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TMD

Temporomandibular Disorder Treatment Outcomes: Second Report of a Large-Scale Prospective Clinical Study

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ABSTRACT: Longitudinal studies of outcomes for temporomandibular disorder (TMD) treatment are rarely done and even when conducted often suffer methodological weaknesses. These may include the lack of valid outcome measures for symptom changes. This second report of a long-term multi-site study of 2104 treated, 250 untreated, and 44 long-term treated TMD patients is part of a continuing effort to study TMD treatment efficacy in a very large patient population. A validated symptom measurement system, the TMJ Scale, assured a valid and uniform assessment of treatment outcomes across a large number of practices. Data indicate that untreated TMD patients do not improve spontaneously over time and that patients treated with a variety of active modalities achieve clinically and statistically significant levels of improvement with no evidence of symptom relapse after treatment completion. The use of anterior repositioning appliance therapy produced better results than flat plane splint therapy.

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This paper is the second in a series of reports on a continuing large-scale, multi-site study sponsored by the American Academy of Craniofacial Pain (AACP), a professional association of approximately 500 clinical and academic dentists, physicians and other specialists treating temporomandibular disorders (TMD).

The initial publication1 described the procedures and methodologies employed for data gathering and analysis, and these are described briefly below. This study began in the fall of 1996 and continues to the present day.

Sixty clinicians have contributed data sets for 2104 TMD patients who have completed treatment. In addition, data from 250 patients who were diagnosed with TMD, and for various reasons declined treatment, is also included. While these patients in no way constitute a control group, they do provide a basis for comparing symptom change levels with treated patients. If, as some propose, TMD patients improve spontaneously without treatment,2,3 then this comparison group should manifest substantial symptom improvement. In addition, a group of 44 patients who had completed treatment earlier was reassessed (an average of eleven months after completion) to determine whether the positive treatment outcomes noted in the earlier paper remained consistent.

Materials and Methods

The methodological weaknesses of earlier TMD outcome studies were outlined in the first paper of this series.1 Suffice it to say that measuring outcomes by placing patients in improved-not improved categories is wholly unsatisfactory. Statistical determinations of degree of symptom change cannot be made, and minor random changes in symptoms may be confused with statistically significant improvements. When subjective clinical assessments are the primary outcome method, findings are suspect and are not replicable across clinical settings.

In an effort to overcome these weaknesses and the inherent shortcomings in analyzing findings from different sites and different clinicians, the TMJ Scale was adopted as the primary measure of symptom change. The TMJ Scale is a patient-completed symptom report system developed, validated and studied over the past 15 years.4-15 This test has been validated in a variety of clinical settings, including three university studies12,14,16 and is widely used for TMD treatment outcome and other research.16,25 Published sensitivity and specificity for the test range from 88-93% in recent studies.13,19-21

The TMJ Scale includes a global measure of overall TMD symptomatology, as well as subscales measuring pain, joint dysfunction, perceived malocclusion and range of motion limitation. Psychological subscales assess psychological functioning and stress. The contents, validation and definitions of these ten scales are described elsewhere,4,5,7-9 and they are listed following with their abbreviations:

PR: pain report

PP: palpation pain

MO: perceived malocclusion

JD: joint dysfunction

RL: range of motion limitation

NT: non-TM factors

PF: psychological factors

ST: stress

CN: chronicity

GS: global scale

Consecutive TMD patients in the participating practices completed informed consent forms and were asked to complete a TMJ Scale to establish pretreatment symptom levels. They were then given a physical examination, which included various objective diagnostic modalities, including radiography, MRIs, etc. Results of this examination were recorded on the standard Data Protocol form1 and were sent with TMJ Scale data to an independent evaluator for compilation and data analysis.

Upon completion of treatment, which typically consisted of several types of occlusal orthotics (splints) plus other various therapies specifically outlined in the tables presented, another TMJ Scale and Data Protocol were administered and compiled. The determination of when treatment was completed was a clinical judgement. This decision was based upon the clinicianÕs best estimate of the likelihood that further treatment would not be of substantial benefit to the patient. Patients who were initially evaluated but did not choose to have any treatment were later contacted and asked to complete another TMJ Scale six months after the initial TMJ Scale was completed.

Anticipated treatments were specified in the initial data protocol. Treatments actually rendered were listed in the post-treatment protocol and these were used for all analyses.

After patients completed treatment, attempts were made to ask patients for long-term follow-up data. This data is difficult to obtain: patient interest in

filling out forms wanes, they move, etc. Efforts continue to increase the size of the long-term group (44) for
future publications.

Findings

Initially a comparison of demographic and treatment history characteristics between the treated (2104), untreated (250) and long-term post-treatment (44) groups was conducted.

Table 1 reveals the untreated patients were slightly more likely to be younger, have more education, have had their TMD problems for a longer period of time, have had prior orthodontic treatment, and were more likely to have a nontrauma etiology than the treated patients. However, because of the large numbers of patients in the treated and untreated groups, even minor differences, which may not be theoretically important, are statistically significant. Since the long-term post-treatment group is substantially smaller, no tests of statistical significance were performed. The 44 long-term follow-up patients were somewhat more likely to be female, older, better educated, more likely to have had prior TMD treatment and to have a trauma-based etiology.

Table 2 describes the diagnoses for the three groups. TMD patients often present with a variety of symptoms, and this study allowed up to five diagnostic categories for each patient. In the first study, capsulitis/synovitis was the most frequent diagnosis for both treated and untreated patients. This has changed somewhat for the treated group, as disk displacement with reduction (DD w/reduction) is the most common diagnosis, followed by capsuli-

tis/synovitis. For the untreated group, capsulitis/synovitis remains the modal diagnosis, followed by DD w/reduction and myalgia. The long-term group also manifests more capsulitis/synovitis diagnoses, but myofascial pain is the second most frequent diagnosis, followed by DD w/reduction.

Table 3 compares initial symptom levels for treated, untreated and long-term follow-up patients. None of the pre-treatment differences between the treated and untreated groups were statistically significant, with the single exception of the Stress Scale, which was significant at .014. The 44 long-term follow-up patients had the identical Global Scale score as the treated group and reported slightly lower Pain Report and Palpation Pain scores. While they had slightly higher Joint Dysfunction scores, their overall symptom patterns are remarkably similar to the treated group.

A comparison of symptom change levels for the three groups is seen in Table 4. Treated patients reported substantial symptom improvements, while untreated patients remained essentially unchanged, with slight symptom improvements in three scales and worsening in seven. It is noteworthy that long-term follow-up patients reported larger percentages of symptom improvement in all of the physical symptom scales, with the exception of the Perceived Malocclusion Scale.

Considering the internal derangement diagnoses separately (Table 5) regarding initial symptom levels and symptom changes, the pattern found in Table 4 remains consistent. The two groups did not differ prior to treatment and post-treatment scores were all substantially and significantly improved for treated patients and unchanged for the untreated group.

Tables 6 and 7 evaluate initial symptom levels and symptom changes for patients diagnosed with disk displacement with reduction and disk displacement without reduction respectively. When examining a specific subset of joint dysfunction patients, those with a reducing disk displacement displayed the same pattern as Table 5. That

is, the treated patients improved significantly and the untreated patients did not. In Table 7 the same pattern emerges, even for the patients without disk reduction. Their level of improvement for the Global Scale, Pain and Joint Dysfunction scales is comparable to the level for patients with reducing disks.

Initial symptom levels and percent improvement for 2104 treated patients by treatment history and their relativeÕs TMD history is shown in Table 8. Neither prior orthodontic treatment nor whether the patientÕs father or sibling had TMD affected initial symptoms or improvement levels. Patients with prior TMD treatment and those whose mothers had TMD reported higher

Table 1

Demographic and Treatment History Characteristics for 2104 Treated, 250 Untreated, and 44 Treated Long-Term Follow-Up Patients

	Treated	Untreated	Sig. of Difference	Long-term
% Female	85.6%	84.0%	NS*	93.2%
Mean age(yrs.)	37.7	35.9	.042	40.7
Mean edu.(yrs.)	14.0	14.4	.005	14.8
Prob length (mos)	36.9	46.8	.023	45.4
Mos. btw tests	8.6	9.1	NS	11.1
% w/prior TMD Tx	22.5%	24.8%	NS*	34.1%
% w/prior ortho Tx	31.7%	42.2%	.001*	40.9%
% w/trauma etiol.	31.1%	21.6%	.002*	34.2%

* Chi Square (with Yates correction) used for the significance of difference statistic. For all others, difference of means T-tests used.

Table 2

Diagnoses for Treated, Untreated, and Long-Term Patients

	2104 Treated	250 Untreated	44 Long-term
Capsulitis/synovitis	50.0%	56.2%	62.8%

Myofascial pain 45.5 33.4 56.0
Muscle spasm 15.9 18.0 18.4
Myositis 11.4 3.6 5.2
Myalgia 40.9 41.1 15.6
DD w/reduction 65.9 48.0 36.0
DD w/o reduction 36.4 24.8 12.8
Reflex splinting 2.3 1.4 0.8
Contracture 0 0.6 0.8
Osteoarthrosis 0 2.0 0.8
Osteoarthritis 13.6 21.1 16.8
Sprain 0 7.7 2.4
Hypermobility 4.5 0.8 1.6
Trigeminal neuralgia 0 0.9 0.8
Neoplasm 0 0 0
Bony ankylosis 0 0 0
Fibrous ankylosis 0 0.7 0
Deviation in form 0 8.0 32.0
Mandibular dislocation 0 0.2 0.4
Hyperplasia 0 0.1 0.4
Hypoplasia 2.3 0.4 0.4

Note: Percentages add up to more than 100%, because
multiple diagnoses were allowed.

Table 3

Initial Symptom Levels for Treated, Untreated,
and Long-Term Patients
(Std. Dev. Shown in Parentheses)

44
2104 250 Long-
Treated Untreated term
PR 1.87 (.81) 1.93 (.99) 1.71 (.77)
PP 1.26 (.87) 1.36 (.99) 1.22 (.79)
MO 1.60 (.98) 1.68 (.98) 1.78 (.79)
JD 1.59 (.88) 1.68 (.91) 1.77 (.73)
RL 2.28 (.86) 2.25 (.97) 2.28 (.76)
NT 1.03 (.64) 1.11 (.71) 0.87 (.54)
PF 0.95 (.76) 1.04 (.79) 0.91 (.80)
ST 1.47 (.83) 1.62 (.91) 1.42 (.92)
CN 0.80 (.72) 0.77 (.79) 0.76 (.64)
GS 1.82 (.64) 1.87 (.78) 1.82 (.62)

Note: None of the pretreatment differences between the
treated and untreated groups were statistically significant,
with the single exception of the Stress (ST) scale, which
was significant at .014.

initial symptoms and lower improvement percentages.
Trauma patients began treatment with more severe symptoms but reported more improvement. There was no distinction made regarding the type of trauma the patient may have suffered.

Table 4

Symptom Change Levels for Treated, Untreated,
and Long-Term Patients
(Std. Dev. Shown in Parentheses)

44
2104 250 Long-
Treated Untreated term
PR 52.7% (38.4) 6.8% (44.1) 59.2% (42.0)
PP 49.4% (59.9) -4.5% (63.3) 53.1% (62.9)

MO 22.5% (65.3) -6.1% (56.9) 20.5% (80.9)
JD 47.0% (53.1) -6.0% (50.4) 59.3% (42.8)
RL 41.9% (41.5) 1.8% (38.7) 44.6% (42.3)
NT 41.5% (46.1) -2.7% (48.3) 32.9% (48.2)
PF 18.3% (63.9) -8.0% (64.4) 9.0% (62.2)
ST 20.0% (50.2) -10.7% (48.7) 14.0% (54.4)
CN 22.0% (69.7) -17.2% (70.6) 28.1% (68.9)
GS 47.2% (32.5) 3.6% (36.1) 51.5% (32.1)

Note: All differences between treated (including long-term) and untreated patients are statistically significant at the .001 level.

Studying the effect of malocclusion, measured using AngleÕs classification, on initial symptoms and symptom improvement (Table 9) indicated Class I patients reported significantly more improvement on all scales.
With the exception of the Perceived Malocclusion Scale, no significant initial symptom differences were found between Class I and Class II patients. During the study four occlusal measurements were made: right and left molar occlusion and right and left cuspid occlusion. For Table 9 only those patients with all four Class I's or IIÕs were included. The mixed occlusal group was also examined and they tended to begin with significantly higher symptom levels than Class I patients but did not differ significantly in treatment outcome.

Mandibular range of motion (ROM) is another measure of joint function. Table 10 indicates that initial range of motion does not predict overall symptom improvement, as measured by the Global Scale. However, patients with a ROM of less than 40 mm did report significantly more improvement in protrusion, opening and bilateral lateral movement than patients with an initial ROM of more than 40 mm. This is possibly because those patients opening less than 40 mm initially had more room for improvement.

Table 11 illustrates that when comparing percentage improvement for patients treated with a flat plane appliance versus an anterior repositioning appliance (ARA) there were no significant differences in most of the physical symptom measures. However, there was significantly more improvement in the symptoms of internal derangement (Joint Dysfunction Scale) for patients receiving anterior repositioning appliances. Overall

(Global Scale), the ARS patients improved significantly more than the patients treated with flat plane appliances, with an average percentage improvement of 50 percent for the ARS patients.

The diagnostic modalities and treatment approaches applied to the patients in this follow-up study are shown in Tables 12 and 13. Table 12 indicated that the most commonly employed diagnostic modality (other than the TMJ Scale, which was used on all patients) continued to be panoramic imaging, with tomography second and Doppler ultrasonography third. The results for the other modalities were very similar to the initial study results. Magnetic resonance imaging (MRI), computerized tomography (C-T Scan) and arthrography were utilized for a low percentage of patients. The treatment modalities for the patients in this follow-up study showed similar results as the initial study. A combination of pharmacological, behavior modification, physical modalities and appliance (both flat plane and ARS) therapy was the most commonly used treatment paradigm. Ninety percent of

Table 5

Initial Symptom Levels and Symptom Changes for 1426 Treated and 120 Untreated TMD Patients with Internal Derangement Diagnoses (DD w/ and DD w/o reduction)

	Initial Symptom Levels			Percent Symptom Change		
	Treated	Untreated	Signif.	Treated	Untreated	Signif.
PR	1.88 (.81)	1.90 (.99)	NS	55.2% (36.9)	1.1% (47.9)	.001
PP	1.19 (.83)	1.35 (1.03)	NS	52.2% (59.5)	-5.8% (64.7)	.001
MO	1.61 (.96)	1.61 (.96)	NS	23.1% (64.7)	-9.0% (54.1)	.001
JD	1.76 (.85)	1.90 (.89)	NS	53.9% (46.6)	-2.0% (46.7)	.001
RL	2.37 (.82)	2.31 (.99)	NS	45.0% (39.7)	-0.4% (37.0)	.001
NT	1.02 (.64)	1.13 (.75)	NS	44.2% (45.5)	-2.2% (49.3)	.001
PF	0.90 (.71)	1.06 (.82)	.042	20.2% (62.9)	-5.4% (63.1)	.001
ST	1.47 (.81)	1.62 (.89)	NS	21.4% (49.2)	-8.4% (46.1)	.001
CN	0.76 (.70)	0.85 (.86)	NS	23.4% (70.4)	-10.5% (71.7)	.001
GS	1.86 (.61)	1.90 (.80)	NS	49.5% (31.3)	3.2% (34.8)	.001

Significance levels based on 2-tailed t-tests for differences of means.

NS = not significant at the .05 level.

(Percentages are based on second scores subtracted from initial scores, divided by initial scores—positive percentages imply

a decrease in symptoms, negative scores, an increase.)

the patients were instructed to wear their appliances full before treatment, after treatment when maximum imtime, with less than seven percent directed to wear them provement was deemed to have occurred and again at an
part time. average of eleven months after that. All of the difference

Table 14 assesses long-term symptom change for 44 between the first and second and the first and third
patients. TMJ Scale scores were obtained at three points: (follow-up) tests were statistically significant. Conversely,

Table 6

Initial Symptom Levels and Symptom Changes for 1010 Treated and 91 Untreated TMD Patients with Disk Displacement with Reduction (Std. Dev. in Parentheses)

	Initial Symptom Levels			Percent Symptom Change		
	Treated	Untreated	Signif.	Treated	Untreated	Signif.
PR	1.88 (.82)	1.84 (.94)	NS	54.3% (37.6)	1.8% (46.4)	.001
PP	1.22 (.84)	1.33 (1.00)	NS	51.3% (60.0)	-5.1% (65.2)	.001
MO	1.57 (.95)	1.62 (.99)	NS	21.4% (65.3)	-6.4% (53.2)	.001
JD	1.81 (.85)	1.98 (.90)	NS	54.5% (45.6)	-0.3% (46.4)	.001
RL	2.25 (.84)	2.20 (.99)	NS	44.4% (40.7)	-1.3% (37.3)	.001
NT	1.04 (.64)	1.11 (.72)	NS	44.5% (43.5)	-2.3% (50.5)	.001
PF	0.91 (.72)	1.07 (.82)	NS	22.0% (61.9)	-7.2% (63.1)	.001
ST	1.51 (.80)	1.66 (.86)	NS	22.3% (47.3)	-7.5% (43.3)	.001
CN	0.76 (.70)	0.88 (.85)	NS	23.6% (70.0)	-7.1% (69.6)	.001
GS	1.83 (.62)	1.85 (.80)	NS	49.2% (31.4)	2.2% (33.5)	.001

Significance levels based on 2-tailed t-tests for differences of means.

NS = not significant at the .05 level.

(Percentages are based on second scores subtracted from initial scores, divided by initial scores—positive percentages imply

a decrease in symptoms, negative scores, an increase.)

Table 7

Initial Symptom Levels and Symptom Changes for 521 Treated and
33 Untreated TMD Patients with Disk Displacement without Reduction
(Std. Dev. in Parentheses)

	Initial Symptom Levels			Percent Symptom Change		
	Treated	Untreated	Signif.	Treated	Untreated	Signif.
PR	1.88 (.77)	2.14 (1.06)	NS	58.6% (33.8)	1.0% (46.6)	.001
PP	1.17 (.82)	1.40 (1.11)	NS	56.4% (57.3)	-2.6% (63.4)	.001
MO	1.71 (.99)	1.67 (.88)	NS	27.7% (62.7)	-14.3% (54.1)	.001
JD	1.68 (.85)	1.81 (.92)	NS	54.1% (48.1)	-4.1% (46.2)	.001
RL	2.66 (.68)	2.70 (.89)	NS	47.8% (35.9)	2.1% (34.1)	.001
NT	0.97 (.65)	1.19 (.83)	NS	44.7% (49.0)	0.2% (44.7)	.001
PF	0.88 (.70)	1.01 (.79)	NS	18.3% (64.6)	3.3% (62.0)	NS
ST	1.41 (.84)	1.50 (.94)	NS	20.6% (51.9)	-6.6% (53.6)	.007
CN	0.74 (.68)	0.74 (.86)	NS	23.7% (70.5)	-13.6% (77.1)	.010
GS	1.94 (.57)	2.09 (.77)	NS	51.3% (30.7)	6.5% (36.8)	.001

Significance levels based on 2-tailed t-tests for differences of means.

NS = not significant at the .05 level.

(Percentages are based on second scores subtracted from initial scores, divided by initial scores—positive percentages imply

a decrease in symptoms, negative scores, an increase.)

none of the differences between the second and third test These data thus do not support the assumption that TMD
were statistically significant. Thus, no significant changes symptoms rebound or relapse after the completion of
occurred after the completion of treatment for this group. treatment.

Table 8

Initial Symptom Levels and Percent Improvement for 2104 Treated Patients
by Treatment History and Relative’s TMD History
(Std. Dev. in Parentheses)

Prior TMD
Treatment

yes
no
Initial
global scale
1.95 (.63)
1.76 (.62)
Signif.
.001
Percent
improvement
41.6% (32.1)
47.7% (32.5)
Signif.
.001
Prior ortho
Treatment
yes
no
1.81 (.61)
1.83 (.64) NS
47.2% (32.4)
47.1% (32.7) NS
Trauma
Etiology
yes
no
1.99 (.67)
1.74 (.60) .001
50.4% (32.2)
45.7% (31.7) .003
Mother
had TMD
yes
no
1.89 (.65)
1.81 (.63) .027
38.8% (34.6)
48.9% (31.9) .001
Father
had TMD
yes
no
1.77 (.57)
1.82 (.63) NS
43.8% (32.7)
48.0% (32.4) NS

Sibling
had TMD
yes
no
1.87 (.62)
1.81 (.63) NS
43.4% (35.4)
48.2% (32.5) .050

Table 9

The Effects of Occlusal Class on Initial Symptoms and Symptom Improvement
for 1122 Pure Class I and 365 Pure Class II Patients
(Std. Dev. in Parentheses)

	Class I		Class II		
	Initial score	% improved	Initial score	% improved	Significances Initial % improved
PR	1.84 (.79)	54.2% (38.1)	1.86 (.90)	47.1% (40.6)	NS .003
PP	1.25 (.86)	53.0% (56.8)	1.21 (.92)	36.2% (68.9)	NS .001
MO	1.50 (.97)	24.4% (67.6)	1.77 (1.03)	16.8% (61.7)	.001 .047
JD	1.54 (.85)	49.4% (51.6)	1.56 (.90)	40.7% (57.6)	NS .010
RL	2.24 (.84)	43.6% (40.2)	2.28 (.90)	37.0% (44.7)	NS .013
NT	0.99 (.62)	42.3% (47.0)	1.03 (.71)	33.4% (41.5)	NS .003
PF	0.93 (.74)	20.4% (64.8)	0.96 (.83)	11.9% (63.9)	NS .027
ST	1.43 (.82)	22.3% (50.1)	1.48 (.89)	11.9% (52.3)	NS .001
CN	0.76 (.70)	22.9% (71.2)	0.89 (.81)	13.1% (68.8)	.006 .019
GS	1.78 (.60)	49.2% (31.6)	1.84 (.72)	39.8% (36.8)	NS .001

Note: During the study, four occlusal measurements were made: left and right molar occlusion and left and right cuspid occlusion. For this table, only those patients with all four class I's or II's were included in the table. The mixed occlusal grup was also examined: they tended to begin significantly higher symptom levels than Class I patients but did not differ significantly in outcomes.
Significance levels based on 2-tailed t-tests for differences of means.
NS = not significant at the .05 level.
(Percentages are based on second scores subtracted from initial scores, divided by initial scores—positive percentages imply

a decrease in symptoms, negative scores, an increase.)

Table 10

Initial Range of Motion Measurements in Mean Millimeters and Improvements for Treated
Patients with 40 mm or More Opening (n=1143) and less than 40 mm of Opening (n=937)
(Std. Dev. in Parentheses)

Protrusion

Initial
<40mm
5.7mm (2.3)
Initial
>40mm
7.0mm (2.5)
Signif.
of diff.
.001
% improvemt
<40mm
40.7% (67.7)
% improvemt
>40mm
13.7% (37.2)
Signif.
of diff.
.001
Right lateral 7.4mm (2.6) 9.6mm (3.1) .001 51.5% (79.5) 18.1% (64.5) .001
Opening 30.8mm (6.6) 45.9mm (5.0) .001 43.7% (66.5) 4.2% (12.0) .001
Left lateral 7.2mm (2.6) 9.4mm (2.4) .001 59.2% (1.02) 19.5% (60.8) .001
Global scale 1.91mm (.61) 1.75mm (.65) .001 48.2% (31.9) 46.2% (33.0) NS

Significance levels based on 2-tailed t-tests for differences of means.

NS = not significant at the .05 level.

(Percentages are based on second scores subtracted from initial scores, divided by initial scores—positive percentages imply
a decrease in symptoms, negative scores, an increase.)

Table 11

Percentage Improvement for 1250 Patients
Treated with a Flat Plane Appliance and 764
Patients Treated with an ARA
(Std. Dev. in Parentheses)

	Flat plane	ARA	Signif.
PR	52.3% (36.9)	54.0% (40.6)	NS
PP	48.1% (58.7)	52.2% (61.1)	NS
MO	22.3% (64.5)	21.4% (67.8)	NS
JD	43.7% (55.0)	54.4% (51.0)	.001
RL	41.9% (55.0)	42.8% (43.3)	NS
NT	39.0% (47.1)	46.8% (43.3)	.001
PF	16.0% (63.8)	22.6% (64.1)	.024
ST	17.3% (49.3)	24.4% (51.1)	.002
CN	21.9% (70.0)	23.1% (69.3)	NS
GS	45.9% (31.6)	49.9% (33.0)	.008

Note: No significant pretreatment symptom differences
existed between patients receiving a flat plane or ARA
appliance.

Discussion and Conclusions

This is the second report of a large-scale, multi-site
study of TMD treatment outcomes. As in the first report,1 this study finds that untreated patientsÕ symptoms

Table 12

Diagnostic Modalities Employed for
2104 Treated Patients*

%**	Modalities
89.8	1. Panoramic x-ray (orthopantomograph)
1.7	2. Magnetic resonance imaging
46.7	3. Transcranial
.2	4. Computerized tomography scan
64.8	5. Tomography

.3 6. Arthrogram
5.7 7. Other imaging
17.5 8. Joint vibration analysis
27.3 9. Mounted models
11.3 10. Jaw tracking
16.1 11. Electromyography
54.4 12. Doppler
* Based on post treatment report.
** Adds up to more than 100%, since more than one choice was allowed.

Table 13

Treatments Administered to 2104 Patients

% Treatment

40.2 1. Pharmacological
51.9 2. Behavior modification
46.9 3. Physical modalities
23.7 4. Nutritional counseling
1.8 5. Biofeedback
2.5 6. Psychological/counseling
12.0 7. Diagnostic appliance
28.0 8. Nightguard
2.7 9. Equilibration
7.3 10. Trigger point injection
6.7 11. Orthodontics
3.8 12. Prosthetics
% Orthotics
46.2 13. Upper
60.5 14. Flat plane
90.1 15. Full time
76.5 16. Lower
36.4 17. Anterior repositioning splint
6.7 18. Part time
% Surgery

.1 19. Open joint

1.0 20. Arthroscopic
1.4 21. Arthrocentesis
0 22. Radio frequency

essentially remain unchanged, although as Table 4 suggests, symptoms actually worsen slightly for most physical symptom categories, as well as for all psychosocial subscales. As was shown in Tables 4 through 7, treated

patients showed consistent and clinically significant levels of symptom improvement. The data could not be clearer: TMD patients who are not actively treated do not spontaneously improve. Active treatment is essential for TMD symptom improvement.

The earlier paper cautioned that long-term outcomes could not be determined yet and that the longevity of the symptom improvements found was untested. The inclusion of a small long-term group now suggests that relapses are not common occurrences and that the efficacy of TMD treatments seems to remain intact over time. As Table 14 indicates, the 44 TMD patientsÕ symptoms changed only slightly in the eleven months after treatment was completed. There is no evidence that symptoms regress to the mean after the completion of treatment.

Table 14

Three Test Scores for 44 Long-Term
Follow-up Patients
(Std. Dev. in Parentheses)

	1st test	2nd test	3rd test
PR	1.71 (.77)	.70 (.52)	.66 (.57)
PP	1.22 (.79)	.36 (.44)	.38 (.54)
MO	1.78 (1.11)	1.15 (.86)	1.06 (.96)
JD	1.77 (.73)	.53 (.54)	.65 (.66)
RL	2.88 (.76)	1.17 (.71)	1.16 (.66)
NT	.87 (.54)	.49 (.38)	.50 (.38)
PF	.91 (.08)	.59 (.56)	.62 (.50)
ST	1.42 (.92)	.96 (.55)	1.03 (.60)
CN	.76 (.64)	.40 (.47)	.43 (.49)
GS	1.82 (.62)	.85 (.43)	.84 (.53)

Note: All of the differences between the 1st and the 2nd and the 1st and the 3rd tests are statistically significant at least at the .004 level. None of the differences between the 2nd and 3rd tests are statistically significant.

The efficacy of anterior repositioning appliances (ARA) over flat plane splints was demonstrated in Table

11. While no differences were found for pain, perceived malocclusion and range of motion scales, ARAs produced significantly more symptom improvement for the symptoms of internal joint derangement (Joint Dysfunction Scale), as well as overall symptoms, as measured by the Global Scale.

Vallon, et al.26 completed a seven-year follow-up of treatment outcomes in 50 patients with TMD of muscular origin. Patients were randomly assigned to a treatment group or to a control group of untreated patients. The authorsÕ findings suggest that a combination of treatment approaches (including appliance therapy, counseling, occlusal therapy, biofeedback, medications, and physiotherapy) resulted in better outcomes than single treatments. Sixty-five percent of all treated patients reported symptom improvement at the seven year follow-up. In the data discussed here, very few patients experienced

biofeedback, psychological counseling or equilibration therapy, yet substantial improvements were reported.

Ekberg and Nilner27 studied 60 patients assigned to two equally sized groups (a treatment group and a control group). The treated group was given an upper flat plane stabilization appliance to be worn at night for ten weeks, while the control group was given a control appliance to wear which had no effect on the occlusion. Their conclusions, similar to those in the present study, were that the

treatment group improved significantly more than the control group.

In conclusion, this study does not offer support for the hypothesis that untreated TMD patients improve spontaneously over time. Treated patients reported statistically and clinically significant levels of symptom improvement, without any evidence of post-treatment relapse.
Moreover, a treatment paradigm utilizing splint therapy (with ARAs being more effective overall), behavior modification and physical medicine modalities appears to be the most effective. The inclusion of a long-term follow-up cohort in this study allows an assessment of the longevity of treatment efficacy. In this limited sample TMD treatment benefits were not attenuated over time.

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