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Conventional and nonoccluding splint therapy compared for patients with myofascial pain dysfunction syndrome

The success of occlusal splint therapy for treatment of patients with myofascial pain dysfunction (MPD) is well documented,[1-15] and several techniques have been advocated for fabrication of occlusal stabilization splints.[5,6,10-13,16,17] Clark has discussed various theories about why these splints work.[18] A common element in all these theories is that the influence of a faulty occlusion is interrupted by the interposition of the splint between the maxillary and mandibular teeth. However, several papers in recent years have questioned the importance of occlusion as the dominant factor in the etiology of temporomandibular disorders.[19-23] If a faulty occlusion (which usually is thought to be characterized by balancing interferences or an asymmetric slide from retruded contact position to intercuspal position) is the predominating etiological factor, a hypothesis might be proposed that a conventional occluding splint would be more effective than a nonoccluding splint in relieving signs and symptoms of MPD. The only report that addresses this issue found the subjective responses to both an occluding and a nonoccluding splint to be roughly equal, thus casting doubt on the hypothesis. However, the report's lack of random assignment of patients and of objective measurements, and the lack of replication from other laboratories suggest that further research is needed.[4]

Here we report on an experiment that was performed to evaluate from both objective (clinical signs) and subjective (symptoms) viewpoints the therapeutic value of a conventional maxillary occlusal stabilization splint compared with a nonoccluding maxillary splint.

Methods and materials

Patients—Fifty patients responding to a newspaper notice were screened in the Graduate Clinic of the School of Dental Medicine at the State University of New York at Buffalo. Thirty met the criteria for acceptance into the study; two were eliminated (one dropped out and one failed to complete the study, and their data are omitted). Twenty-four patients were women and four were men. Their mean age was 33.7 years (range 18-to-62 years).

Acceptance criteria for patients diagnosed as having MPD were a complaint of facial pain and one or more of the following: limited opening, joint sounds, deviation on opening, and tenderness to muscle palpation. In addition, it was required that both clinical and radiographic assessment demonstrate absence of organic pathologic condition of the temporomandibular joint (TMJ).[24] Participants were required only to have enough maxillary teeth to retain an appliance without clasping. Patients were excluded from the study if they wore a complete upper or lower denture, had experienced recent major changes in occlusion, had third molar problems such as pericoronitis, had previously worn an occlusal splint, or were judged to have an alternative diagnosis for the cause of their facial pain.

Design—Twenty-eight patients were randomly assigned to wear either a conventional (occluding) or an experimental (nonoccluding) splint. Two dentists participated in this study, one as an examiner and one as a therapist. Neither the examiner nor the patient knew which type of appliance the patient wore. Moreover, the therapist was unaware of the data collected by the examiner during the six weeks of active treatment. Finally, patients were asked not to discuss their therapy with others in the study.

Data collection—Initial data collected included a medical and dental history and a panoramic radiograph. The examiner measured the maximal interincisal distance, deviation on opening, presence or absence of joint sounds, and tenderness derived from palpation of the following regions in order: temporalis, masseter, medial pterygoid, sternocleidomastoid, lateral pterygoid, suprahyoid, infrahyoid, suboccipital and trapezius muscle groups, and the lateral and intrameatal aspects of the TMJ.[25] Patient responses to palpation of each region were graded on a scale of 0 to 3 as follows: no response = 0; verbal report of discomfort = 1; verbal report of pain with facial movement such as palpebral reflex = 2; retreat of head in anticipation of palpation along with report of considerable pain upon contact = 3.[1,24] These responses were summed to obtain a palpation score.

In addition, the patients completed a pain diary daily and turned it in at the end of each week of treatment

(Fig. 1). Finally, a success rating form was completed at the end of the study. The rating form read as follows: "Please check the place that is most appropriate to describe your condition since wearing the splint: (1) worse, (2) no change, (3) slight improvement, (4) moderate improvement, (5) great improvement, (6) complete improvement."

Treatments—Maxillary and mandibular alginate impressions were made for each patient, and master casts were poured from these impressions.

Fifteen patients received conventional maxillary stabilization splints designed to cover all the maxillary teeth and provide flat plane occlusion with bilateral, simultaneous contact of all teeth in centric relation (Fig. 2).[3,6] In lateral excursion, guidance for canine teeth was preferred, while posterior disclusion and anterior tooth contact were required while in protrusion.

These splints were constructed in wax, while the patient was manually guided into a centric relation position. From this position, functionally generated markings were made in protrusive and lateral eccentric positions. In cases of deep overbite, it was often necessary to include canine contact in protrusive excursions. In some patients, a group function or canine-first premolar contact was required in lateral excursion. These appliances were then full flasked and processed for nine hours at 165° F in clear heat-cured acrylic resin (Microlon).*

Thirteen patients received the experimental or nonoccluding palatal appliance, which was constructed on the master cast and covered the palate and was entered into the lingual gingival embrasures (Fig. 3). If an existing removable partial denture was replaced by this splint, stock anterior nonoccluding teeth were added to the appliance where required to enhance cosmetic acceptance during treatment. The appliance was full-flasked and heat-processed for nine hours at 165° F in clear heat-cured acrylic resin. The palatal thickness of this appliance was approximately 2.5 mm in the center of the vault.

Participants were examined and their appliances adjusted weekly following the insertion of these splints. Adjustment of each splint continued until no further alterations were required at two consecutive appointments.[6] Each patient was advised to wear the splint 24 hours a day, removing it only for cleaning and eating. Patients in the nonoccluding splint group received mock splint adjustments each week by the therapist.

No attempt was made to explain the general nature of the subject's TMJ problem. However, the dentist-therapist remained supportive and optimistic regarding the potential benefits of the splint therapy. In addition to splint therapy, the therapist suggested that each patient apply moist heat to any painful regions of the face and neck. To alleviate harmful oral habits, all patients were instructed to place their lips together with their teeth apart and to keep their jaws relaxed as a two-minute daily home exercise. They were encouraged to repeat this procedure whenever possible.

Name: _____ Date of exam: _____

Directions: You are to rate the intensity of the pain in the jaw three times a day. Please try to fill this form out correctly. If you do not remember the intensity of the pain, just leave the space blank. Use a scale from 0-5. Use only one number per time period, the highest during that period. Also indicate any medications taken in relation to jaw pain—the amount, type, and time. Bring this form with you to your next appointment. Thank you!

0 = No pain at all.
1 = Some very slight pain. Easy to ignore. Feel it only if you think about it.
2 = Low pain. If you get involved in something, you forget about the pain.
3 = Medium pain. Annoying. Unable to ignore or forget about it even when involved in something.
4 = Strong pain. Begins to interfere with your ability to do things. Slightly incapacitating.
5 = Most intense pain ever experienced in area, or incapacitating. Unable to carry on with everyday activities.

Day	Date	Morning	Afternoon	Evening	Notes and medication

Fig. 1. Pain diary.

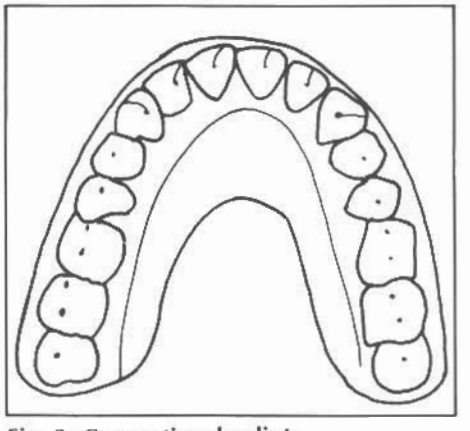

Fig. 2. Conventional splint.

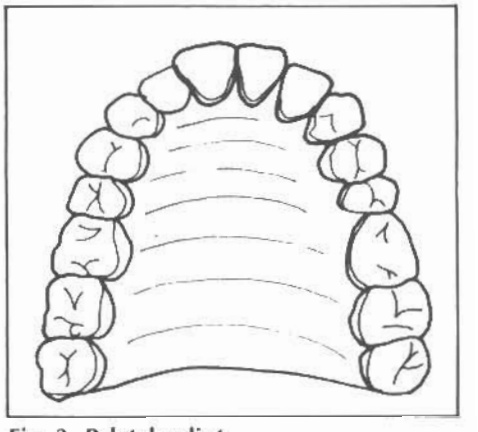

Fig. 3. Palatal splint.

Results

Conventional splint group—The group that received the conventional (occluding) splint consisted of 15 patients,

Table 1. Data for group with occluding splint

	Sex	Maximal opening*		Joint sounds		Palpation score		Deviation**		Pain diary		Success rating
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	
1	M	41	40	Y	N	3	1	N	N	1.33	0.19	4
2	F	59	49	Y	Y	7	7	Rt	N	0.60	0.00	3
3	F	48	50	Y	Y	2	0	N	N	2.09	1.19	4
4	M	37	41	N	N	3	2	N	N	1.65	1.17	4
5	F	52	48	Y	Y	13	10	N	N	0.77	1.08	4
6	F	49	54	N	N	5	0	N	N	0.69	0.15	4
7	F	51	53	N	N	26	15	N	N	1.00	1.00	5
8	F	47	50	Y	Y	19	17	N	N	0.81	0.48	5
9	M	41	42	N	N	26	25	Rt	Rt	0.90	0.95	3
10	F	55	59	Y	N	6	2	N	N	1.00	0.65	4
11	F	15	27	Y	N	2	0	Lt	Lt	3.00	1.33	4
12	F	36	41	Y	N	23	6	N	Rt	2.80	2.20	5
13	F	54	56	Y	Y	14	10	N	N	0.83	0.13	5
14	F	42	42	Y	Y	10	5	N	N	1.56	0.37	5
15	F	50	54	Y	N	11	8	Rt	N	—	—	4

Table 2. Data for group with nonoccluding splint

	Sex	Maximal opening*		Joint sounds		Palpation score		Deviation**		Pain diary		Success rating
		Initial	Firtal	Initial	Final	Initial	Final	Initial	Final	Initial	Final	
1	F	37	42	N	Y	8	4	Lt	N	1.67	1.46	5
2	F	54	—	Y	—	16	—	N	—	1.90	—	5
3	F	40	39	N	N	14	20	Rt	Rt	3.62	3.22	3
4	F	47	48	Y	Y	9	2	N	N	2.15	0.00	4
5	F	46	47	Y	Y	10	3	N	N	1.79	0.00	5
6	F	29	35	N	N	18	20	N	N	0.92	1.14	3
7	F	58	56	N	N	9	5	N	N	2.76	0.00	6
8	M	49	48	Y	Y	4	6	N	N	1.69	1.27	4
9	F	47	50	N	N	12	16	N	N	2.73	1.00	4
10	F	54	52	N	N	9	5	N	N	2.33	2.32	2
11	F	53	52	Y	N	10	7	N	Rt	2.63	0.03	5
12	F	49	—	Y	—	0	—	N	—	0.77	—	4
13	F	53	50	Y	Y	9	4	Rt	N	0.52	0.30	5

*mm **N = none; Rt = to patient's right; Lt = to patient's left

3 men and 12 women (Table 1).

The measurements have been divided into objective (the clinical signs) and subjective (the symptoms) categories. For the objective measurements, results were as follows: the average maximal opening before treatment was 45.1 mm and after treatment it was 47.1 mm. The average increase in maximal opening was 2.0 ± 4.8 mm (mean ± standard deviation) and was not statistically significant (t test, $p>.05$). Joint sounds were observed in 11 of the 15 patients before treatment and 6 of 15 after treatment. The decrease in the number of patients with joint sounds was significant ($p = .031$, McNemar test).[26] The initial palpation score averaged 11.3, the final palpation score averaged 7.2, and the average decrease was 4.1 ± 4.4. The initial and final scores differed significantly when tested by either the paired-t test ($p<.05$) or the nonparametric Wilcoxon matched pairs signed ranks test ($p<.005$). The deviation on opening was lost by two patients during treatment and acquired by one (not significant, binomial test).

For the subjective measurements, results were as follows: the mean score of the pain diaries decreased from 1.36 ± 0.78 to 0.78 ± 0.61 with a mean decrease of 0.58 ± 1.89 and was significant (paired-t test, $p<.05$). The frequency of responses by the patients in this group to the success rating question were as follows: worse = 0, no change = 0, slight improvement = 2, moderate improvement = 8, great improvement = 5, and complete improvement = 0. Thus, 13 of 15 patients (87 percent) reported moderate to complete improvement.

Nonoccluding splint group—The group that received the nonoccluding splint originally was to consist of 15 patients; however, two dropped out of the study completely and another two had incomplete data. Of the remaining 11, there was 1 man and 10 women (Table 2).

Results of the objective measures were as follows: The average maximal opening was 46.6 ± 8.5 mm before treatment and 47.2 ± 6.2 mm after treatment. The mean increase, 0.55 ± 2.98 mm, was not significant (paired-t test, $p>.05$). Joint sounds were observed in five patients both before and after treatment. The mean palpation score decreased from an initial rating of 10.2 ± 3.6 to a final rating of 8.4 ± 6.8. The mean of the differences, 1.82 ± 4.51, was not significantly different from zero by the paired-t test or the Wilcoxon test. For the deviations, three were observed initially and two finally; two lost the deviation and one acquired it (not significant, binomial test).

Results of the subjective measures were as follows: The mean pain diary score decreased from 2.1 ± 0.9 to 1.0 ± 1.1. The mean decrease of 1.1 ± 1.1 was statistically significant by the t test ($p<.05$) and the Wilcoxon matched pairs signed ranks test ($p<.005$). The responses to the success rating question were as follows: worse = 0, no

change = 1, slight improvement = 2, moderate improvement = 4, great improvement = 5, and complete improvement = 1. Thus, 10 of 13 patients (77 percent) reported moderate to complete improvement.

Comparisons between groups—Inspection of the data indicates that the maximal openings were very close between the two groups both before and after treatment.

The numbers of patients who acquired or lost joint sounds during treatment were compared between the two groups using Fisher's exact test. The groups failed to differ significantly ($p = .28$).

The decrease in palpation scores was not significantly greater in the occluding splint group than in the nonoccluding splint group (t test, $.05<p<.10$).

Deviations were also examined and did not differ between the two groups ($p = .6$, Fisher's exact test).

One subjective measure, the pain diary, also provided nearly identical changes for the two groups. The other subjective measure, the rating of success, showed no significant difference between the success rating of the two groups as tested by the Mann-Whitney U test or by the Chi square test. The statistical results are summarized in Table 3.

In summary, none of the measures showed significant differences in treatment effectiveness between the group that received the occluding splint and the group that received the nonoccluding splint.

Table 3. Statistical significance of results

Measures	Within group		Between groups
	Occluding	Nonoccluding	
Objective			
Maximal opening	No	No	No
Joint sounds	Yes	No	No
Palpation score	Yes	No	No
Deviation	No	No	No
Subjective			
Pain diary	Yes	Yes	No
Success rating	*	*	No

*Post-test data only, so no within-group test

Discussion

The main finding of this study was our inability to show a significant difference in treatment outcome between the group that received an occluding splint and the group that received a nonoccluding splint. Random assignment of patients to groups, separate dentists for observation and treatment, and assessment of both objective and subjective clinical measures were all used to provide a fair comparison between treatment modalities.

Greene and Laskin used a nonocclusing splint on all patients; then nonresponding patients received occluding splints, first with anterior occlusal contacts only, then, if necessary, full arch occlusal contacts.[4] In spite of the differences in methods, results of both that study and the present one indicate the same general conclusion: both nonoccluding and occluding splints are effective in ameliorating subjective symptoms.

The methods used in the present study require some critical evaluation before the results can be interpreted to mean that occlusal influences are not important. Such an interpretation would depend on the absence between the two splint groups of significant differences with the measures employed. We will discuss splint fabrication, sample sizes and appropriateness, measurement techniques, treatments common to both groups, duration of the study, and differences between the two types of splints.

First, the occlusal splints may not have been fabricated with sufficient skill. It may be argued that the success of any occlusal splint therapy depends heavily on the technical and diagnostic skills of the therapist. In that regard, fabrication and adjustment of splints to conform to commonly accepted occlusal guidelines (even centric contacts, anterior guidance, and no balancing interferences) were given careful attention. Moreover, the significant decrease in palpation scores in the conventional splint group, the reduction in the number of patients with joint sounds, and the large number of patients who reported moderate to complete improvement indicate that the splints were fabricated with skill equivalent to that of other investigators. Specifically, the cure rates obtained here, above 75 percent for each group, are above the median of 67 percent for many other studies reviewed by Strychalski et al.[27] Thus, the degree of skill in fabricating splints is probably not the reason for the lack of difference between treatment modalities.

Second, the sample sizes may not have been sufficient to demonstrate differences between the two types of splints. Statistical power analyses of the present data suggest that to show differences between the two groups with an alpha level of 0.05 and a beta level of 0.20, samples would be required of about 200 in each group for maximal opening and over 30 in each group for the palpation scores. Thus, it is possible that doubling the size of the sample might have shown significant differences in palpation scores between the two groups. On the other hand, response to muscle palpation is usually considered to be a sign, not a symptom, and may be more interesting to the clinician than to the patient.

Third, the sample of patients may not have been representative of the population of patients with MPD.[28] We obtained our sample through responses to a notice in a newspaper rather than the more common referral sources. Thus, our sample may have been biased toward milder conditions that were tolerable to the patient until prompted by a media notice.

Fourth, the measurement techniques may have been inadequate. This can be rejected on the basis that the same signs and symptoms that were involved in the patient's seeking treatment were used to assess the success of treatment.

Fifth, common elements in both treatments may have contributed to the success of treatment and thereby precluded showing a difference between splints. These elements include the support provided by the therapist, the moist heat and exercise (physical therapy) recommended by the therapist, and the academic setting of the treatment. It may be of importance that while we

applied a different splint treatment to each of two groups, two other treatment modalities (support and physiotherapy) were provided for each group.[29-31] These modalities might have provided the common denominator of success for both groups, in effect masking any differences due to splint type. Therefore, the alternative of common treatment elements cannot be excluded by data internal to our experiment.

Sixth, it is possible that six weeks is an insufficient amount of time for assessing treatment outcome. Results of this study might therefore be classified as short-term results. Both groups, however, showed reasonably good short-term success rates, so an additional few weeks of study would not be likely to reveal a difference between the two treatment groups.

Finally, while we considered the issue of occlusion versus nonocclusion to be the primary difference between the two splints, another difference was that the nonoccluding splint covered the whole palate, while the occluding splint did not. Several authors suggest a possible physiological effect of any maxillary appliance in that the available tongue space is lessened, possibly mediating an alteration in the neuromusculature.[4,32-34] Since the nonoccluding splint may have interfered with tongue space more than the occluding splint, this difference could have confounded the results.

Summary

Twenty-eight patients with MPD were treated with conventional maxillary occlusal stabilization splints or with nonoccluding splints. One dentist fabricated and adjusted the appliances while another dentist, unaware of the treatment modality, measured changes in maximal jaw opening, deviations of the jaw, palpable irregularities of the TMJ region, and tenderness of various muscle regions. Patients also completed a pain diary and were asked to rate their general improvement at the completion of treatment.

The following results were observed: Clinical palpation scores and the number of patients with joint sounds showed a significant decrease (improvement) in the occluding splint group, but not in the nonoccluding splint group. Weekly scores in pain diaries showed significant decreases (improvement) in pain in both groups, and a subjective success rating showed considerable improvement in both groups. However, none of the pre- to post-treatment differences showed a statistically significant difference between the two groups.

From these data, it is concluded that a conventional occluding splint may be more effective than a nonoccluding splint in relieving clinical signs of dysfunction, but both conventional and nonoccluding splints seem to relieve symptoms equally.

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