscles tenderness, and pain during mandibular movement. The total Di score can range from 0 to 45.

To assess mandibular movements, the patients were asked to perform maximum mouth opening, lateral movements, and protrusion while a graded tongue blade was used to measure the distance between various points. For maximum opening, the distance between the incisal edges of the upper and lower teeth was measured. For maximum right and left lateral movements, the distance between the midlines of the upper and lower central incisors was measured. The coincidence of the upper and lower midlines was first checked. For maximum protrusion, the horizontal distance between the incisal edges of the upper and lower teeth was measured.

The scale used to assess lumbar disability was subjective and involved confirming the presence of backache through consultation with a neurologist and the Rolland Morris questionnaire [25]. The questionnaire asked about the frequency of pain and factors that aggravate or alleviate it. The Rolland Morris questionnaire consists of 24 yes/no questions about daily activities, with each affirmative answer given a score of one. The total score can range from 0 to 24.

We evaluated bruxism and clenching habits using clinical diagnosis indicators recommended by the American Academy of Sleep Science [13]. Bruxism was diagnosed when either the patient was aware of it or someone sleeping next to the patient reported the sound of gnashing teeth during sleep. This habit, along with at least one of the following symptoms, was confirmed: abnormal tooth wear (especially in incisal edges or cusp tip), morning pain, stiffness, or fatigue in the masticatory muscles, and masseter muscle hypertrophy by palpation. As for clenching, definitive diagnostic criteria have not yet been established. In this study, patients were asked to close their mouths at rest, and after a few moments, the lips were isolated to check for teeth contact. The presence of a concave view on the lateral margins of the tongue (crenation) showing excessive pressure of the tongue on the teeth was examined.

After the initial examination and obtaining written consent, patients were informed that in order to alleviate their pain, they needed to quit their bruxism and clenching habits. They were instructed to keep their mastication muscles relaxed during the day by maintaining a freeway space between their upper and lower teeth, except when eating or sleeping. Patients were asked to place their tongue behind their maxillary central incisors, as if pronouncing the letter "N," and then gradually close their mouth until only a few millimeters of space remained between their upper and lower teeth, with minimal pressure on the lips. Patients were instructed to practice this position regularly to overcome their parafunctional habits and alleviate their muscle pain. Text messages were sent to patients every other day as reminders, and they were advised to set alarms on their cell phones every hour to remind them. Sticky notes were also suggested in areas where they spent the most time. Patients were scheduled for a two-month follow-up, during which they were contacted twice by phone to assess their progress and encourage them to continue practicing. At the end of the two-month period, patients were asked to complete the backache questionnaire again to evaluate the severity and frequency of their back pain. The TMJs and muscles of mastication were also examined to assess changes in the severity of TMDs.

Exclusion criteria during the two-month period included any changes in the patient's regular pharmaceutical regimen, initiation of a new treatment regimen other than our protocol, failure to receive the text messages, non-adherence to self-management instructions for any reason, incorrect contact information, and the development of conditions affecting the severity of pain during the study. Out of 300 patients, 250 had TMD along with parafunctional habits according to the Helkimo's index, and out of the 250, 190 had lumbar pain according to the Rolland Morris criteria. Patients were thoroughly informed about the study's duration and the importance of their cooperation, and those who gave their written informed consent underwent further examinations.

A total of 136 patients successfully completed the two-month study course, including 92 females and 44 males. Data were statistically analyzed using paired Student's t-test, Wilcoxon, Mann-Whitney, and Spearman correlation tests, with a significance level of P<0.05.

RESULTS

The Wilcoxon test showed that the median severity of subjective (Ai) and objective (Di) TMD scores, as well as lumbar disability scores, significantly decreased after intervention (P=0.0001; see Table 1). The Ai score decreased in 127 patients, increased in 7 patients, and remained unchanged in 2 patients. The Di score decreased in 126 patients and remained unchanged in 10 patients.

The Mann–Whitney test revealed that the median decrease in the severity of subjective (Ai) TMD and lumbar disability scores, but not objective (Di) TMD score, was significantly higher in females than in males after intervention (P=0.0001, P=0.01, and P=0.146, respectively; see Table 2).

The paired Student's t-test demonstrated that the mean maximum mouth opening, maximum right lateral movement, maximum left lateral movement, and maximum protrusion significantly increased after the elimination of parafunctional habits (P=0.0001; see Table 3).

Table 1. The median (inter quartile range) of lumbar disability and temporomandibular disorder (TMD) severity scores before and after elimination of parafunctional habits

Scores	Before intervention	After intervention	P
Lumbar disability	8(9)	2(4)	0.0001*
Ai TMD	4(2)	1(1)	0.0001*
Di TMD	9(6.75)	2(4)	0.0001*

Ai: anamnestic dysfunction index; Di: clinical dysfunction index
*Significant according to Wilcoxon test

Table 2. Median (inter quartile range) changes of lumbar disability and temporomandibular disorder scores in males and females

Score changes	Female (n=92)	Male (n=44)	P
Lumbar disability	7(6)	5(2)	0.01*
Ai TMD	3(2)	4(2)	0.0001*
Di TMD	7(6)	6(5)	0.146

Ai: anamnestic dysfunction index; Di: clinical dysfunction index
* Significant according to Mann–Whitney test

Table 3. Mean±standard error of mandibular mobility range (mm) before and after eliminating parafunctional habits

	Before	After	P
Max mouth opening	37.25±0.25	39.65±0.16	0.0001*
Max right lateral movement	5.76±0.12	6.99±0.08	0.0001*
Max left lateral movement	5.83±0.11	7.10±0.08	0.0001*
Max protrusion	4.45±0.13	6.10±0.08	0.0001*

Max: maximum
* Significant according to Paired student's t-test

Based on the Spearman's correlation test there was a significant correlation between age and lumbar disability score (r=0.353, P=0.001), between lumbar disability score and Di TMD score, r=0.199, P=0.02) and between Ai TMD score and Di TMD scores (r=0.328, P=0.0001). No relationship was found between age and Ai TMD score (r=0.118, P=0.112), age and Di TMD score (r=0.167, P=0.053).and between lumbar disability score and Ai TMD scores (r=0.042, P=0.63).

DISCUSSION

Most patients who present to the OMFD of the School of Dentistry, Tehran University of Medical Sciences, with complaints of non-odontogenic pain are those who suffer from TMD [23]. There are three main types of TMJ disorders that include: myofascial pain disorder, internal derangement of the joint and degenerative joint disease [23].

In our study, we evaluated myofascial pain disorder, the most common TMD which has been reported to demonstrate a prevalence of more than 50% [26]. The investigation included patients with myofascial pain disorder (TMD, according to Helkimo's index), without degenerative and internal derangement diseases (anterior disk displacement with reduction and without reduction), who also had lower back pain, which was confirmed by a neurologist as originating from muscle spasm. The patients' bruxism or clenching habits were also confirmed during an objective and subjective examination. These types of patients are known to complain of pain in other body parts, and parafunctional habits during clinical examination [21].

The relationship between TMD and backache has been previously examined in different studies. A matched case-control study using screening, a questionnaire, and clinical examination found a significant relationship between long-term lower back pain and musculoskeletal disorders and coexistence between the two diseases. In another case-control study, a significant correlation between the severity and frequency of spinal pain and TMD was reported and it was suggested that risk factors may be common among the two or they might affect each other. A 3-year prospective study applied a symptom report questionnaire at baseline and yearly intervals in 266 women aged 18 to 34 years with no TMD and indicated that 16 (6%) of them developed TMD. People with TMD, initially reported more experience of low back pain and pain in other areas than people without TMD. A cross-sectional retrospective study on 12,375 TMD patients observed a strong association between the presence of TMD and spinal pain. This association became stronger with increasing TMD severity, indicating a positive correlation between TMD severity and spinal pain [21]. The current study aimed to investigate whether improving TMD could also improve back pain when the association between TMD and backache is present.

Muscles contain muscle spindles and extrafusal muscle fibers, both of which are innervated by gamma motor neurons. The extrafusal fibers also receive innervation by alpha motor neurons. The receptors send signals for motor control to various parts of the nervous system including the spine, cerebellum, brain cortex, and other regions. Fast tensions of the muscle spindle result in a phasic response; however, in static positions, stimulation of secondary receptors occurs more frequently, leading to a tonic response. These secondary receptors are stimulated by static gamma motor neurons. The sensory and motor centers for the head and neck region are separate in the brain and follow the solitary pathway.

Involuntary actions in these regions are controlled by the nuclei in this pathway. To maintain balance, the axial muscles of the human body (including the head and vertebral column) contract simultaneously, and the contraction of each muscle is often associated with the contraction of others. Continuous contraction of muscles can decrease blood flow and stimulate pain receptors. As a result, patients who constantly maintain facial muscles in a contracted position can stimulate muscle spindle receptors, resulting in the stimulation of motor centers in the face and spinal cord and causing muscle contraction in these areas. Over time, this process can decrease blood supply, leading to muscle spasms and pain. This hypothesis provides evidence for the suggested mechanism behind the clinical association between backache and TMD [27].

Stressors are conditions that cause stress and activate the hypothalamus, which prepares the body to react. This activation increases the activity of gamma efferent neurons, leading to the contraction of skeletal muscle fibers inside the muscle spindles. As a result, the muscle spindle becomes sensitized to the point where even slight tension can trigger muscle contraction. In many cases, stressful activities can lead to increased muscle activity in the muscles of mastication [13]. Painful and stressful conditions increase the risk of TMD by four times [20]. Stress was shown to have a cumulative effect on pain associated with TMJ and muscle disorders [28]. Stress and anxiety are present in most patients with chronic pain, which emphasizes the role of psychological factors in the chronicity of pain [29]. Studies have shown that women are more prone to develop psychological conditions, have lower pain tolerance, and experience more stress throughout their lives, suggesting the significant role of mental health and psychological factors in the development of TMD [29, 30]. In our study, we found that 83% of TMD patients were women.

Following clenching or grinding, a long-term spasm of masticatory muscles occurs, which results in pain. On the other hand, increased intra-muscular pressure leads to hypertrophy of the muscles especially, the masseter muscle [10,31]. Two theories have been suggested for the occurrence of pain. The first one states that long-term contraction prevents blood supply to the muscle and consequently carbon dioxide and metabolic products accumulate in the muscle spindles and cause pain, which is quickly alleviated when the pressure is relieved by eliminating the occlusal contact and reinstating blood supply. The second hypothesis suggests that the continuous activation of multiple motor units with low thresholds can tolerate excessive load, but may become traumatized, leading to the destruction of ultrastructural muscle fibers and connective tissue. This can trigger inflammation, eventually causing pain and tenderness. This phenomenon is called delayed-onset muscle soreness [31]. In order to maintain balance, the axial muscles such as those of the head and vertebral column are simultaneously contracted and the contraction of each muscle is often associated with the contraction of others. Continuous contraction decreases the blood flow of the muscle and stimulates pain receptors [32]. TMD is rarely seen alone and can be associated with pain in other body parts such as backache [21].

To the best of our knowledge, this is the first interventional study to accomplish pain alleviation following treatment of parafunctional habits in patients with TMD and backache. Therefore, there is no similar research to compare. We showed that the mean subjective and objective TMD scores decreased after the elimination of parafunctional habits (Table 4). Also, a correlation existed between the subjective and objective components before and after treatment. Although TMJ pain and dysfunction may be due to several reasons, its primary treatment is often non-surgical and aims to decrease pain and inflammation of the joints and muscles and improve the function of the jaw. In fact, many patients with myofascial pain dysfunction syndrome and internal destruction of the joint recover without long-term or invasive treatments.

Thus, we eliminated parafunctional habits as a non-invasive cost-free method that was effective and had no side effects. However, in order for this modality to be effective, patients must fully cooperate and set reminders to keep reminding themselves to maintain the freeway space between their upper and lower teeth until a new healthy habit is formed. The

Table 4. Percentage of changes in the anamnestic dysfunction index (Ai) and clinical dysfunction index (Di) following intervention

	Questions	Worsening	Unchanged	Recovery
Temporomandibular disorder Ai	**Stiffness upon awakening or moving the mandible**	0	30.9	69.1
	Hearing sound in the joint at the front of the ear	5. 1	91.2	3.7
	Fatigue in the joint area	0	18.4	81.6
	Difficulty and discomfort when opening the mouth	0	49.3	50.7
	History of jaw locking	0	91.2	8.8
	History of jaw locking	0	29.4	70.6
	Pain during mandibular movements	0	65.4	34.6
	History of jaw dislocation	0	95.6	4.4
Temporomandibular disorder Di	**Maximum mouth opening**	1.4	44.9	53.6
	Maximum right lateral movement	0.7	63.2	36
	Maximum left lateral movement	2.2	61.8	36.1
	Maximum protrusion	2.2	47.8	50
	Mouth opening pattern	2.2	91.9	5.9
	Joint function	0.7	84.6	14.7
	Muscle pain on palpation	2.2	8.1	89.7
	Joint pain on palpation	0.7	44.9	54.4
	Pain in mandibular movements	0	60.3	39.8

reason for the lack of reduction or slight increase in TMD severity observed in a few patients, was probably due to the lack of cooperation and may not be due to treatment failure. Some patients showed reduced severity of TMD and backache in the first follow up; however, they did not continue to maintain the freeway space and the reduction trend did not continue to the second follow up and because of the continuation of parafunctional habits and their effects on the TMJ and muscles, the severity of TMD and, backache increased.

Our patients mostly complained of jaw movement limitation, which gradually improved after the elimination of parafunctional habits; this further encouraged them to adhere to treatment. We also found that tenderness and pain of the mastication muscles improved and the range of mandibular movements significantly increased in the last follow-up due to the elimination of bruxism and clenching. The lumbar disability score significantly decreased by elimination of parafunctional habits. By discontinuation of non-physiological spasms of the mastication muscles, lumbar muscle spasms decreased and backache subsequently subsided. The change in TMD and lumbar disability scores after treatment was significantly greater in women than in men, indicating a better response in female compared to male patients. This may indicate that women are more concerned about their health than men and the fact that they better accept and adhere to health instructions and thus, better cooperate to decrease their pain.

CONCLUSION

Parafunctional habits may be a potential cause of both TMD and back pain. It is possible that by addressing and eliminating TMD through self-care and instructing patients to quit parafunctional habits, lumbar pain may also be resolved. However, further studies with larger patient samples are needed to confirm these findings

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