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Factors Influencing the Duration of Occlusal Appliance Treatment for Patients with Temporomandibular Joint Internal Derangement

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Purpose: The purpose of this study is to determine factors influencing the duration of occlusal appliance (OA) treatment for patients with temporomandibular joint (TMJ) internal derangement.

Methods: Ninety patients were included for this study, who satisfied the following including criteria: (i) those who were diagnosed as disc displacement of TMJ by taking magnetic resonance imaging (MRI) and (ii) those who were finished OA treatment. The subjects were classified into three groups according to the period of OA treatment: (i) early response group (<6 months), (ii) moderate response group (6 months-1 year), and (iii) delayed response group (>1 year). Demographic data, data from chief complaints and past history of temporomandibular disorder, data from clinical examination and diagnostic imaging including panoramic view and TMJ MRI were compared among groups. One-way ANOVA and chi-square analysis were used to test statistical significance.

Results: There were no significant differences in demographic data, data from chief complaints and TMJ imaging. However, only the prevalence of oral parafunctional habits including bruxism, clenching, and unilateral chewing showed significant differences among groups.

Conclusions: Oral parafunctional habits could be factors to influence the duration of OA treatment in the patients with TMJ internal derangement.

Key Words: Conservative treatment; Occlusal appliance; Oral parafunction; Temporomandibular joint internal derangement

INTRODUCTION

Temporomandibular joint internal derangement (TMJID) describes an abnormal positional relationship of the articular disc to the mandibular condyle and the articular eminence. The disorder has been associated with characteristic clinical findings such as pain, joint sounds, and irregular or deviating jaw function.

It is generally accepted concept that temporomandibular disorder (TMD) is self-limiting and the natural course of disc displacement of the TMJ is relatively favorable and the management goals for TMJID are similar to those of other orthopedic conditions, namely, reduction of pain and adverse loading, improvement of function, and restoration of normal, daily activities. Several studies of conservatively treated patients showed that a series of fairly predictable adaptations were likely to occur in the majority of TMJID.[1] The emphasis should be on conservative treatment that facilitates the musculoskeletal system's natural healing capacity and treatment that involves the patient in the physical and behavioral management of their own problem. A multidisciplinary model that includes patient education and self-care, cognitive behavioral intervention, pharmacotherapy, physical therapy, and orthopedic appliance treatment is endorsed for the management of nearly all TMD patients.[2]

Among several noninvasive and reversible treatments,

occlusal appliance (OA) has been predominantly recommended for the TMD treatment.[3] The use of OA relieves the amount of load placed on the condyle and protects the TMJ and articular disc from degeneration as well as the excessive tension placed on the joint.[4] In the research of Fricton et al.,[3] it has been supported that a group treated with OA shows the highest efficacy compared to the groups either treated with non-occluding appliance or with no OA in patients with TMJ pain. Since the principles of mechanism and the efficiency of OAs have been proven in many researches, OAs are widely used as an initial and long-term treatment for TMD with pain.

Because clinical characteristics and other considerable contributing factors vary among patients, it is difficult to predict the outcome of conservative treatment, specifically OA treatment for TMD. There have been many studies on the comparisons on influential factors and predictive factors for the treatment outcome of TMD.[5] According to Ekberg and Nilner,[6] male patients showed more positive influence and severe pain at the initial visit showed more negative impact on the treatment outcome. Emshoff[7] had proposed the onset of pain is the most important factor determining the prognosis of OA treatment. In addition, Grossi et al.[8] concluded that neuropsychological and psychosocial problems yield poor treatment outcome. As mentioned above, several studies have been suggested that the treatment outcome may be affected by various factors, such as demographic factor, pain history, clinical findings and psychological problems.

Most patients wonder about the period of treatment and the frequency of their visits to dental clinics to conservatively treat and alleviate their TMJ problems at their first visit to the clinic. Yet, because it is difficult to propose the exact period of treatment to the patients according to their varying symptoms, some patients quit receiving the treatment when the period of the treatment is prolonged than they expected. Moreover, 10% of TMD patients show no sign of improvement despite their efforts and time spent. Surprisingly, this group of patients account for more than 40% of the expenses for the entire TMD patients.[5] Therefore, it is important for the clinicians to be able to distinguish patients who would respond to certain treatment and who would not, so that the optimal treatment option can be selected according to their varying symptoms to anticipate the best treatment results. However, there has been no attempt to predict the duration of the treatment based on patients' predisposing factors by dividing the patients into groups of different treatment termination period and analyzing clinical characteristics of each group. Moreover, although the duration of treatment with OAs to relieve symptoms can be generally expected with clinical experiences, it is difficult to accurately estimate how the period of treatment would change depending on each symptom.

We expect that patients would show improved patient's compliance without mid-treatment withdrawal if the treatment period of conservative treatment, specifically OA treatment, were predicted based on the information acquired at the patient's initial visit. The purpose of this study was to classify the patients with TMJID, who had received conservative treatments including OAs, into three groups of different response rates and to analyze various clinical factors observed at the initial visit of each group in order to predict the patient's treatment period with the factors.

MATERIALS AND METHODS

1. Subjects and Data Collection

Subjects in this study were selected from patients who visited the Department of Oral Medicine at Kyungpook National University Hospital (Daegu, Korea) with disc displacement in TMJ from January 2011 to March 2014. Ninety patients were included for this study, who satisfied the following including criteria: (i) those who were diagnosed as disc displacement of TMJ by taking magnetic resonance imaging (MRI) and (ii) those who were finished OA treatment. No subject had undergone invasive and surgical treatment. The subjects were classified into three groups according to the period of OA treatment: (i) early response group (<6 months), (ii) moderate response group (6 months-1 year), and (iii) delayed response group (>1 year).

The criteria of the end of treatment were as follows:

1) The pain or discomfort during TMJ movement or function is completely alleviated.
2) The normal activities of mandible are allowed.
3) Active range of motion (AROM) is greater than 38 mm.
4) No progressive sign of TMJ degenerative change.

The data were recorded when patients visited the Department of Oral Medicine at Kyungpook National University Hospital for the first time. The data were based on modified Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD). Demographic data, data from chief complaints and past history of TMD, data from clinical examination and diagnostic imaging including panoramic view and TMJ MRI were collected and compared among groups. Bruxism was exceptionally assessed by patient's questionnaire and wear facets of the OA (Table 1). The study protocol was approved by the Institutional Review Board of Kyungpook National University Hospital (KNUH 2015-11-025-001).

2. Statistical Analysis

The one-way ANOVA and the chi-square analysis were used to test differences between the early response group, the moderate response group and the delayed response group. The one-way ANOVA test was performed to compare the differences in age, onset of symptoms, visual analogue scale (VAS), AROM, overjet and overbite and the numbers of missing teeth between the three groups. The Pearson chi-square test was used to analyze the differences in extra factors between the three groups. A difference of $p<0.05$ was considered statistically significant. Statistical evaluation of the data was performed using the IBM SPSS Statistics ver. 22.0 for Windows (IBM Co., Armonk, NY, USA), including the one-way ANOVA test and the Pearson chi-square test.

RESULTS

There were no significant differences in demographic data, data from chief complaints and TMJ imaging. However, only the prevalence of oral parafunctional habits including bruxism, clenching, and unilateral chewing showed significant differences among groups (Tables 2, 3).

Table 1. Summary of factors collected of patient's initial visit

Category	Factor
Demographic data	Age, sex
Chief complaints	Pain, spontaneous pain, mouth opening limitation, joint sound
History of TMD	Onset of symptoms
	Initiating factors (facial trauma, long dental treatment, luxation of the jaw, etc.)
	Oral parafunctional habits: bruxism, clenching, unilateral chewing, unilateral posture (while sleeping), chewing gum
Clinical examination	Visual analogue scale
	Motions of mouth opening: active range of motion, deviation, deflection
	Tenderness of muscles: temporalis, masseter and TMJ
	Joint sound: clicking, crepitus
	Occlusion: Angle's classification, overjet, overbite
	Pain aggravation factors: while opening, chewing, stress
Diagnostic imaging data	Numbers of missing teeth
	TMJ MRI analysis

TMD, temporomandibular disorder; TMJ, temporomandibular joint; MRI, magnetic resonance imaging.

Table 2. Comparison of demographic data (n=90)

Demographic data	Response rate			
	Early response	Moderate response	Delayed response	p-value
Number of patients	30 (33.3)	30 (33.3)	30 (33.3)	
Female	25 (83.3)	23 (76.7)	22 (73.3)	0.638[a]
Male	5 (16.7)	7 (23.3)	8 (26.7)	
Mean age (y)	31.8	31.3	32.5	0.953[b]

Values are presented as number (%) or number only.
[a]Chi-square. [b]One-way ANOVA.

Table 3. Comparison of signs and symptoms

Sign and symptom	Response rate			p-value
	Early response (n=30)	Moderate response (n=30)	Delayed response (n=30)	
Chief complaints				
Pain	28 (93.3)	27 (90.0)	26 (86.7)	0.905[a]
Spontaneous pain	6 (20.0)	8 (26.7)	10 (33.3)	0.506[b]
Mouth opening limitation	13 (43.3)	18 (60.0)	13 (43.3)	0.329[b]
Joint sound	11 (36.7)	9 (30.0)	9 (30.0)	0.816[b]
History of TMD				
Onset of symptoms (over 6 mo)	12 (40.0)	10 (33.3)	7 (23.3)	0.380[b]
Initiating factors	8 (26.7)	8 (26.7)	5 (16.7)	0.572[b]
Oral parafunctional habits				
Bruxism	6 (20.0)	13 (43.3)	22 (73.3)	0.000[b]**
Clenching	6 (20.0)	5 (16.7)	14 (46.7)	0.018[b]*
Unilateral chewing	14 (46.7)	6 (20.0)	16 (53.3)	0.020[b]*
Unilateral posture (while sleeping)	6 (26.7)	2 (6.7)	7 (23.3)	0.106[b]
Chewing gum	4 (13.3)	4 (13.3)	2 (6.7)	0.763[a]
Clinical examination				
VAS	4.6	4.7	4.9	0.781[c]
Motions of mouth opening				
AROM (mm)	38.6	32.7	35.5	0.028[c]*
Deviation	2 (6.7)	2 (6.7)	1 (3.3)	1.000[a]
Deflection	3 (10.0)	5 (16.7)	10 (33.3)	0.067[b]
Tenderness of muscles				
Temporalis	1 (3.3)	3 (10.0)	5 (16.7)	0.284[a]
Masseter	7 (23.3)	4 (13.3)	8 (26.7)	0.420[b]
TMJ	13 (43.3)	10 (33.3)	12 (40.0)	0.721[b]
Joint sound				
Clicking	11 (36.7)	4 (13.3)	7 (23.3)	0.108[b]
Crepitus	5 (16.7)	1 (3.3)	2 (6.7)	0.263[a]
Occlusion				
Angle's classification				
Class I	23 (76.7)	23 (76.7)	24 (80.0)	
Class II	2 (6.7)	2 (6.7)	3 (10.0)	0.939[a]
Class III	5 (16.7)	5 (16.7)	3 (10.0)	
Overjet (mm)	3.4	3.1	2.8	0.486[c]
Overbite (mm)	2.2	2.4	2.1	0.780[c]
Pain aggravation factors				
Opening	10 (33.3)	12 (40.0)	12 (40.0)	0.828[b]
Chewing	22 (73.3)	21 (70.0)	26 (86.7)	0.271[b]
Stress	3 (10.0)	3 (10.0)	5 (16.7)	0.780[a]
Diagnostic imaging				
Numbers of missing teeth	1.3	0.4	0.5	0.163[c]
TMJ MRI analysis				
DD w/ R	9 (30.0)	6 (20.0)	7 (23.3)	0.656[b]
DD w/o R	21 (70.0)	24 (80.0)	23 (76.7)	

TMD, temporomandibular disorder; VAS, visual analogue scale; AROM, active range of motion; TMJ, temporomandibular joint; MRI, magnetic resonance imaging; DD w/ R, disc displacement with reduction; DD w/o R, disc displacement without reduction.
Values are presented as number (%) or mean number only.
[a]Fisher exact. [b]Chi-square. [c]One-way ANOVA.
*p<0.05. **p<0.001.

1. Demographic Data

Of the total 90 patients, 70 was females and 20 was male. There was no gender difference in the patient of all three groups. There were no statistically significant differences in age of patient between group means as determined by one-way ANOVA ($F(2,87)=0.048$, $p=0.953$) even though the oldest was in delayed response group and the youngest was in early response group.

2. Chief Complaints

1) Pain and spontaneous pain

Pain was observed the highest in early response group as 93.3% and the lowest in delayed response as 86.7%. There was no significant difference in all groups. In spontaneous pain, the highest in delayed group was observed without a significant difference.

2) Mouth opening limitation and joint sound

There was no significant difference between mouth opening limitation and joint sound, while being the highest in early response group.

3. History of TMD

1) Onset of symptoms (over 6 months)

There was no significant difference in onsets of TMD between each group, although it gradually increased from delayed response group to early response group.

2) Initiating factors

There was no significant difference in initiating factors between each group, despite the lowest was in delayed response group.

3) Oral parafunctional habits

Bruxism and clenching in delayed response group were significantly higher than those in the other groups. There was significant difference in unilateral chewing between in all three groups. There was no significant difference in unilateral posture (while sleeping) and chewing gum between each group.

4. Clinical Examination

1) VAS

The average of VAS was 4.7 and there were no statistically significant differences in VAS between group means as determined by one-way ANOVA ($F(2,87)=0.248$, $p=0.781$).

2) Motions of mouth opening

AROM in moderate response group was significantly lower than AROM in early response group. There was statistically significant difference in AROM between groups as determined by one-way ANOVA ($F(2,87)=3.741$, $p=0.028$). Post hoc comparisons using the Tukey honestly significant differences (HSD) test indicated the the mean score of the moderate response group (32.73 ± 8.60) was significantly different than the early response group (38.63 ± 7.94). However, the delayed response group (35.47 ± 8.53) did not significantly differ from the moderate and early response groups.

While there was no significant difference in deviation and deflection between each group, deflection was most frequently observed in delayed response group.

3) Tenderness of muscles

Despite the response rate depending on tenderness of masseter muscle and temporalis muscle scored the highest in delayed response group, there was no significant difference between all groups.

4) Joint sound

Clicking and crepitus scored the highest in early response group, but there was no significant difference between the groups.

5) Occlusion

(1) Angle's classification

Class I was observed most frequently than the other classifications in all response groups, but there was no significant difference between the groups.

(2) Overjet and overbite

There was no statistically significant differences in overjet and overbite between group means as determined by one-way ANOVA (overjet, $F(2,87)=0.727$, $p=0.486$; overbite, $F(2,87)=0.249$, $p=0.780$).

6) Pain aggravation factors

Stress was scored the highest that aggravates pain in delayed response group, but there was no significant difference between the groups. There was no significant difference in opening and chewing between the groups.

5. Diagnostic Imaging

1) Numbers of missing teeth

There was no statistically significant differences in numbers of missing teeth between group means as determined by one-way ANOVA ($F(2,87)=1.850$, $p=0.163$).

2) TMJ MRI analysis

Although disc displacement without reduction (DD w/o R) constituted higher than disc displacement with reduction (DD w/ R) in every group, there was no significant difference in DD w/ R and DD w/o R.

DISCUSSION

TMJID is the most common form of temporomandibular disorders, which shows clinical symptoms and signs such as pain, joint sounds, and irregular or deviating jaw function. TMJID appears when the positional relationship of the articular disc to the mandibular condyle change. The primary treatment of TMJID, including conservative and non-surgical treatments, should be emphasized on the reduction of pain and the improvement of mouth opening.[9] Conservative treatment involves patient education, pharmacotherapy, physical therapy, and OA treatment. OA allows TMJ to be replaced in the most orthopedically stable position and establishes optimal occlusal condition that restructures myoneural reflex, which consequently reinforces normal myofunction and diminishes abnormal muscular activities.[10] In several studies regarding the effectiveness of treatment with OAs in TMJID patients, it has been suggested that the treatment outcome may or may not be influenced by numerous factors, such as demographic factor, pain history, clinical findings and psychological problems.

Our results showed that there were no significant differences in demographic data, data from chief complaints and diagnostic imaging. However, only the prevalence of oral parafunctional habits including bruxism, clenching, and unilateral chewing showed significant difference among groups. Before conducting the study, it was predicted that the more severe the initial symptoms presented, the more delayed response rate for the treatment would be. However, there was no significant difference between most of the initial symptoms and treatment response rate. In previous study, Emshoff[9] reported that the time since pain onset is a critical factor determining the prognosis of OA treatment. Additionally, it was supported that the patients with chronic pain lasting longer than 6 months were much more difficult to treat because they often accompany muscle disorders.[11] Furthermore, pain severity, considered as a negative factor affecting the treatment of TMD, is suggested as a significant factor predicting the treatment outcome.[6,7] According to Clark et al.,[12] the treatment responses to physical medicine and OA were much lower when the degree of jaw function interference was more severe. Although several studies mentioned above revealed that the onset of symptom, pain severity, and jaw function limitation are important factors in determining therapeutic outcome, in this study, it was difficult to find a significant difference between the groups in most of the initial symptoms.

The reasons for dissimilarity between the results of our study and the anticipated results or the results of previously investigated studies may be contributed to the multidimensional nature of the etiologies of TMD, patients' psychological factors that could not be included in the study, differences in patients' compliance to the treatment, the limitation of retrospective study of failing to rule out the influence of other conservative treatments, and the differences between the clinicians in regard to the termination of the treatments. Since the etiology of TMD is multidimensional, various factors, including biomechanical, neuromuscular, biopsychosocial, and neurobiological factors, may affect the disorder as predisposing, initiating and aggravating factors.[2,13] Furthermore, it is suggested that when a patient accumulates various factors, even if each of these factors is not particularly intense, the effect of all these factors together may exceed the threshold to induce pain.[14] In the same context, it can be understood from our study that because various factors influence one another and accumulation of these factors cause TMD symptoms, it is difficult to simply distinguish the clinical factors at the initial visit

as positive or negative factors by means of their intensities and existence.

Psychological factor in TMJID patients was not considered in the present study. In the research of Grossi et al.,[8] neuropsychologic and psychosocial assessments of TMD patients showed none or low level of response to treatments when the patients were predisposed to greater memory deficits, sleep disturbances, depression, fatigue and lower energy levels. Moreover, it was reported that distinguishing the responders and non-responders with maximum inter-incisal opening and muscle tenderness were difficult to measure.[8] Further, Gale and Funch[15] demonstrated that psychosocial factors are more important factor than clinical and demographic factors in predicting the treatment efficiency. As responses to treatments that are affected by psychosocial factors, health locus and patients' compliance to treatments also influence the treatment outcomes. Wig et al.[16] suggested that if a patient had a greater pain and limited TMJ movement at the initial visit, the level of compliance of the patient becomes higher. Likewise, more severe symptoms of a patient motivate oneself to carry out the treatment recommendations more thoroughly to relieve the symptoms.[16] Thus, it may be assumed that the reason for the result of this study not showing slow response rate to the treatment depending on the severity of initial symptoms is that samples with fair patients' compliance are unaffected by the severity of the symptoms and show rapid response rate to the treatment.

Bruxism is a common oral parafunctional habit activity that includes grinding or clenching of the teeth. It has been universally accepted that bruxism is responsible for particular facial pain and discomfort of the mandible.[17] According to Magnusson et al.,[18] there is a significant correlation between bruxism and TMD symptoms and it may be used as a predicting factor for TMD treatment. Manfredini and Lobbezoo[19] reported that although bruxism has been regarded as a risk factor for masticatory muscle disorder, it is uncertain whether bruxism is a potential cause of either excessive load on the joint or muscle damage. The research of Pergamalian et al.[17] also showed that there is an inverse correlation between bruxism and TMJ with pain. Yet, because the research of Pergamalian et al.[17] relies only on patients' self-reports, unconscious bruxism may have been neglected. Considering many subjects are unaware of their oral parafunctional habits, actual frequency of the bruxism may have been higher.[10] Wear facets of the OA as well as patient's questionnaires were evaluated in our study because many patients are unaware of their bruxism. Moreover, unlike other factors, which were evaluated only with the records at the initial visits, bruxism was also evaluated with records extended to follow-up visits in this report.

It can be inferred that there is a significant relationship between bruxism and treatment response because considerably many patients in delayed response group showed bruxism. The reason for a remarkably significant relationship between bruxism and TMD symptoms compared to other previous researches is that the patients with nocturnal bruxism shows higher psychological demand for using the appliance in spite of the alleviation from pain and the recovery of TMJ function. Moreover, due to the continued use of OAs even after eliminating the symptoms for protection of the joint structure and function, the patients with bruxism may have been included in delayed response group.

Even if the association between bruxism and TMD remains unclear, this result could explain that bruxism may be a negative factor for the recovery of TMJ function. It may also be understood that clenching and unilateral chewing, as oral parafunctional habits that apply excessive loads to the joint, act as factors hindering the process of adaptation of the joint. According to Glaros et al.,[20] oral parafunctional habits, which cause an increase to muscle pain, is a strong predictor of the jaw pain in TMD patients.

In conclusion, persistent oral parafunctional habits could influence the duration of OA treatment in the patients with TMJ internal derangement. Because the treatment response rate was turned out to be significantly related to the presence of bruxism, clenching and unilateral chewing. This implies that continuous patient education and the clinician's effort to increase patient's compliance to control the oral parafunctional habits should be given to the patients for better treatment outcome.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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