

The Long-Term Effect of Occlusal Therapy on Self-Administered Treatment Outcomes of TMD

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Because of a lack of substantial scientific data, the efficacy of occlusal therapy for the management of temporomandibular disorders (TMD) is still controversial. Of a total of 1405 consecutive TMD patients examined over the last 10 years, 369 (26.3%) were determined to have completed treatment at least 1 year before the present survey. A sample questionnaire was mailed to each patient in this sample population. The questionnaire failed to reach 46 patients; of the 323 patients who received the questionnaire, 260 (80.5%) responded. The mean duration of time between their last visit and this survey was 3.7 years. The questionnaire elicited information on treatment outcomes, present treatment needs, and current signs and symptoms. Participants were divided into two treatment groups: (a) those who underwent some occlusal therapies (Phase II) following successful reversible therapies (Phase I) (20 men and 114 women); and (b) those who underwent reversible therapy only (33 men and 93 women). Participants were further differentially diagnosed into five diagnostic subgroups of TMD, based on the clinical examination at the initial visit, tomography, and, for some patients, magnetic resonance imaging. The subgroups included myalgia, arthralgia, anterior disc displacement with and without reduction, and osteoarthritis/osteoarthrosis. Only 12.3% of the total population surveyed reported lack of improvement to an acceptable level and further need for treatment. The remaining patients reported satisfactory results in the reduction of TMD symptomatology and no further need for treatment, because their symptoms had either disappeared or improved to an acceptable level. Regardless of treatment groups and diagnostic subgroups, the current subjective signs and symptoms were negligible in most patients, and mean mouth openings were in the normal range. No particular diagnostic subgroups seemed to have significantly better outcome following Phase II occlusal therapy. These results suggest that the majority of TMD signs and symptoms improve to an acceptable level with only reversible therapy, and the long-term value of additional occlusal therapy following reversible therapy is minimal. Therefore, permanent occlusion-changing therapies apparently are not generally needed to maintain TMD symptom reduction over time.

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Over the past several decades, a wide variety of methodologies and modalities have been used to treat temporomandibular disorders (TMD). Occlusal therapy especially has been widely used for years by the dental profession, and it has been described as a successful treatment option for TMD.¹⁻⁷

However, recent controlled clinical studies, although surprisingly scarce, failed to prove the superiority of occlusal therapy when compared to placebo or other reversible therapies.⁸⁻¹⁰ Since the duration for perspective in these studies was extremely short, and long-term studies for TMD are substantially lacking, the efficacy of occlusal therapy for TMD is still controversial.

TMD is a collective term that encompasses various musculoskeletal pathologic conditions that involve the temporomandibular joint (TMJ), masticatory muscles, or both.¹¹⁻¹³ Therefore, treatment efficacy might be related to particular pathologic subgroups of TMD, and, if possible, the validity of occlusal therapy should be differentially established according to the subcategory of TMD.^{14,15}

The purposes of this study were: (1) to assess the long-term effect of occlusal therapy on TMD signs and symptoms using a patient self-administered questionnaire; and (2) to determine whether the effectiveness of occlusal therapy is different among diagnostic subgroups of TMD.

Materials and Methods

Patients

Patients selected for this study were examined and diagnosed as having one or more of the subcategories of TMD during the past 10 years at the Department of Fixed Prosthodontics of Okayama University Dental School, Okayama, Japan. The patients were divided into two groups: a noncompliant population and a compliant population. Follow-up results of the noncompliant population were described in our previous report.¹⁶ The compliant population consisted of patients who either completed treatment, or remained in treatment during the period of this survey, or were referred to other clinics, or were judged by the examiner not to require treatment. Patients who were retrospectively determined to be treatment completers by chart review were sampled first. Among the completers, 369 patients who completed treatment at least 1 year before this survey were selected for this study. The patient was defined as having completed treatment when the investigator judged that some treatment was instituted, and that treatment was not terminated unilaterally by the patient against the therapist's advice or by the therapist against the patient's demands. The study population included 78 males and 291 females with a mean age of 42.3 ± 17.4 years, ranging from 16 to 86 years, and these patients represented approximately 26.3% of

1405 consecutive TMD patients examined at the authors' clinic in the past 10 years.

The chart review method was also used to divide the completed patients into two groups: a group who underwent reversible therapy only, and a group who underwent a combination of reversible and occlusal therapies. The number of teeth involved in the occlusal therapy was different from patient to patient, ranging from one tooth to all teeth.

Diagnosis at the Initial Visit

A clinical examination was performed for each patient to detect signs and symptoms of TMD using methods routinely employed at the Department of Fixed Prosthodontics, Okayama University Dental School.¹⁷ The examination included recording of general medical and dental history, pain, range of mandibular movements, temporomandibular joint sounds, tenderness on palpation of the TMJ and masticatory muscles, accompanying symptoms, general posture, and occlusion.

For the vast majority of patients, sagittal TMJ tomography at intercuspal and maximum mouth opening positions was undertaken bilaterally to detect advanced structural bony changes suggesting degenerative joint disease (ie, osteophyte, flattening, erosion, sclerosis).^{18,19} The images were obtained under hypocycloidal movement with the use of Optiplanimat (Siemens, Munich, Germany). One third of the patients referred to our clinic since 1992 had their disc position determined by T1-weighted magnetic resonance imaging (MRI), obtained bilaterally in the intercuspal and maximum mouth opening positions using Signa 1.5T (General Electric) or Magnetom 1.5T (Siemens).^{20,21}

According to the results obtained from clinical and imaging examinations, TMD was differentially diagnosed from other similar diseases, and then subcategorized based on the recently developed Research Diagnostic Criteria for Temporomandibular Disorders.¹¹ The TMD diagnostic subgroups were: masticatory muscle disorders (myalgia) only, arthralgia suspected as resulting from capsulitis and/or synovitis only, internal derangements of the TMJ, and osteoarthritis/osteoarthritis. Myofascial pain, muscle spasm, myositis, and muscle contracture were included in masticatory muscle disorders, although patients with muscle spasm, myositis, and muscle contracture were extremely rare.¹¹ Patients who had both muscle and joint problems or more than two joint problems were assigned to only one subgroup based on the criteria that met their more serious symptoms. All patients were examined and diagnosed by any one of the three experienced experts.

Treatment

Prior to treatment, all patients received an explanation of their diagnosed disease. Possible perpetuating factors were discussed, and patients were instructed as to how they might reduce these factors in their daily lives. They were also assured that TMD is generally benign and has a good prognosis.

All patients were then treated conservatively (cf Table 1 in the present authors' previous report¹⁶). The same three experts treated the majority of patients. As stated above, the therapeutic interventions were divided into two types: reversible therapy and occlusal therapy. One group received reversible therapy only. The other group received reversible therapy followed by occlusal therapy to obtain occlusal stability. Reversible therapy consisted of pharmacologic management, transcutaneous electrical neural stimulation (TENS), physical therapy, and appliance therapy. Occlusal therapy consisted of occlusal adjustments and restorative or prosthetic procedures. When gross occlusal discrepancies were present as a result of restorative procedures, they were eliminated by occlusal adjustments before starting reversible therapy.

Masticatory Muscle Disorders Only. For patients with masticatory muscle disorders and no organic TMJ pathology, pharmacologic, physical, and appliance therapies were typically provided. Patients were instructed to voluntarily disengage the teeth and to stop oral habits such as clenching or bruxing whenever they became aware of it. They were also encouraged to avoid stress as much as possible and to lead a well-ordered life. Nonsteroidal anti-inflammatory drugs (NSAIDs) and/or muscle relaxants were prescribed in the early stage of treatment for patients with severe pain. In some cases TENS was provided to assist in muscle relaxation. Most patients wore a stabilization appliance²² typically on the maxillary teeth during night time, especially whenever parafunctional activity during sleep was suspected. Occlusal therapy was performed when occlusal instability was recognized following reversible therapy.

Arthralgia Suspected as Resulting From Cap-sulitis and/or Synovitis Only. All patients were instructed to restrict wide mouth opening and to take only soft foods so as to rest inflamed TMJ structures. In addition, mild analgesics such as NSAIDs were prescribed for most patients. Appliance therapy was considered only when patients' symptoms had not been relieved by these treatments. Occlusal adjustment therapy was performed in about half of these patients.

Internal Derangements of the TMJ. TMJ internal derangements were mostly subclassified into anterior disc displacement with and without reduction. One patient was diagnosed as having spontaneous posterior disc displacement during wide mouth opening, and one other patient was diagnosed as having both anterior disc displacement and synovial osteochondromatosis. Both of these patients were included in the subclassification "others." Regardless of the diagnostic subclassification, NSAIDs were often prescribed in the early stage of treatment for patients with severe pain. Muscle pain concomitant with disc displacement was treated simultaneously with joint problems.

Anterior Disc Displacement With Reduction. Patients diagnosed as having unilateral or bilateral anterior disc displacement(s) with reduction were mainly treated by appliance therapy according to the therapeutic algorithm shown in Fig 1. Patients were asked to open and close their mouth at protruded mandibular position to diagnose whether the displaced disc was temporarily reduced.²³ When the reciprocal clicking was instantly eliminated in the protruded position, an anterior repositioning appliance was used. The appliance was fabricated as previously described²⁴ and usually placed on the maxillary arch. When a disc could not be maintained in normal position with mandibular positioning possibly owing to fibrous adhesion or severe disc deformity, or when a patient complained of pain or discomfort in the therapeutic position, a stabilization appliance was used. Patients were instructed to wear the appliance as much as possible, especially during sleep, but to remove it for meals. When pain and other symptoms had been reduced, typically after 1 or 2 month(s), the appliance was sequentially adjusted and its thickness was slowly reduced to allow the mandible to return to an appropriate position for permanent occlusal reconstruction.^{25,26} The condylar position, as revealed by tomography taken when a patient wore the adjusted appliance, was used as a reference for determining the final therapeutic position.

When both discs had been successfully maintained in their normal position in the final therapeutic position, provisional metal onlays were cemented on the unprepared bilateral posterior teeth.²⁷ The onlays were used for at least 6 months before the permanent occlusal reconstruction in the final therapeutic position was performed. In cases where the final therapeutic position determined after the walk-back procedure was very near the original intercuspal position, occlusal adjustments were performed to finalize and stabilize the occlusion at the therapeutic position. This treatment avenue was not very common.

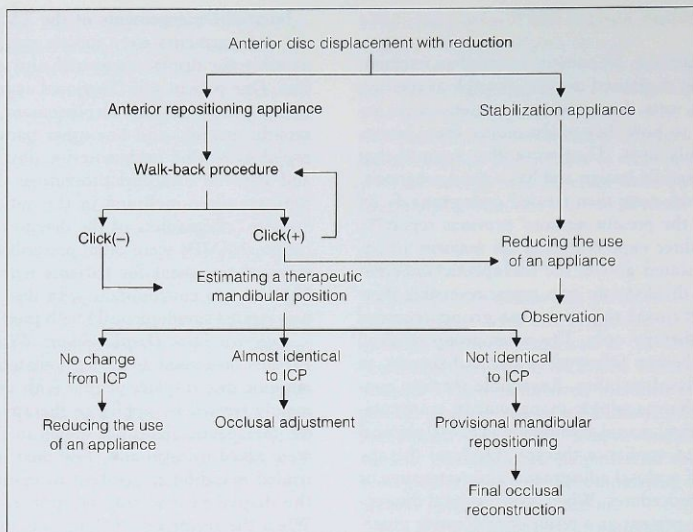


Fig 1 The therapeutic algorithm for patients with anterior disc displacement with reduction (ICP= original intercuspal position).

When a patient did not experience pain, clicking, intermittent locking, and other symptoms during the observation period with the provisional onlays, final occlusal reconstruction to the therapeutic position was performed prosthodontically. The extent of the prosthodontic reconstruction was individually determined based on the need to obtain occlusal stability in the therapeutic position. Only two to four teeth were reconstructed at one time so as to maintain the molar support. An etched-porcelain resin-bonded onlay technique was used for intact teeth or teeth with small restorations.²⁸ In cases that were resistant to disc recapture, occlusal therapy was not basically performed.

In patients free of both pain and any history of intermittent locking, patient education and simple behavioral modification instructions, instead of an appliance, were provided.

Anterior Disc Displacement Without Reduction. Patients diagnosed as having unilateral or bilateral anterior disc displacement(s) without reduction were treated according to the therapeutic algorithm shown in Fig 2. When a patient complained of obvious joint pain and restricted mouth opening, especially with a history of acute closed lock, Farrar's manual manipulation²⁹ or pumping manipulation³⁰ was employed to reduce the disc. If the displaced

disc was successfully reduced by the manipulation, a temporary anterior repositioning appliance was immediately fabricated at the chairside and the patient was instructed to wear the appliance 24 hours a day, including meals. The temporary appliance was later replaced with a processed appliance, and the same treatment was employed as in patients with disc displacement with reduction.

If the displaced disc was not successfully reduced by the manipulation, passive stretching exercises were performed by a therapist during each patient visit until a normal range of mandibular movement was achieved and the joint pain was alleviated. The patients were also instructed to perform mouth-opening exercises at home 3 times daily. For patients whose displaced disc was not reduced and for patients without severe pain and symptoms during the initial visit, a stabilization appliance was inserted. If a patient felt more comfortable in a slightly protruded mandibular position, an anterior repositioning appliance was fabricated in this position. In most cases, use of the appliance was gradually decreased as the pain and dysfunction decreased. Some patients complained of occlusal instability or difficulty in chewing because the mandible did not reassume its pretreatment position. For these patients, occlusal therapy was considered.

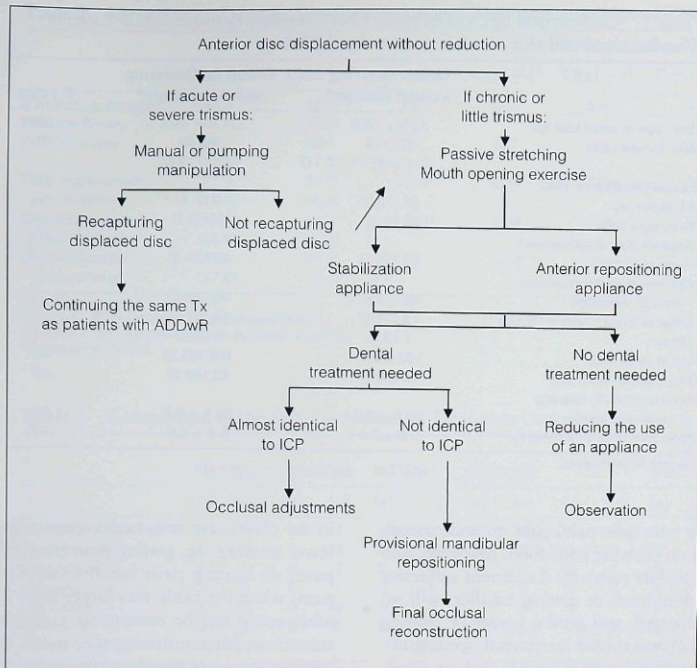


Fig 2 The therapeutic algorithm for patients with anterior disc displacement without reduction (ICP = original intercuspal position; Tx = treatment; ADDwR = anterior disc displacement with reduction).

Osteoarthritis/Osteoarthrosis. The initial treatment goal was directed toward reducing any intra-articular strains between the articulating surfaces. Since the osteoarthritis/osteoarthrosis in most patients was diagnosed as being secondary to a disc displacement without reduction, similar therapeutic interventions were used for these patients as with patients having anterior disc displacement without reduction. This diagnostic subgroup included many denture wearers. For patients who were wearing complete or near-complete partial dentures, the vertical dimension was directly increased by adding a small amount of self-curing acrylic resin to the occlusal surface, because most dentures did not have enough stability to allow a reasonable appliance to be fabricated over them. By increasing the vertical dimension only on the occlusal surface, it was anticipated that the intra-articular pressure of the TMJ during clenching decreased, resulting in the improvement of joint fluid dynamics.³¹ In most cases, den-

tures were refabricated when the signs and symptoms were alleviated.

Questionnaire

A self-administered questionnaire was sent to each patient using an unfamiliar sender's name, and not that of the chief dentist involved with the examination or treatment. This approach was used to encourage an honest and candid response. Patients who did not return the questionnaire by a specified return date were contacted by telephone and encouraged to return it. The mean duration of time between the last patient visit and the survey was 3.7 years.

Each questionnaire contained seven major variables: (1) self-assessment of treatment outcomes (totally symptom free, much improved, little improved, unchanged, and got worse); (2) the current pain intensity on a visual analogue scale (VAS); (3) the cur-

Table 1 Comparison of Demographic Characteristics Between TMD Patients Who Received and Did Not Receive Occlusal Therapy

	Group receiving occlusal therapy*	Group not receiving occlusal therapy*	P value
Mean age at initial visit (y)	42.9 ± 16.5	31.7 ± 15.8	< .0001
Male/female ratio	20/114 (14.9/85.1)	33/93 (26.2/73.8)	.02
Subclassification of TMD			.55
Myalgia only	18 (13.4)	9 (7.1)	
Arthralgia only	12 (9.0)	11 (8.7)	
Anterior disc displacement with reduction	43 (32.1)	47 (37.3)	
Anterior disc displacement without reduction	45 (33.6)	43 (34.1)	
Osteoarthritis/Osteoarthrosis	15 (11.2)	15 (11.9)	
Others	1 (0.8)	1 (0.8)	
Pain at initial visit	102 (76.1)	105 (83.3)	.15
TMJ noise at initial visit	73 (54.5)	62 (49.2)	.40
Maximum mouth opening at initial visit (mm)	39.6 ± 9.2	39.5 ± 0.5	.93
Mean time after treatment (y)	3.9 ± 2.1	3.5 ± 2.0	.12

*Percent in parentheses.

rent subjective pain (jaw pain, pain on wide mouth opening, pain on chewing hard food, headache, and neck and/or shoulder pain); (4) the current subjective joint noise (eliminated or getting smaller, still no sound or unchanged, and getting louder or starting to feel noise); (5) maximum interincisal opening objectively measured by another person, such as a family member, using a millimeter ruler following the instructions provided in the questionnaire; (6) limited activity of daily living (ADL) as a result of their pain or other symptoms (18 questions)³²; and (7) self-assessment of the current need for treatment (no need because symptom free, no need because of improvement, like treatment if possible, or need treatment as soon as possible). The present subjective pain was compared with the pain at the initial visit and rank-ordered in four ranks (getting pain free, still having no pain, still having pain, and starting to feel pain). Regarding ADL, each question was also rank-ordered into four ranks according to severity (no problem [0], a little difficult [1], a lot difficult [2], and almost impossible [3]). The total score of ADL in each patient ranged from 0 to 54 (18 questions × 3 = 54) and used for statistical analysis.

Statistical Analysis

Student's *t* test was used to analyze ratio data, whereas chi-square test and Mann-Whitney *U* test were used to analyze nominal and ordinal data, respectively. If one cell contained an expected frequency of less than 1, or if more than 20% of the cells contained expected frequencies of less than 5

in the chi-square test, ranks were collapsed into a fewer number (eg, getting pain free, still having no pain, or having pain for the current subjective pain) when the table was larger than 2 × 2. If the table could not be reasonably collapsed, a Yate's correction for continuity was used. The levels of significance were based on two-tailed tests where *P* < .05 was considered statistically significant.

Results

The questionnaire failed to reach 46 patients because of address change or death. Of the remaining 323 patients (accessible population), 260 (53 males and 207 females from 16 to 86 years; mean 43.3 ± 17.5 years) returned a questionnaire, and their data were analyzed in this survey (participants). The return rate was 80.5%.

According to the treatment provided, the participants were divided into two groups: those participants who underwent some occlusal therapies (20 males and 114 females), and those who did not undergo any occlusal therapies (33 males and 93 females). Table 1 presents comparison of demographic data at the initial visit between the two groups, and Table 2 shows mean ages and gender distributions among diagnostic subgroups of TMD. There was no significant difference in the distribution of diagnostic subgroups between the two groups (*P* = .55). There were also no significant differences in frequency of patients with pain or TMJ noise at the initial visit, maximum mouth

Table 2 Mean Age and Gender Distribution Among Diagnostic Subgroups of TMD

	Mean age			Male/female ratio		
	Occl (+) [†]	Occl (-) [†]	P value	Occl (+) [†]	Occl (-) [†]	P value
Masticatory muscle disorders only	44.9 (11.1)	33.0 (16.7)	.03*	6/12	5/4	.49
Arthralgia only	48.3 (18.1)	33.4 (17.3)	.06	5/7	3/8	.78
Disc displacement with reduction	37.9 (15.4)	27.6 (16.4)	.003*	6/37	17/30	.03*
Disc displacement without reduction	49.5 (16.9)	32.0 (13.3)	.003*	1/44	7/36	.05
Osteoarthritis/osteoarthritis	53.3 (17.6)	41.3 (16.0)	.06	1/14	1/14	> .99

Standard deviation in parenthesis.

[†]Occl (+) = TMD patients receiving occlusal therapy.[†]Occl (-) = TMD patients not receiving occlusal therapy.*Significant at $P < .05$.**Table 3** Comparison of the Self-Assessment of Treatment Outcomes

	Myalgia		Arthralgia		ADDwR		ADDwoR		OA		All patients	
	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
Totally symptom free	8	2	7	4	17	10	23	18	9	6	64	40
Much improved	7	4	5	4	21	20	22	22	6	7	62	58
Little improved	1	0	0	2	2	9	0	2	0	1	3	14
Unchanged	2	1	0	1	3	7	0	0	0	0	5	9
Got worse	0	0	0	0	0	0	0	0	0	1	0	1
No answer	0	2	0	0	0	1	0	1	0	0	0	4
P value (chi-square)	0.070		0.14		0.02*		0.29		0.26		0.001*	

Note: For statistical analysis, patients who answered "little improved," "unchanged," and "got worse" were included in the same cells, and patients who did not answer were excluded because of scarce data. Chi-square tests were performed in 2×3 tables. Two patients in "Others" were included in "All patients."

ADDwR = Anterior disc displacement with reduction.

ADDwoR = Anterior disc displacement without reduction.

OA = Osteoarthritis/osteoarthritis.

(+)= TMD patients receiving occlusal therapy.

(-)= TMD patients not receiving occlusal therapy.

*Significant at $P < .05$.

opening at the initial visit, and mean time after treatment between the two groups. On the other hand, the mean age in the group receiving occlusal therapy was significantly higher than that in the group not receiving occlusal therapy. No statistically significant differences between mean ages were found in diagnostic subgroups of arthralgia only and osteoarthritis/osteoarthritis (Table 2). A statistically significant difference was found in gender distribution between the two groups. However, a significant difference was found only in the diagnostic subgroup of anterior disc displacement with reduction when the same comparison was separately performed in each subgroup of TMD (Table 2).

Table 3 demonstrates the self-assessment of treatment outcomes. Only 32 patients (12.3%) re-

ported that their symptoms improved little, did not change, or became worse, as compared to 224 patients (86.2%) who reported that their problems totally went away or were much improved. While there was a statistically significant difference in the distribution of self-assessment between the two treatment groups overall ($P = .001$, chi-square test), only patients who underwent occlusal therapy for anterior disc displacement with reduction reported more favorable treatment outcomes when the same comparison was separately performed in each diagnostic subgroup of TMD.

Table 4 presents the current intensity of pain scaled by VAS. There was no statistically significant difference between the mean pain scores in the two treatment groups (10.5 ± 19.3 versus 9.5 ± 18.6). Among diagnostic subgroups of TMD, only

Table 4 Comparison of Current Pain Intensity (VAS)

	Occlusal therapy		P value
	(+)	(-)	
All patients	10.5 ± 19.3	9.5 ± 18.6	.57
Masticatory muscle disorders only	19.4 ± 25.0	0	.01*
Arthralgia only	5.8 ± 11.7	14.9 ± 21.7	.22
Disc displacement with reduction	9.0 ± 18.6	10.5 ± 20.2	.67
Disc displacement without reduction	7.3 ± 16.5	7.6 ± 16.3	.98
Osteoarthritis/osteoarthrosis	18.3 ± 23.2	12.5 ± 21.9	.37

Note: Mean and standard deviation listed for comparison, although P values were calculated by Mann-Whitney U test.

*Significant at $P < .05$.

Table 5 Present Subjective Pains and Joint Noise Compared With Those at the Initial Visit[†]

	Myalgia	Arthralgia	ADDwR	ADDwoR	OA	All patients
Jaw pain	.03*	.09	.92	.78	—	.13
Pain on wide mouth opening	.14	.01*	.95	.27	.26	.04*
Pain on chewing hard food	.004*	.26	.17	.03*	.27	.003*
Headache	.84	.27	.34	.83	.23	.45
Neck/shoulder pain	.71	.50	.62	.83	.63	.44
Joint noise	.45	.64	.78	.39	.22	.89

[†]P values, calculated by chi-square test.

ADDwR = Anterior disc displacement with reduction.

ADDwoR = Anterior disc displacement without reduction.

OA = Osteoarthritis/osteoarthrosis.

*Significant at $P < .05$.

the subgroup of patients with myalgia reported more pain when they had undergone occlusal therapies. The mean pain score of the myalgia subgroup receiving occlusal therapies was the highest (19.4 ± 25.0), while no myalgia patients who were not receiving occlusal therapies reported pain. All mean pain scores obtained in diagnostic subgroups were quite low (less than 20 out of 100).

Table 5 presents the statistical results in changes of several subjective pains and joint noise compared with those at the initial visit. There were statistically significant differences in changes of pain on wide mouth opening and pain on chewing hard food between the two treatment groups. No statistically significant differences were found in changes of jaw pain, headache, neck and shoulder pain, and joint noise. In each diagnostic subgroup of TMD, statistically significant differences between the two treatment groups were found in changes of jaw pain in a subgroup of myalgia only, in changes of pain on wide mouth opening in a subgroup of arthralgia only, and in changes of pain on chewing

hard food in both subgroups of myalgia only and anterior disc displacement without reduction.

Table 6 presents changes of mean maximum mouth opening. In this survey, there was no statistically significant difference in maximum mouth opening between the two treatment groups. In each diagnostic subgroup of TMD, a significant difference was found between mean maximum openings only in a subgroup of arthralgia patients at the time of this survey ($P < .05$, Student's *t* test), although immediately after treatment there was no significant difference. The mean mouth opening increased with any treatment and was maintained in normal range until this survey in all diagnostic subgroups of TMD.

Table 7 shows the current ADL scores. There were no statistically significant differences in ADL scores between the two treatment groups. Without exception, all ADL scores obtained were very low compared with the full range of the scale from 0 to 54.

Table 8 shows the comparison of the self-assessment of the current need for treatment. Of the 260 participants, 138 patients (53.1%) reported no need

Table 6 Changes in Mean Maximum Mouth Opening (mm)

	Before treatment		After treatment		At present	
	Occl(+)	Occl(-)	Occl(+)	Occl(-)	Occl(+)	Occl(-)
All patients	39.6 ± 9.2	39.5 ± 10.3	48.1 ± 6.2	48.0 ± 6.7	48.3 ± 9.0	46.2 ± 8.8
Masticatory muscle disorders only	45.8 ± 5.6	39.1 ± 10.2	49.6 ± 3.5	46.1 ± 5.9	47.0 ± 7.5	46.1 ± 9.2
Arthralgia only	45.0 ± 9.4	38.3 ± 9.2	50.6 ± 8.7	45.6 ± 6.4	49.7 ± 9.9	40.8 ± 7.9
Disc displacement with reduction	44.4 ± 7.0	47.1 ± 8.2	50.3 ± 5.9	51.8 ± 5.9	48.3 ± 8.6	50.6 ± 6.8
Disc displacement without reduction	32.2 ± 7.5	33.5 ± 8.3	46.7 ± 5.3	47.2 ± 6.1	48.7 ± 9.6	45.0 ± 7.5
Osteoarthritis/osteoarthritis	39.5 ± 6.0	35.4 ± 8.9	43.1 ± 6.3	44.0 ± 7.3	47.5 ± 10.8	41.0 ± 12

Occl (+) = TMD patients receiving occlusal therapy.

Occl (-) = TMD patients not receiving occlusal therapy.

P* < .05.Table 7** Comparison Between Diagnostic Subgroups of the Current Score* of Activity of Daily Living (ADL)

	Occlusal therapy		<i>P</i> value
	(+)	(-)	
All patients	2.5 ± 3.5	2.1 ± 2.9	.33
Masticatory muscle disorders only	3.5 ± 3.9	1.9 ± 3.0	.27
Arthralgia only	2.8 ± 3.1	2.6 ± 4.6	.90
Disc displacement with reduction	2.0 ± 2.3	1.9 ± 2.5	.84
Disc displacement without reduction	2.0 ± 4.1	1.5 ± 1.3	.51
Osteoarthritis/osteoarthritis	3.7 ± 3.6	3.9 ± 5.2	.90

Note: Means and standard deviations listed for comparison, although *P* values were calculated by Mann-Whitney *U* test.

*Highest possible score = 54.

Table 8 Comparison Between Diagnostic Subgroups of the Self-Assessment of the Current Need for Treatment

	Myalgia		Arthralgia		ADDwR		ADDwoR		OA		All patients	
	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
No need because symptom free	9	5	6	7	22	23	27	22	9	8	73	65
No need because of improvement	4	2	4	3	15	15	13	18	2	4	38	43
Like Tx if possible	2	1	2	1	6	7	4	3	3	1	17	13
Need Tx as soon as possible	1	0	0	0	0	0	0	0	0	0	2	0
No answer	2	1	0	0	0	2	1	0	1	2	4	5
<i>P</i> value (chi-square)	.92		.77		.97		.48		.43		.45	

Note: For statistical analysis, patients who answered "like Tx if possible" and "need Tx as soon as possible" were included in the same cells, and patients who did not answer were excluded because of scarce data. Chi-square tests were performed in 2 × 3 tables. Two patients in "Others" were included in "All patients."

ADDwR = Anterior disc displacement with reduction.

ADDwoR = Anterior disc displacement without reduction.

OA = Osteoarthritis/Osteoarthrosis.

(+)= TMD patients receiving occlusal therapy.

(-)= TMD patients not receiving occlusal therapy.

for further treatment because of complete disappearance of their symptoms. Eighty-one patients (31.2%) also requested no treatment because their symptoms improved to an acceptable level. Only 32 patients (12.3%) claimed to be in need of treatment. No statistically significant differences were found between the two treatment groups, nor in any of the diagnostic subgroups.

Discussion

Because occlusal therapy is a treatment modality designed for permanent correction of the occlusion itself through changing the tooth morphology and/or mandibular position, it is more invasive as well as more time-consuming and expensive than reversible therapy. Consequently, in order to justify occlusal therapy as an effective and necessary treatment modality for TMD, its superiority in comparison with reversible approaches should be clearly demonstrated. However, the number of comparative studies that have been conducted between reversible and occlusal therapies to measure their relative treatment effectiveness for TMD is extremely limited.⁸ Longitudinal studies on irreversible occlusal therapy are also scarce.^{33,34} Despite the fact that there is a substantial lack of evidence that producing a stable occlusal condition is important for long-term TMD management, many dental professionals still believe in its treatment efficacy.³⁵ Hence, descriptive studies on occlusal therapy for TMD can be meaningful, especially if they compare occlusal therapy with other approaches, and even if they do not involve manipulation of variable or randomization.

Since this is a retrospective study, we were unable to manipulate and control any confounding variables. Mean age at the initial visit and gender ratio were significantly different between the two groups who did and did not receive occlusal therapy, although both variables could bias the efficacy of treatment interventions for TMD.³⁶ However, it would not be ethical to randomly assign TMD patients into two groups that receive or do not receive occlusal therapy in controlled clinical trials because of the irreversible character of the therapy. It would appear logical that the mean age of the group receiving occlusal therapy was higher than that of the group not receiving occlusal therapy because there was a higher frequency of poor dental restorations or dentures in older patients. On the other hand, no statistically significant differences were found between the two treatment groups in frequencies of patients who complained of pain and joint noises at the initial visit; and the mean maximum mouth openings

of the two groups were almost equal. The distribution of diagnostic subgroups was also comparable between the two treatment groups. Thus, the average severity of signs and symptoms at the initial examination was not greatly different between the two groups. Although the time after treatment could be a serious confounding variable for a longitudinal study on TMD because of its cyclic and self-limiting nature,^{16,37,38} the two treatment groups had similar mean times lapsed since completing treatment. Therefore, findings obtained from this survey could be meaningfully interpreted within the context of limitations by variables of age and gender.

One of the primary disadvantages of mailed questionnaires is that the return rate is often quite low. Low returns can severely threaten the external validity of survey results. Fortunately, since the return rate of our questionnaires was very high (80.5%), it is likely that the external validity of this survey was not biased by nonresponders. As a result, the number of usable responses obtained was adequate for reasonable statistical analysis, thereby making it possible to compare survey results among diagnostic subgroups of TMD.

A retrospective study often presents problems in diagnostic and therapeutic consistency among examiners and therapists. In the present study, all patients were examined by one of three experienced experts based on the standardized examination form that was developed in our clinic.¹⁷ Objective imaging data obtained from MRI and tomography were certainly useful for ensuring consistency of diagnosis. A previous study showed that our reliability for diagnosing disc displacement on MRI was sufficiently high.³⁹ Regarding treatment, the same three experts treated the majority of patients. Although a small number of patients was treated by several other therapists, their treatments were supervised by these experts. A fixed therapeutic algorithm was used in each diagnostic subgroup of TMD, although some parts of therapeutic interventions were slightly modified during the past 10 years. We believe that these considerations for making clinical examinations and therapeutic interventions as consistent as possible strengthen the generalizability of the outcomes obtained in the current survey. However, even with detailed operational definitions and equal clinical skills, different examiners and therapists are not always in agreement regarding the quality of examination and treatment. These variables were not completely controlled in this study.

Of the 260 participants to this survey, 224 patients reported satisfactory results in reduction of TMD symptomatology (86.2%), and only 32 patients (12.3%) reported unsatisfactory results.

Similarly, 219 patients (84.2%) sought no further treatment because their symptoms had disappeared or improved to an acceptable level, and only 32 patients (12.3%) reported to be in need of treatment. This very low rate of seeking additional treatment, together with the highly favorable treatment outcomes reported, likely shows that TMD patients often have a favorable prognosis with respect to subjective severity of signs and symptoms, although the distribution of treatment need did not completely coincide with that of treatment outcomes. This is also supported by the results that regardless of diagnostic subgroup of TMD, both scores of the current pain intensity (VAS) and the current activity of daily living (ADL) were very low, and mean maximum mouth openings obtained at this survey were maintained in the normal range.

Occlusal therapy has been demonstrated to be effective for signs and symptoms of TMD.¹⁻⁷ It is regarded as a useful treatment option, both for offering occlusal stability to TMD patients whose occlusal disturbances are considered a causative factor,⁴⁰⁻⁴² and for stabilizing recaptured discs in a normal position.^{33,43,44} At first glance, the treatment outcomes reported in this survey also seem to suggest the superiority of occlusal therapy over reversible therapy, since the self-assessment between the two groups who received and who did not receive occlusal therapy was significantly different ($P = .001$, chi-square test). The percentage of patients who reported "symptom free" or "much improved" was higher (94.0%) in patients receiving occlusal therapy compared with that in patients not receiving occlusal therapy (77.8%). However, in agreement with other recent controlled studies that failed to show a significant effect of occlusal adjustments on signs and symptoms of TMD,⁸⁻¹⁰ other results obtained from this survey suggest that occlusal therapy may not provide any substantial superiority. For example, no statistically significant difference was found in the current need for treatment, nor was there any difference in both mean scores of VAS and ADL between the two treatment groups. There was also no statistically significant difference in maximum mouth opening between the two groups. Regarding changes of the subjective signs and symptoms compared with those at the initial visit, no statistically significant differences were found in jaw pain, headache, neck and shoulder pain, and joint noise between the two groups. Although statistically significant differences were found between the two groups in changes of pain on both wide mouth opening and chewing hard food, these results may not be valid because the proportion of patients who did and did not have these subjective symptoms at the initial

visit was not equal between the two groups. It is more likely, therefore, that the overall degree of improvement of signs and symptoms in patients receiving occlusal therapy was almost identical to that in patients not receiving occlusal therapy.

Contrary to our expectations, the results of this survey suggest a very minimum effect of occlusal therapy on the subjective reduction of signs and symptoms related to TMD. Among diagnostic subgroups of TMD, the distribution of treatment outcomes of patients receiving occlusal therapy was significantly different from that of patients not receiving occlusal therapy only in the subgroup of anterior disc displacement with reduction. The frequency of patients with reducing disc displacement who reported favorable outcomes was higher in patients receiving occlusal therapy than in patients not receiving occlusal therapy. A considerable number of patients whose displaced disc was successfully recaptured by reversible therapy and then maintained by occlusal therapy contributed to the difference, because they reported quite favorable treatment results without exception. Recapturing of the disc in these patients was ascertained by MRI after treatment (unpublished data). As previous studies have already claimed, this result might suggest that occlusal therapy is a superior treatment modality for reducing the displaced disc to a normal position.^{33,43,44} However, since no statistical difference was found in the self-assessment of the current need for treatment, that superiority, even if it would exist, appears to be minimal. Several other investigators also report that favorable treatment results for disc displacement could be obtained even though the disc remains anteriorly displaced.⁴⁵⁻⁴⁷

In the myalgia subgroup, the mean VAS score of the current pain intensity in patients receiving occlusal therapy was significantly higher than that in patients not receiving occlusal therapy. Conversely, in the arthralgia subgroup, the mean maximum mouth opening in patients who received occlusal therapy was significantly greater than that in patients who did not receive occlusal therapy. However, neither of these significant statistical results may be important because of the small sample size. Overall, no particular subgroup seemed to reveal any consistently greater results with occlusal therapy.

Although the average severity of the two treatment groups at the initial visit was found to be nearly identical, only patients who showed to various degrees some type of occlusal instability after successful reversible therapy underwent occlusal therapy. In addition, patients who received occlusal therapy included those who underwent very minor extent of occlusal adjustments or prosthodontic

treatments. These uncontrolled variables might have introduced some bias into the results of this survey. Therefore, the minimal impact of occlusal therapy observed in this survey might not be the same in a different TMD population. Nevertheless, we definitely found the differences between these two treatment groups to be surprisingly small. The results of this survey greatly disappointed the authors, who had enthusiastically provided occlusal therapy for TMD patients for many years. Since the majority of TMD patient signs and symptoms seem to improve to an acceptable level with only reversible therapy, regardless of the diagnostic subgroup, occlusal therapy should be considered less often as a treatment option for TMD.

Future research must include controlled clinical trials in order to clarify the etiologic role of occlusal factors in TMD and to establish the proper role for occlusal treatment of these disorders.

Conclusion

Of the 260 participants in this survey, only 32 patients (12.3%) reported that they had not improved to an acceptable level and were in need of additional treatment. In all of the diagnostic subgroups of TMD, both scores of the current pain intensity (VAS) and the current activity of daily living (ADL) were very low; mean maximum mouth openings obtained at this survey were maintained within the normal range. These results support the concept that reversible therapy is both effective and sufficient for the majority of patients to obtain significant reduction of subjective signs and symptoms related to TMD.

The long-term efficacy of occlusal therapy following reversible therapy on subjective signs and symptoms of TMD was nearly identical to reversible therapy only.

No particular diagnostic subgroup of TMD seemed to have obtained any specific benefit from receiving irreversible occlusal therapy following reversible therapy.

Since most occlusal therapies are both costly and irreversible, their use should be limited to specific clinical indication. At this time, no consensus exists about what those indications might be in TMD cases.

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Resumen

El efecto a largo plazo de la terapia oclusal sobre los resultados de tratamientos auto-administrados para la articulación temporomandibular

La eficacia de la terapia oclusal para el manejo de los desórdenes temporomandibulares (DTM) es todavía controversial debido a la falta de información científica considerable. Se determinó que de un total de 1.405 pacientes consecutivos que sufrían de DTM y que habían sido examinados durante los últimos 10 años, 369 (26.3%) habían completado el tratamiento por lo menos 1 año antes de completar este estudio. Se enviaron cuestionarios de muestra a cada uno de los pacientes de esta muestra de la población. Cuarenta y seis personas no recibieron el cuestionario; de los 323 pacientes que recibieron el cuestionario, 260 (80.5%) respondieron. La duración media del tiempo transcurrido entre su última visita y este examen fue de 3,7 años. El cuestionario produjo información relacionada a los resultados del tratamiento, necesidades de tratamiento actuales, y los signos y síntomas corrientes. Los participantes fueron divididos en dos grupos de tratamiento: (a) aquellos que habían recibido terapias oclusales (Fase II) luego de terapias reversibles que habían tenido éxito (Fase I) (20 hombres y 114 mujeres); y (b) aquellos que habían sido sometidos a terapia reversible solamente (33 hombres y 93 mujeres). Los participantes fueron además diagnosticados diferencialmente en cinco subgrupos de diagnóstico de DTM, basados en el examen clínico de la visita inicial, tomografía, y para algunos pacientes, las imágenes de resonancia magnética. Los subgrupos incluyeron: Mialgia, artralgia, desplazamiento anterior del disco con o sin reducción, y osteoartritis/osteoartritis. Solamente el 12.3% de la población total examinada reportó la falta de mejoría hacia un nivel aceptable y la necesidad de tratamiento adicional. El resto de los pacientes reportaron resultados satisfactorios en cuanto a la reducción de la sintomatología de los DTM y además reportaban que no necesitaban tratamiento adicional, debido a que sus síntomas habían ya sea desaparecido o mejorado hasta un nivel aceptable. Sin tener en cuenta los grupos de tratamiento y los subgrupos de diagnóstico, los signos y síntomas subjetivos corrientes fueron insignificantes en la mayoría de los pacientes, y las medias de las aperturas bucales estaban dentro de lo normal. Ningún subgrupo de diagnóstico en particular pareció haber tenido un mejor resultado después de la Fase II - terapia oclusal. Estos resultados indican que la mayoría de los signos y síntomas de los DTM mejoran hacia un nivel aceptable con solo la terapia reversible, y que el valor de la terapia oclusal adicional a largo plazo después de la terapia reversible, es mínimo. Por lo tanto, aparentemente las terapias que cambian la oclusión permanentemente no son necesarias en general, para mantener la reducción en los síntomas de los DTM en el transcurso del tiempo.

Zusammenfassung

Die Langzeitwirkung der okklusalen Therapie auf Selbstbehandlungs-Ergebnisse bei TMD

Wegen eines Mangels an wesentlichen wissenschaftlichen Daten ist die Wirksamkeit der okklusalen Therapie für die Behandlung von temporomandibulären Erkrankungen (TMD) immer noch umstritten. Aus einem Total von 1405 fortlaufend über die letzten 10 Jahre untersuchten TMD-Patienten wurden 369 (26.3%) bestimmt, die die Behandlung mindestens 1 Jahr vor der aktuellen Studie abgeschlossen haben mussten. Ein Musterfragebogen wurde jedem Patienten dieser Probenpopulation geschickt. Der Fragebogen erreichte 46 Personen nicht; von den 323 Personen, welche den Fragebogen erhielten, antworteten 260 (80.5%). Die durchschnittliche Dauer zwischen deren letztem Besuch und dieser Umfrage betrug 3.7 Jahre. Der Fragebogen holte Information über Behandlungsergebnisse, aktuelle Behandlungsnotwendigkeit, sowie momentane Zeichen und Symptome heraus. Die Teilnehmer wurden in zwei Behandlungsgruppen eingeteilt: (a) jene, welche sich einigen okklusalen Therapien unterzogen (Phase II) folgend auf erfolgreiche reversible Therapien (Phase I) (20 Männer und 114 Frauen); und (b) jene, die sich nur reversible Therapien unterzogen (33 Männer und 93 Frauen). Weiter wurden die Teilnehmer unterscheidend in fünf diagnostische Untergruppen von TMD diagnostiziert, basierend auf der klinischen Untersuchung beim ersten Besuch, einer Tomographie und bei manchen Patienten einer Kernspintomographie. Die Untergruppen enthielten Myalgie, Arthralgie, anteriore Diskusverlagerung mit und ohne Reduktion, sowie Osteoarthritis/Osteoarthrose. Nur 12.3% der betrachteten Gesamtpopulation berichtete über keine Verbesserung zu einem ertragbaren Niveau und über weitere Behandlungsnotwendigkeit. Die verbleibenden Patienten schilderten befriedigende Ergebnisse bei der Abnahme der TMD-Symptomatik und keine weitere Behandlungsnotwendigkeit, da ihre Symptome entweder verschwunden waren oder sich auf ein erträgliches Niveau verbessert hatten. Ohne Rücksicht auf Behandlungsgruppen und diagnostische Untergruppen waren die aktuellen Zeichen und Symptome bei den meisten Patienten geringfügig, und die durchschnittliche Mundöffnung bewegte sich im normalen Rahmen. Keine besonderen diagnostischen Untergruppen schienen signifikant bessere Ergebnisse nach einer Phase II okklusalen Therapie aufzuweisen. Diese Resultate lassen vermuten, dass sich die Mehrheit der TMD-Zeichen und -Symptome nur mit der reversiblen Therapie auf ein erträgliches Niveau verbessert, und der Langzeitwert der zusätzlichen okklusalen Therapie im Anschluss an die reversible Therapie ist minimal. Daher sind offenbar permanente die Okklusion verändernde Therapien nicht allgemein notwendig, um eine Reduktion der TMD-Reduktion über die Zeit zu erhalten.

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