
Anterior midline point stop device (AMPS) in the treatment of myogenous TMDs: Comparison with the stabilization splint and control group

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Two occlusal splints, the full-arch stabilization splint and the anterior midline point stop (AMPS) device, were evaluated for their efficiency in relieving myogenous temporomandibular disorders (TMD). One hundred and fourteen patients with myogenous TMD were distributed into 3 groups. The first group was treated with the AMPS device, the second with the stabilization splint, and the third group was the control group. Pain intensity was scored using the visual analogue scale before treatment and 1 month and 3 months after treatment. Statistical Package for the Social Sciences (SPSS, Chicago, Ill) and multiple comparisons tests were used to compare results before and after treatment and to compare the groups. The use of AMPS device in the first group resulted in a significant improvement after 1 month and 3 months ($P \leq .001$) and showed a 56.66% pain reduction. A significant improvement was also noticed in the second group ($P = .001$) with a 47.71% pain reduction. Although pain reduction percentage appeared more in the first group, this was not statistically significant. There was a highly significant difference between groups treated with both kinds of splints and the control group. It was concluded that both types of occlusal splints are beneficial to patients with myogenous TMD. (**Oral Surg Oral Med Oral Pathol Oral Radiol Endod** 2006;101:741-7)

High masticatory muscle activity, especially in the masseter and temporalis muscles, was found in patients with myofascial pain compared with healthy individuals.^{1,2} Reduction of masseter and temporalis muscle activity has been reported in both patients and healthy individuals when exposed to occlusal splints.¹⁻⁵

Various types of removable intraoral splints have been recommended for the treatment of patients with temporomandibular disorder (TMD) syndrome. Some clinicians consider the splints as merely a symptom-relieving modality,^{6,7} others believe that successful splint therapy confirms the presence of occlusal disharmonies and that appliances should be used to locate or establish a proper intermaxillary relationship after relief of symptoms and before occlusal reconstruction.^{8,9}

One treatment option for myogenous TMDs is an occlusal stabilization splint, which is beneficial in reducing symptoms up to 70% to 90% in patients with TMD. However, there is no agreement concerning their action mechanism.^{10,11} Moreover, there are contradictory reports regarding the efficacy of splint therapy in TMD patients.

Greene and Laskin¹² studied 2 types of occlusal splints that were designed to relieve symptoms of patients with TMD and compared them with a third group who received placebo splints. Of the 71 patients in the study, 84% reported some improvement in their condition when they used the occlusal splints. Similar results were found by other studies.^{13,14}

The stabilization splint was found to be more effective in relieving symptoms, both subjectively and objectively, in TMD and internal derangement patients.¹⁵⁻¹⁷

Gavish et al.¹⁸ evaluated the efficiency of the stabilization splint in reducing signs and symptoms in TMD patients. They had a therapeutic group opposing a control, undergoing a functional chewing test. The stabilization splint group had a statistically significant reduction in pain intensity, in mean muscle sensitivity to palpation, and in the pain experience during the chewing test compared with no change in the controls. They concluded that stabilization splints have therapeutic value beyond its placebo effects.

On the other hand, Rubinoff et al.¹⁹ and Dao et al.²⁰ reached the conclusion that flat occlusal splints had no significant role in the treatment of TMD.

Raphael and Marbach²¹ tried to explain the controversies in the previous studies. They supposed that there may be some subtypes of myofascial pain that respond to oral splints more than others. They studied the state of widespread pain (fibromyalgia) as opposed to local-sited myofascial pain and concluded that oral splints positively affect local myofascial pain cases and reduce pain intensities while they fail to cause improvements in patients suffering widespread pain (fibromyalgia).

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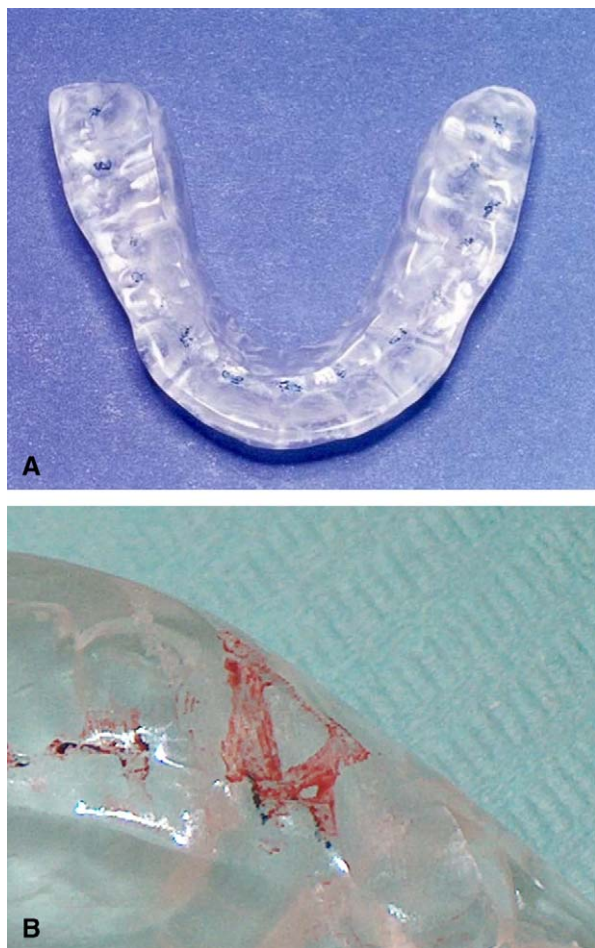


Fig. 1. **A**, The stabilization splint with centric stops in blue. Even contact between the splint and all opposing teeth in the centric relation jaw position is achieved. **B**, The red V-shaped mark indicates that ideal anterior guidance is provided.

Great attention has been given to the full-arch stabilization splint, which proved to be a successful option in many studies.¹⁵⁻¹⁸ Therefore, as in any other treatment modality, disadvantages were encouraging further investigations leading to design modifications. It is presumed that the anterior midline point stop (AMPS) device is a splint that takes advantage of the jaw-opening reflex by stimulating the nociceptive trigeminal inhibition receptors at the lower anterior teeth periodontal ligament, which in turn signals the trigeminal nerve to inhibit elevator muscle contractions. This kind of splint is becoming a widely used treatment option in the United States with little if any studies to support its use.²² This study aims to evaluate the efficiency of 2 occlusal splints (AMPS, stabilization splint) in relieving myogenous TMDs and compare the 2 appliances in relieving symptoms.

MATERIALS AND METHODS

This study involved 114 patients with myogenous TMDs. These patients were selected randomly from diagnosed cases at the Jordan University of Science and Technology Health Center. Every patient had at least 1 symptom, such as masticatory muscle pain, limitation, deviation, or tenderness that characterizes the myogenous TMD, and excluded any patient with articular problems. All subjects had class 1 incisal relationships and did not use any dental prosthesis.

Diagnosis was done by the basic chair-side examination procedure. Severity of pain before and after treatment was measured using visual or linear analogue scale (VAS).

The patients were divided into 3 groups of 38 patients each. The first received the AMPS device, the second group received the full-arch maxillary occlusal splint (SS), and the third constituted the control group.

AMPS and SS appliances were constructed in the dental school laboratory using clear heat cure acrylic resin (Meliodent, Heraeus Kulzer, Wehrheim, Germany) and were modified at the chair side for occlusal needs or relining. Patients were instructed not to use any type of therapeutic drugs (eg, tranquilizers, nonsteroidal anti-inflammatory).

The stabilization splints were constructed to give stability in the patient's mouth; balanced in centric relation; equal intensity stops on all teeth; immediate posterior disclusion in lateral, protrusive, and extended lateral excursions (crossover); a "skating rink" surface; smooth transitions; comfort during wear; and reasonable esthetics (Fig. 1).

At the delivery visits, repetitive adjustments of the splint were made after marking the occlusal contacts with thin articulating film until the full range of centric stops were achieved. Patients were instructed to use the splints only at night.

Patients were reviewed on weekly basis to ensure that splints were in the correct shape, but assessments were taken on the VAS only 1 month and 3 months after delivering the splints.

The AMPS device covers the upper central incisors and allows for a point stop (discluding element), typically perpendicular to the long axis of lower incisors, and ideally on the mesial incisal edges of the 2 lower centrals and discludes the posterior teeth (Fig. 2).

The AMPS devices prevented posterior and canine occluding in all excursive and protrusive movements. The point or the discluding elements were ramped antro-posteriorly to provide a smooth path in protrusion while horizontally narrow enough to prevent the canines from touching it.

The control group received no treatment during the study period, only assurance, and they were told that if



Fig. 2. **A**, Frontal view showing the AMPS device fitted on the 2 upper central incisors. **B**, The discluding element of the device touches the 2 lower central incisors only by a single point.

they weren't improved at the end of the study they would receive appliances free of charge.

Patients scored pain severity on the VAS after 1 month and 3 months. Signs and symptoms were recorded at every follow-up visit using the VAS, and patients were asked to state any discomfort and comment on any advantages and disadvantages. Appliances were adjusted at every visit for any occlusal interference.

Results were analyzed in the computer using the Statistical Package for the Social Sciences (SPSS, Chicago Ill), and multiple comparison tests were used to compare results before and after treatment and to compare the groups.

RESULTS

One hundred and fourteen patients with myogenous TMD were involved in this study, 49 (43%) were males and 65 (57%) were females. The mean age for all patients in all groups was 33.5 years, ranging from 15 to 62 years old. The mean age for the first group (AMPS) was 32.7, the second group (SS) was 31.8 years, and 36 years for the control group. There were no significant age differences within the groups.

The pretreatment pain severity scores obtained from the VAS are shown in Table I. Before treatment, the VAS scoring for the first group (AMPS) ranged from 2.5 to 9.6 with a mean of 6.29. After 1 month of treatment

Table I. Severity of pain scored by VAS scale and amount of pain reduction before and after treatment for the 3 groups

Device	n	Minimum	Maximum	Mean	SD
AMPS (group 1)					
Before Treatment	38	2.50	9.60	6.29	1.88
1 month after treatment	38	0.80	7.00	3.65	1.60
3 months after treatment	38	0.30	6.80	2.62	1.80
Pain reduction after 1 month	38	-5.60	0.70	-2.64	1.72
Pain reduction after 3 months	38	-7.50	0.30	-3.67	2.13
SS (group 2)					
Before treatment	38	2.60	9.50	6.32	1.57
1 month after treatment	38	0.40	7.30	4.12	1.73
3 months after treatment	38	0.00	7.00	3.2	1.73
Pain reduction after 1 month	38	-7.00	0.70	-2.19	1.98
Pain reduction after 3 months	38	-9.50	0.30	-3.12	2.21
Control (group3)					
Before treatment	38	4.60	8.70	6.35	1.34
1 month after treatment	38	3.80	8.50	6.12	1.38
3 months after treatment	38	3.80	8.30	5.71	1.23
Pain reduction after 1 month	38	-2.60	1.20	-0.17	0.88
Pain reduction after 3 months	38	-3.50	2.00	-0.59	1.08

AMPS, Anterior midline point stop; SS, stabilization splint.

Table II. The significance of improvement after 1 month and after 3 months for the 3 groups

Device	t	df	Significance (2-tailed)
AMPS after 1 month	9.44	37	.000
After 3 months	10.61	37	.000
SS after 1 month	6.82	37	.000
After 3 months	8.71	37	.000
Control after 1 month	1.39	37	.172
After 3 months	3.16	37	.051

AMPS, Anterior midline point stop; SS, stabilization splint.

scores ranged from 0.8 to 7.0 giving a mean of 3.65. The scores' mean became 2.62 at the end of the third month and ranged from 0.3 to 6.8.

The second group started with a mean of 6.32 and a range from 2.6 to 9.5. VAS scores recorded after 1 month ranged from 0.4 to 7.3 with a mean 4.12. At the end of the third month VAS scores ranged from 0 to 7 giving a mean of 3.2 (Table I).

The control group started with mean VAS score similar to the previous groups: 6.35, ranging from 4.6 to 8.3. There was little reduction after 1 month with 6.12 mean and at the end of the third month the mean for the VAS scores was 5.71.

Percentage of pain reduction was calculated by dividing the difference between mean scores at the third month and baseline divided by the mean score at baseline (Table I). This calculation revealed a 56.66% pain reduction for the group receiving the AMPS device (first group) and a 47.71% reduction for the group receiving the SS (second group) within 3 months of

treatment. There was only 13.41% pain reduction in the control group.

The Student *t* test comparing the 2 means showed that using the AMPS device for the patients in the first group resulted in a significant improvement after 1 month and 3 months ($P \leq .001$; Table II). A significant improvement was also noticed after 1 month and 3 months with patients in the second group who received the SS ($P = .001$; Table II). There was no significant improvement in the control group (Table II).

Multiple comparisons were carried out to examine the differences in the pain reduction among the 3 groups as shown in Table III. Before any treatment there were no differences at all between the 3 groups, with similar VAS average in the baseline scores. After treatment with either AMPS device or SS, a highly significant difference was found in both groups when compared to the control group ($P \leq .001$). Although pain reduction percentage appeared more in the group treated with the AMPS device, this was not statistically significant ($P = .55$ after 1 month and $P = .37$ after 3 months) and both splints were not different in their success rate when tested based on their marginal means as shown in Table III. Figure 3 shows the linear drop in the severity of pain from pretreatment points until the last assessment (after 3 months) for the 3 groups. Although more reduction of pain appears with the AMPS device, this was statistically insignificant.

DISCUSSION

The reduction of painful symptoms with appliance therapy has been well documented. Many studies

Table III. P values showing the differences between different groups based on estimated marginal means before treatment, 1 month after treatment, and 3 months after treatment

Dependent variable	(I) Device	(J) Device	Mean difference (I - J)	SE	Significance	95% Confidence Interval	
						Lower bound	Upper bound
Severity of pain before treatment	AMPS	SS	-.026	.3708	1.000	-.928	.875
	AMPS	Control	-.053	.3708	1.000	-.954	.849
	SS	Control	-.026	.3708	1.000	-.928	.875
Severity of pain after 1 month	AMPS	SS	-.471	.3544	.559	-1.332	.390
	AMPS	Control	-2.468*	.3544	.000	-3.330	-1.607
	SS	Control	-1.997*	.3544	.000	-2.859	-1.136
Severity of pain after 3 months	AMPS	SS	-.571	.3689	.374	-1.468	.326
	AMPS	Control	-3.082*	.3689	.000	-3.978	-2.185
	SS	Control	-2.511*	.3689	.000	-3.407	-1.614

AMPS, Anterior midline point stop; SS, stabilization splint.

*The mean difference is significant at the .05 level.

have found resolution of symptoms after insertion of occlusal appliances.^{18,23-27} In this study patients expressed a significant reduction of pain when treated either by AMPS or SS interocclusal splints (SS, 47.71% reduction; AMPS device, 56.66%). The results of this study support that the reduction in myogenous TMD pain is due to the use of either AMPS or SS and is not due to other factors, because when these findings were compared with the control group a highly significant difference was reported ($P \leq .001$). These results support and reproduce previous documentation concerning the SS.^{15-17,28,29} The AMPS device, which previously received little attention by researchers, was also shown to be impressively effective by this study.

Most clinicians instruct their patients to use their appliances until resolution of symptoms is achieved. This period is followed by a weaning-off period until the use of the appliance is totally discontinued. Patients not showing any positive response within 3 to 4 weeks are reevaluated, and further investigations are usually indicated.³⁰ No specific overall treatment time is agreed on, but splint therapy has shown to be effective over time.^{10,27,28}

Following up the 2 groups of patients who received intraoral occlusal splints in this study for 3 months showed that pain reduction was significant after 1 month of treatment, and this reduction continued to be significant during the following 2 months. It seems that 3 months of splint therapy is satisfactory if it is followed by periodic evaluation and a sufficient weaning-off period. From a research point of view, 3 months of follow-up may be enough to evaluate the mood of progress done by the splints.¹⁰ Short-term studies that report success of various therapies need to be questioned regarding their actual effect, if the fluctuation of symptoms associated with chronic pain conditions is addressed. "Regression to the mean" is a statistical term

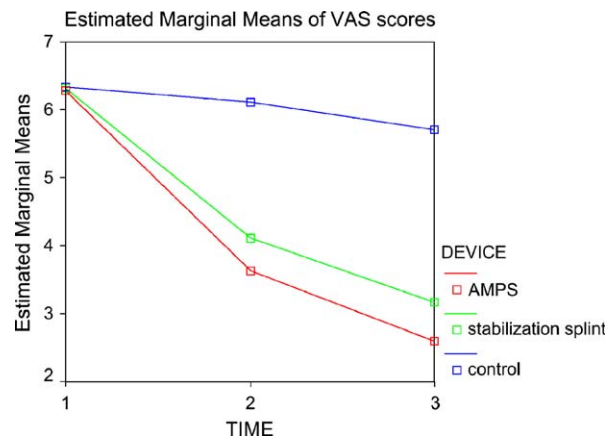


Fig. 3. Linear drop in the severity of pain using 2 devices (red, AMPS; green, stabilization splint; blue, control group) throughout the treatment period.

that addresses this issue.¹⁰ Pain intensity often varies on a daily basis. When using the VAS, patients should report an average of their pain. If patients visit the clinic when the intensity exceeds the mean and regression to the average occurs after therapy, the clinician must question if pain reduction is a result of therapy or a natural regression to the mean. Short-term studies lack the ability to differentiate this issue.

The study groups were instructed to wear their splints only at night. This appeared to be effective since reduction of symptoms was significantly recorded. Wilkinson et al.³¹ suggested that nocturnal use of occlusal splint only was more successful in patients with muscle disorders, whereas patients with articular disorders benefited from continuous occlusal splint. This agrees with our findings since we are dealing with patients with myofascial pain and excluded any patient with articular problems.

The unified concept of TMD etiology (1 cause, 1 disease) has been questioned, and the trend has shifted to accept the more applicable multifactorial etiology concept.²⁷ One of the implications of this concept is that it helps to explain the diversity of school of thought regarding interocclusal appliance designs, where each design is aimed to deal with a specific expected etiological factor. Despite these various designs, all splints have common features that may explain why occlusal appliances reduce symptoms. They all alter occlusal conditions and condylar positions, increase the vertical dimension, increase peripheral input to the central nervous system, and have a cognitive awareness and a placebo effect.

Clinicians have not agreed on an optimal splint design that could be considered superior over the others.^{18,27} A good reputation has accompanied the SS despite its disadvantages. Great enthusiasm has introduced the AMPS device as a simple, comfortable, easily constructed, and, most important, very effective splint. Patient cooperation is one of most important factors on which the success or failure of occlusal appliance therapy depends.¹⁰ Patients who do not respond favorably to this therapy should be questioned regarding their compliance with the prescribed use of the appliance. Therefore, this was ensured when comparing the SS with the AMPS device in the present study. It was clear while interviewing the patients that they find the AMPS easy to use and comfortable, while the bulkiness of the SS has led to some complaints in the second group using it. Continuous encouragement was needed to ensure compliance. In our opinion this could be a very important advantage of the AMPS over the SS since better cooperation can be gained with the device.

On the other hand, some of the patients who used the AMPS device complained of slight soreness in the upper anterior teeth at the beginning and it goes away as they continue using it. A few patients experienced a sort of disorientation that their bite became quite strange and it took them a short time to find their correct bite. It seems that the AMPS causes a kind of deprogramming to the muscles of mastication similar to what has been reported by other kinds of splints.¹⁰ Movements in the teeth or changes in the occlusion have not been in any of the patients who used both splints and this supports the findings of Kinoshita et al.³² that for posterior teeth to super erupt it must go unopposed without any contact for at least 8 days. Therefore, since AMPS or any other removable splint must be removed whenever the patients eat, the daily masticatory stimulation of the molars prevents their super eruption.

It is apparent from Fig. 1 that, although the tendency was for a better pain reduction in patients treated with the AMPS when compared with SS, the difference was

not statistically significant; ie, both types of occlusal devices used in this study resulted in an improvement within the same time duration with no statistically significant difference. Although the 2 splints appear, in some respects, to be opposed in both objective and mood of action, this may not be applicable to all aspects. Both could induce changes in the cognitive awareness and result in behavioral modification of the patients.^{10,14} More importantly, both remove the possibility of the patient occluding in their habitual bite. Finally, although the SS removes posterior interferences by design, the AMPS device may do the same by accident.

As Greene and Laskin³³ pointed out in 1972, it is important to note at this point that the preoccupation with the mechanical dynamics of splints unfortunately has caused most investigators to overlook the potential psychological effects of these appliances. The combination of physical and psychological effects produced by splints will contribute significantly to their clinical success. Thus any hypotheses about the mechanisms of splint therapy for myofascial pain dysfunction problems that is based solely on the effects of the occlusal platform, or that considers only changes in the vertical or horizontal placement of the mandible, is necessarily incomplete.

CONCLUSIONS

The use of occlusal SS and AMPS device has significantly reduced the pain intensity in patients suffering from myogenous TMD. In this study there was no significant difference between the AMPS device and the SS regarding their success rate, but patients were more cooperative while dealing with the AMPS device. The use of the VAS was very useful and easy to use in recording the intensity of myofascial pain.

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