Original Article

Treatment Outcome of Temporomandibular Disorder Patients Referred to the Department of Prosthodontics at Mashhad Dental School

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Abstract

Introduction: This study aimed to evaluate the treatment outcomes of patients with temporomandibular disorder (TMD). **Methods:** This cross-sectional study examined records of 165 TMD patients who referred to the Department of Prosthodontics at the Dental School of Mashhad University of Medical Sciences, Iran, from 2012 to 2017. Patients were recalled and clinically reexamined for reduced signs and symptoms or total improvement. Treatment outcomes were characterized as "improved" and "not improved" in terms of clicking sound and pain in the joint. The data were analyzed using SPSS software (version 18) using the Chi-squared and Fisher's exact tests at a significance level of less than 0.05 ($P<0.05$). **Results:** The subjects included 53 males (32.1%) and 112 females (67.9%) with a mean ±SD age of 31.7 ± 13.6 years. The patients with a locked mandible and joint sounds while opening their mouth or chewing recovered significantly. Moreover, a significant association was found between improvement and the absence of the anterior slide, and patients without an anterior slide improved better than those with the anterior slide ($P<0.05$). **Conclusion:** The use of conservative methods in the treatment of TMD is highly recommended regardless of factors such as age, gender, and clinical symptoms.

Keywords: Temporomandibular joint disorders, Treatment outcome, Pain, Stomatognathic system

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Introduction

Temporomandibular disorder (TMD) is a dysfunction in the head and neck region, manifesting as clinical symptoms such as pain, restriction on mandibular movements, deviation or deflection of the mandible and pathologic temporomandibular joint (TMJ) sounds (1). TMD symptoms have been observed in 41% of the general population. In terms of dental disorder prevalence, TMD is followed by dental caries and periodontal diseases (2). Studies have reported an annual incidence rate of 3.9% for TMD pain (3). Many studies have shown that TMD is more common among women between the ages of 20 and 50 years. TMD has also been frequently encountered and diagnosed in children (7–12 years old) and adolescents (12-19 years old) (7%-30%), and its prevalence gradually decreases with age (4-8). According to a national survey on 1,577 Finnish adults in 2019, over one third of the subjects were experiencing at least one TMD-related symptom (9).

TMD is a disease of multifactorial etiology, involving both physical and psychological aspects (10). TMJ anomalies include condylar hypoplasia, psychosomatic stress, macro and microtrauma (parafunctions, such as bruxism, clenching, and thumb thrusting), systemic diseases, such as internal disorders and rheumatoid arthritis (11). While some previously conducted studies consider occlusion-related factors including posterior crossbite, anterior open bite, Angle class II and III malocclusions, extreme overjet, and maximum intercuspation to be the main TMD signs and symptoms (8, 12); on the contrary, other studies do not support this opinion (13, 14). Therefore, TMD signs and symptoms

related to malocclusion are less understood, uncertain and viewed as insignificant (15, 16). The self-believed etiology of TMD for individual phenotypes has also been determined (17).

Typical TMD symptoms include facial pain and dysfunction of the masticatory system. Long-term epidemiological studies have shown that symptoms can recur even after 20 years (7).

Previous studies have investigated patients' characteristics (7, 11, 18) and treatment modalities (4, 5, 19), including the number of referrals, sociocultural factors, gender, age, severity and duration of symptoms, diagnosed clinical signs, number of visits, treatment time, treatment methods and their effectiveness.

Magnusson *et al.* (6) evaluated the signs and symptoms of 282 TMD patients (79 males and 203 females) treated with exercise therapy, occlusal adjustment, splint therapy, as well as a combination of several treatments. Symptoms included muscle tenderness (60%), clicking (27%), limitation of mandibular function (16%), and premature contact on the nonworking side (19%). Moreover, most of the patients recovered with no or mild persisting symptoms. However, improvement was not observed patients in some cases, which indicated the need for an extended treatment period. Brown *et al.* (4) evaluated the TMD treatment outcomes in treated, untreated, and under-treatment patients. The results showed that the symptoms did not improve over time in the untreated patients, while the treated patients recovered significantly over time, and disease recurrence was not reported in this group.

This cross-sectional study aimed to investigate the relationship between signs/symptoms and treatment outcomes in patients with TMD who referred to the Department of Prosthodontics at the Dental School of Mashhad University of Medical Sciences, Iran, between 2012 and 2017.

Materials and Methods

The archived records of 165 TMD patients who referred to the Department of Prosthodontics at the Dental School of Mashhad University of Medical Sciences, Iran, between 2012 and 2017 were examined in the present study. The inclusion criteria were patients who thoroughly completed demographic information questionnaires. However, those with incomplete questionnaires or incomplete course of treatment or follow-up were excluded from the study. The questionnaire contained demographic information, such as age and gender. The evaluated TMD symptoms are presented in Table I.

Table I. TMD symptoms questionnaire

1. Do you have difficulty or pain when opening your mouth, for example, when yawning?
2. Does your jaw get stuck, locked, or displaced?
3. Do you have difficulty or pain when chewing, talking, or using jaws?
4. Do you feel noises in the jaw joints?
5. Do you regularly feel stiffness, tightness, or tiredness in the jaws?
6. Do you have pain in or around your ears, temples, or cheeks?
7. Do you frequently experience headaches, neck aches, or toothaches?
8. Have you had a recent injury in the head, neck, or jaws?
9. Have you noticed any irregularities when biting?
10. Did you previously receive treatment for unexplained facial pain or jaw joint problems?

The questions regarding participants' habits concerned nocturnal sleep bruxism, clenching, playing specific musical instruments, tongue thrusting, biting lips or cheeks, biting external objects and nails and putting hands under the chin. Patients were then asked to mark their painful facial areas on schematic face drawings of the profile and lateral view (20).

According to research diagnostic criteria for TMD (RDC/TMD), the patients were clinically examined by an

experienced prosthodontist in a single-blind procedure (21). TMD signs that were assessed included facial symmetry, amount of mouth-opening in millimeters (interincisal distance+ overbite), restrictions in lateral movements, deviation, deflection, pain in the masseter muscle, temporal muscle and TMJ area. Pain intensity was evaluated using visual analog scale (VAS) scores. Joint popping sounds (e.g., crepitus and click) were checked. The presence of sounds was detected by bilateral palpation of the TMJ, with the left index finger positioned on the right TMJ and the right index finger on the left TMJ in the preauricular area, anterior to the auricular tragus. Angle class of occlusal scheme, anterior or lateral slide, tooth wear, premature contacts in centric and eccentric movements were evaluated as well. After establishing a final diagnosis (muscle disorder, condyle-disc complex disorder, or inflammatory disorder); an appropriate treatment plan was developed. Commonly applied treatment methods were determined, including interocclusal appliances, jaw exercises, physiotherapy, selective occlusal adjustment and pharmacotherapy.

All patients were recalled and reexamined clinically for reduced signs and symptoms or complete recovery. In the meantime, follow-up examinations were scheduled between treatment and recall appointments. Since the patients were monitored for five years, the follow-up period varied from six months to five years. The therapeutic results were rated as "improved" or "not improved" in jaw sound or pain.

All participants were thoroughly informed about the aims and methods of the study and signed written consent for the anonymous inclusion of their information. The study protocol was approved by the Ethics Committee of the Mashhad University of Medical Sciences, Mashhad, Iran (IR.mums.sd.REC.1394.284).

Kolmogorov–Smirnov test was used to assess the normality of the variables. Chi-squared and Fisher's exact tests were used to evaluate the association between the improvement and the patients' occlusion status. In addition, the Mann-Whitney test was employed to compare quantitative variables in improved and non-improved groups. The data were analyzed by a single-blind statistician using SPSS software (Version 18.0). A P-value less than 0.05 ($P<0.05$) was considered statistically significant.

Results

The study population included 53 (32.1%) males and 112 (67.9%) females with a mean age of 31.7±13.6 years and an age range of 12 to 70 years. The patients expressed TMD symptoms, including difficulty or pain during mouth opening (60.3%), chewing or talking (55.2%), pain in or around the ears, temple, or cheek (56.4%), intermittent headache, neckache or toothache (45.0 %), increasing pain after waking up (35.8%), aggravating pain in the evening (20.0%), history of trauma to the head, neck, or mandible (13.9%), history of locked jaw (43.0%), closed lock and not opening the mouth (29.1%), open lock (10.9%), sound during chewing or opening mouth (69.1%), changes in teeth closure (21.8%), and history of previous treatment for mandibular or facial pain (11.5%). More common habits of patients included placing a hand under their chin or one side of the face (38.2%), pressing teeth together during the day (38.2%), chewing gum (36.4%), grinding teeth at night (29.1%) and biting the lips or cheeks (27.9%). Less common habits included playing a specific musical instrument (6.1%), biting objects or nails (13.3%) and other habits (3.0%).

As for the occlusion types, the following results were obtained: class I without extraction (49.7%), deep overbite (18.8%), class I with extraction (12.7%), edge to edge (7.3%), open bite (2.4%), severe overjet (4.2%), and crossbite (6.1%). First tooth contact in centric relation (CR) revealed lateral slides (17.6%), anterior slides (17.0%), and severe tooth wear (9.1%). In total, 70.3%, 18.2%, 10.3%, and 1.2% of the patients had no CR slides, a slide size of less than 1 mm, a slide size of 1 to 2 mm, and a slide size of more than 2 mm, respectively. Moreover, 90.3% of the subjects had facial symmetry. Restrictions on lateral movements, deviation, and deflection were observed in 10.3%, 26.7%, and 16.4% of patients, respectively.

Regarding muscle pain, 13.3% of subjects had temporal pain and 18.8% had masseter pain during palpation (Table II). Moreover, 88.5% of patients had no pain during the load test. TMJ pain with gentle, moderate, and firm loading was observed in 5.5%, 4.8%, and 1.2% of patients, respectively. In terms of joint noise, 58.8% of patients had joint clicking and 5.5% had crepitus.

Table II. Frequency distribution of answers to questions about muscles pain during palpation

	Yes		No	
Questions	Number	Percentage	Number	Percentage
Right anterior temporal pain	13	7.9	152	92.1
Right median temporal pain	9	5.5	156	94.5
Right posterior temporal pain	4	2.4	161	97.6
Left anterior temporal pain	15	9.1	150	90.9
Left median temporal pain	11	6.7	154	93.4
Left posterior temporal pain	6	3.6	159	96.4
Right superficial masseter pain	18	10.8	147	86.9
Right deep masseter pain	9	5.5	156	94.5
Left superficial masseter pain	20	12.1	145	87.9
Left deep masseter pain	8	4.8	157	95.2

Description of quantitative study variables

The minimum and maximum recorded mouth openings were 2 and 65 mm, respectively, with a median of 43 mm and a mean ±SD of 41.3±10.6 mm. The minimum and maximum pain scores of right TMJ during opening the mouth were recorded to be 0 and 10, respectively, with a median of 0 and a mean ±SD of 2±0.7. The minimum and maximum pain scores of left TMJ during mouth opening were reported to be 0 and 10, respectively, with a median of 0 and a mean ±SD of 2.2±0.9. The right TMJ's minimum and maximum pain scores during functions were determined to be 0 and 10, respectively, with a median of 0 and a mean of 2.6±1.2. The left TMJ pain scores during function ranged from 0 to 10, with a median of 0 and a mean of 2.6±1.5. All pain level measurements were obtained using VAS evaluations.

In the final diagnosis, the rate of condyle-disc complex, muscular, muscular-condyle disc complex, and inflammatory disorders were estimated at 46.1%, 36.4%, 10.9%, and 6.7%, respectively.

A hard stabilization splint was fabricated for 47.9% of the patients. The prevalence of other treatment modalities is presented in Figure 1.

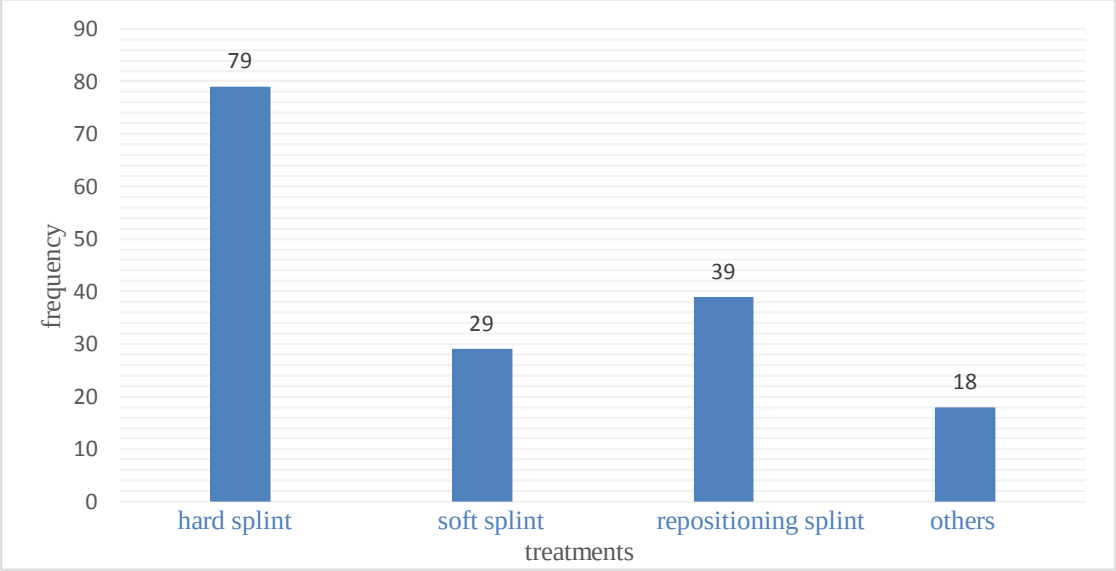

Figure 1. Frequency distribution of different types of treatments

Of all the subjects, 75.15% demonstrated improvements (66.03% of males and 76.78% of females) (Table III). Although the amount of improvement in TMD symptoms was greater among female patients than male patients, this difference was not statistically significant (P=0.145). The mean age of patients in the "improved" and "not improved" groups were about 32 and 31 years, and the difference was not statistically significant (P=0.707). Patients with a locked jaw and TMJ noises during chewing or mouth opening, demonstrated a significant improvement (P=0.012) compared to patients without these dysfunctions (P=0.033). No superior recovery was observed in patients reporting other symptoms than those without such symptoms. Furthermore, no association was found between improvement and habits, malocclusion, and muscle pain.

Table III: Frequency distribution of improvement in males and females

			Improvement		Total
			Yes	No	
	Male	Number	35	18	53
		Percentage	66.03	33.97	100
Gender	Female	Number	86	26	112
		Percentage	76.78	23.22	100
Total		Number	121	44	165
		Percentage	75.15	24.85	100
Chi-squared test result		$\chi^2 = 2.12$, P = 0.145			

However, a significant association was observed between improvement and the absence of an anterior slide, meaning that the patients with no anterior slide recovered better (P=0.033, Table IV). Patients without restriction in lateral movement, deviation, and deflection did not recover significantly. It was also found that there was no correlation between click or crepitus and improvement. In terms of improvement rates, the types of treatment were not statistically different**.** None of the quantitative variables were significantly different in the "improved" and "not improved" groups, except for the mean amount of pain on the left TMJ; which was significantly different between the two groups (P=0.05, Table V).

Table IV: Relationship between improvement and occlusion status

		Improvement				Total		
		Yes		No				
Occlusal examination	Occlusal sign	Number	Percentage	Number	Percentage	Number	Percentage	*P*-value*
Anterior slide	Yes	16	57.1	12	42.9	28	17	0.033†
	No	105	76.6	32	23.4	137	83	
Lateral slide	Yes	22	75.9	7	24.1	29	17.6	0.734†
	No	99	72.8	37	27.2	136	82.4	
Severe tooth wear	Yes	13	86.7	2	13.3	15	9.1	0.358‡
	No	108	72	42	28	150	90.9	

*Statistically significant at P < .050. †Chi-squared test. ‡Fisher's exact test

Table V: Quantitative variables between the "improved" and "not improved" groups

Variable	Improvement	Number	Mean	Standard deviation	Min	Max	Median	Mann-Whitney test
Mouth opening	Yes	65	2	10.3	41.1	121	43	z-scores =0.39 *P*-value =0.693
	No	44	41.7	11.6	4	65	43	
TMJ pain on the right side, based on VAS	Yes	121	0.7	1.9	0	9	0	z-scores =0.28*p*-value =0.780
	No	44	0.8	2.4	0	10	0	
TMJ pain on the left side, based on VAS	Yes	121	1.1	2.4	0	10	0	z-scores =1.96 *P*-value =0.05
	No	44	0.4	1.4	0	8	0	
TMJ pain on the right side, during the function, based on VAS	Yes	121	1.1	2.5	0	10	0	z-scores=1.16 *p*-value =0.245
	No	44	1.6	3.0	0	10	0	
TMJ pain on the left side, during the function, based on VAS	Yes	10	0	2.7	1.6	121	0	z-scores =1.50 *P*-value =0.133
	No	44	1.0	2.4	0	9	0	

Discussion

This retrospective study aimed to investigate the relationship between factors involved in TMD development and the improvement in TMD-related symptoms. According to the obtained results, female patients exhibited higher improvement rates compared to male patients. However, the difference between the number of recovered men and women was not Statistically significant. Although some studies have reported a correlation between gender and TMD development (9, 18), others do not support such a correlation (22, 23). Nevertheless, estrogen has been suggested to be a possible risk factor for TMJ diseases (24).

The mean age of patients who did and did not notice an improvement in symptoms was about 32 and 31 years, respectively; however, this difference was statistically insignificant. This confirmed that improvement of patients, regardless of their gender and age, was mainly

achieved through selecting a correct treatment method and the cooperation of people involved in the treatment process.

In total, 121 out of 165 patients improved in the present study, indicating a high rate of response to treatments, regardless of the applied treatment method. The improvement ratio of patients treated with various therapies, including hard splints, soft splints, repositioning splints, and other methods, such as physical therapy and occlusal adjustment showed no statistically significant difference. The most common treatment methods included hard, soft and repositioning occlusal splints. The results indicated that these three methods would yield positive results if used correctly and continuously. Comparing the treatments with these three methods does not give realistic results due to the small number of samples treated. The results of the present were consistent with other studies that suggested the use of conservative methods for treating TMD (10). In a systematic review conducted by Dinsdale *et al.* (25), conservative interventions (e.g., manual therapy, acupuncture, oral splinting, exercise, and drugs) were able to ameliorate bite function in TMD patients.

In total, 85% of patients recovered after treatment and less than 10% needed more than eight visits. This is consistent with the results of a study conducted by Anastasaki *et al.* (26). In other studies, at least two visits and a mean of 4.4 visits were reported as the necessary number of appointments for splint therapy (27, 28). It appears that the number of visits depends on the patients' age and the severity of symptoms at initial visit. Younger patients require fewer visits, this is most likely due to the fact that younger patients tend to show better adherence to the developed treatment plan.

Patients with a history of a locked mandible or joint noises when chewing or mouth opening improved significantly. They likely suffered from disc displacement disorders in the early stages, and the joint sound markings indicated some degree of condyle displacement on the disc. It was also observed that patients with condyle/disc disorder in the early stages responded better to conservative treatments, such as hard splints. On the other hand, no significant improvement was observed in people who had mandibular joint pain or a history of mandible locking in the open or closed-mouth position. This was probably due to the chronicity of the joint disorder or the more complex etiology of the disorder, which required an application of combination therapies and the study of patients' psychological problems and conservative treatments.

In this study, anterior slide was significantly associated with improvement, whereas no association was found between recovery and lateral slides, tooth wear, and malocclusions. Wang *et al.* assessed occlusal stability in young adults with TMD and reported a significant association between TMD and premature contacts (29). On the other hand, Emes *et al.* assessed the relationship between occlusal type, TMD, and the occurrence of complaints and found no significant correlation between premature contact and TMD (30). In a study by Ebrahimi *et al.* (31), TMD and related factors were evaluated in high school students, and premature contact was found to be one of the most common predisposing factors for TMD.

The effect of occlusion on TMD is a controversial subject in the literature. Berar *et al.* (22) highlighted the relationship between Angle class II malocclusion and the signs and symptoms of TMD. In addition, Dzingutė *et al.* (32) found a connection between the patients' complaints and TMD and static occlusion parameters. The center of the occlusal force distance and the asymmetry index of occlusal force in TMD patients with TMJ pain were significantly higher than those in the control group. Moreover, Nokar *et al.* (23) showed a significant relationship between the overall conditions of the patient's occlusion and the TMD signs and symptoms. However, according to Emes *et al.* (30) occlusal features, are not considered to have a significant role in the development of TMDs.

In the present study, muscle pain and improvement were not correlated; however, Berar *et al.* (22) reported that the pain in the masseter was one of the main signs of TMD. In addition, Conti *et al.* (19) concluded that using bilaterally balanced, canine guidance, and non-occluding splints can alleviate muscle pain in patients with disk displacement and TMJ pain. Conti *et al.* (33) gave patients anterior repositioning occlusal splints and devices for nociceptive trigeminal inhibition clenching suppression and consulted them about behavior change which led to reduced pain intensity. Akbulut *et al.* (34) Observed that using a 3mm splint for 12 months significantly reduced muscle and TMD pain. Pihut *et al.* (35) used anterior repositioning splint in patients with TMJ disc displacement and reported a significant reduction in the verbal numerical rating scale. In another study, patients diagnosed with disc displacement with reduction, were treated with jaw exercise intervention in combination with an information program. The results showed less mandibular locking and improved eating, mouth opening, and patient satisfaction. This program can be considered a cost-effective treatment approach as it has been delivered online (36). In another study, sclerosis was significantly correlated with pain, whereas sclerosis, osteophytes, and erosion had a significant relationship with joint crepitation (37).

Biofeedback-based cognitive-behavioral treatment is beneficial in reducing pain, indicating the psychological aspect of TMD management (38).

Since arthroscopy is a less invasive treatment method, it has been suggested to be applied prior to open surgery, which has been found to have a similar treatment outcome in candidate patients (39). Another study showed a relationship between clinical examination and self-reported results of patients at arthroscopy treatment follow-up, where about 75% of the patients felt TMD pain relief (40).

This study was carried out retrospectively using data from patients who referred to the Department of Prosthodontics at the Dental School of Mashhad University of Medical Sciences, Iran. The provision of patients' data from other public and private health care centers and clinics can lead to more realistic and accurate results. It is recommended that the treatment outcomes of patients with TMJ disorders at different ages be evaluated in a clinical study. Incorporating a larger sample size in future studies is also recommended.

Conclusion

Irreversible therapies, such as surgery or occlusal adjustment should be avoided in the early stages of TMD treatment. Instead, patients should be thoroughly

Conflict of interest

The authors declare no conflict of interest regarding the publication of this study.

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