Efficacy of Soft Occlusal Splint Therapy in Management of Temporomandibular Disorders

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Abstract:

Aim: Assessment of the role of night guard as a simple soft occlusal splint therapy for treatment of patients having myofascial pain dysfunction syndrome or internal derangement of TMJ in form of anterior disc displacement with reduction. ***Patients and Methods:*** This study involved 37 patients (16 males and 21 females) aged 26 to 45 years. They were suffering from myofascial pain dysfunction syndrome (MPD) or internal derangement (ID) of TMJ that had anterior disc displacement with reduction (ADDR). A vacuum made soft occlusal splint (night guard) which was fabricated from rubber sheets of 2 mm thickness to fit the upper arch. It was worn for 4 months. Patients were recalled monthly for this whole period to check for any occlusal tearing of the night guard. All the parameters for TMJ functions were measured preoperatively and monthly till the last time interval at 4th month postoperatively. ***Results:*** There was a progressive decrease in pain scores, muscles tenderness, TMJ clicking and tenderness with various jaw movements and significant improvement in mouth opening in patients on soft occlusal splint therapy during the follow-up period. ***Conclusions:*** Occlusal splint therapy of TMJ using soft night guard has better long-term results in reducing the symptoms of MPD syndrome and improves the internal derangement of TMJ.

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Keywords: Occlusal splint; Night Guard; MPD; Internal Derangement; TMJ.

1. Introduction:

The temporomandibular system consists of two fundamental components; the temporomandibular joint (TMJ) and the associated neuromuscular system, *Kafas and Leeson (2006).*

A temporomandibular disorder (TMD) can result from any defect of one or both. Any problem that prevents this composite system of muscles, bones and joints from working in harmony may result in this disorder, *Kafas and Leeson (2006).* Symptoms may be unilateral or bilateral and involve the face, head or jaw, *Kafas and Leeson(2006).* The American Academy of Orofacial Pain (AAOP) classification divides TMD broadly into muscle-related TMD (myogenous), and joint-related TMD (arthrogenous). The two types can be present at the same time, making diagnosis and treatment more testing, *Kafas and Leeson (2006).* Etiology of temporomandibular disorders is multifactorial. It includes Trauma (such as traumatic injuries from eating, wide jaw opening, and dental management); Bruxism (refers to a non-functional grinding and clenching of the teeth); Malocclusion (causes inappropriate pressure on the joint); Stress and psychiatric illness, *Seligman et al (1982)*; *Fearon and Serwatka (1983); Pullinger and Seligman (1991); Lavigne et al (2008).* TMD is clinically characterized by pain in the temporomandibular region or in the muscles of mastication, pain radiating behind the eyes, in the face, shoulder, neck and/or the back, headaches, ear-ache or tinnitus, jaw clicking, locking or deviation, limited jaw opening, clenching or grinding of the teeth, dizziness and sensitivity of the teeth lacking oral disease, *Pollmann (1993); Kafas et al (2007).* Pain is the most frequently taking place symptom for which patients seek medical attention, *Dworkin et al (1990).* A subset of patients who have TMDs do not experience pain, but complain of popping, clicking, and other noises that emanate from the TMJ while the joint is in motion. On rare occasions, the TMJ may lock, which allows a little or no motion of the mandible. Symptoms can range from barely noticeable to seriously debilitating, *Dworkin and Truelove (1997).* Conservative treatment includes homecare practices (soft diet, jaw exercises, physical therapy, steam baths, muscle massage) *Reisine and Weber (1989);* Occlusal adjustment (repositioning the mandible in a centric position by prosthodontic or orthodontic means and/or occlusal equilibration), *Lundh et al (1988); a*nalgesia and psychotropic medication (such as NSAIDs & diazepam), *Greene (1992)*; Splint therapy, *Kafas et al (2007)*; Complementary therapy (acupuncture therapy, dry needling, trigger points injections), *List et al (1993)* and other treatment modalities (ultrasound, soft laser, diathermy, infrared), *Mohl et al (1990).* Surgical treatment (irreversible) includes three different

treatments for internal derangement of TMJ, i.e., discoplasty, discectomy without replacement, and discectomy with replacement of the disc with a Proplast-Teflon interpositional implant, *Tolvanen et al (1988); Peltola et al (2000).* An occlusal splint is a removable dental appliance that covers several or all of the upper or lower teeth. Different types of splints are available: Stabilization (flat plane) splint; Modified Hawley splint; and Repositioning splint, *Wright et al (1995).* Occlusal splint is relatively simple, reversible, non-invasive and costs less than other treatments. However, the mechanism by which occlusal splints work in alleviating signs and symptoms of such a disorder is still controversial, *Mona et al (2004).* A wide variety of occlusal splint designs is currently available. The majority of comparative studies that evaluated different splint designs relied only on the case history and clinical examination for diagnosing disc displacement, *Lundh et al (1985); Reisine et al (1989).* Soft splints have been advocated for patients with TMD, they can be made for maxillary arches and are easily constructed and often inserted immediately at the initial examination, *Wright et al (1995).* A high degree of patient acceptance has been reported with soft splints. The soft resilient material may help in distributing the heavy load that occurs during parafunctional activity, *Okeson (2003).*

Some theories that tried to explain its mechanism include alteration or improvement of occlusal condition, change in peripheral (motor or afferent) impulses to the central nervous system, alteration or raise in the vertical dimension, alteration of the temporomandibular joint (TMJ) condylar position and increase in the cognitive awareness, *Dylina (2001).*

Aim of the present study was assessment of the role of night guard as a simple soft occlusal splint therapy for treatment of patients having myofascial pain dysfunction syndrome or internal derangement of TMJ in form of anterior disc displacement with reduction.

2. Material and Methods:

2.1. Material:

2.1.1. Sample of the study:

This study involved 37 patients; 16 males and 21 females, who were referred to department of Oral and Maxillofacial Surgery, Faculty of Oral & Dental Medicine, Cairo University at the period from January 2010 till November 2011. Their ages were 26 to 45 years.

Criteria of Patients Selection: All included patients were suffering from myofascial pain dysfunction syndrome **(MPD)** or internal derangement **(ID)** of TMJ that had anterior disc displacement with reduction **(ADDR)**. TMJ **ID** was postulated to have a positive history of joint noise, a reciprocal click, and normal range of motion. Patients suffering from chronic Myofascial pain for a minimum duration of three months were included in this study.

Diagnostic criteria of MPD included:

i) Tender muscles of mastication, often accompanied by neck and strap muscles tenderness.

ii) Restricted or deviated mandibular movement caused by muscular restriction.

2.2. Methods:

2.2.1. Pre-operative examination:

A detailed history was recorded for each patient at the time of diagnosis regarding onset, duration and progress of symptoms & Pain characteristics like type, nature and severity were noted & Pain response to jaw activities such as mastication, phonation, and deglutition were recorded. Intensity of pain was recorded using Visual Analog Scale (VAS, 10 cm line). The extremes were labeled as no pain and worst possible pain. After taking history, maximum comfortable mouth opening of all patients was recorded. TMJ examination included assessment of clicking, tenderness at rest and during various jaw movements (opening, closing, right and left lateral, protrusion and retrusion) and deviation during opening and closing movements. Tenderness of the muscles of mastication and the neck muscles was assessed by means of digital palpation, resistance testing and functional manipulation of the muscles. Extraoral masticatory muscles such as the temporalis and masseter were palpated with a digital pressure. The medial and lateral pterygoid muscles were evaluated by functional manipulation.

2.2.2. Occlusal splint construction:

An alginate impression of the maxillary arch was performed by which a master cast was fabricated for each patient. A vacuum made soft occlusal splint (night guard) was fabricated to fit the upper arch; it was made from rubber sheets of 2 mm thickness and measured 13 x 13 cm. The rubber sheet was placed over the maxillary cast, the fabrication was done in a vacuum former, pressure molding device (Figure 1).

When the rubber sheet had properly adapted to the cast in the vacuum former, it was taken out. The splint was then separated from the cast with a laboratory knife/scissors, the edges were trimmed and the palatal area was removed using scissors to obtain the final shape of Night Guard (Figure 2).

The splint was then disinfected with 2% Glutaraldehyde and placed in the patient's mouth to check for retention (Figure 3).

The splint was worn for 4 months in the following manner: The 1st week; patients were instructed to wear the splint for only 2 hours at the first day, then, increasing the period of wearing the splint gradually by

Fig.1: **Vacuum former, pressure molding device with fabricated Night Guard over Patient cast**

Fig.2: **The final trimmed Night Guard & Patient cast**

Fig.3: **Night Guard inside patient mouth**

more 2 hours daily to reach 14 hours/day at the end of the 1st week. At the 2nd week: splint was worn constantly for 14 hours daily. At 3rd week, patients were instructed to increase the period of wearing the splint again gradually by more 2 hours daily to reach 24 hours /day except the meal time and keep this period of wearing the device till the end of 4th month.

2.2.3. Post-operative follow-up:

Patients were recalled monthly for 4 months to check the Night Guard. If it had occlusal tearing, shift to other treatment modality (hard occlusal splint) was performed. All the parameters for TMJ functions were measured at all follow up periods with the same pre-operative technique.

2.2.4. Statistical analysis:

The collected data were analyzed and comparison made between pre-operative values and post-operative follow up values. The criteria for success was no pain or minimal pain (pain less than 2), clicking absent and maximum mouth opening more than 38mm. Data were processed and statistically analyzed by one way ANOVA followed by LSD (Least Significant Difference) for paired comparison using Microstat 7 statistical package.

3. Results:

3.1. Clinical Results:

All patients in this study (except five patients) responded to 2mm thickness soft splint therapy (Night Guard) and showed improvement of pain, mouth opening, TMJ clicking, and muscle tenderness during the whole follow up time intervals. Two patients did not respond to 2mm soft splint treatment, so, 4mm soft splint was constructed and showed good results at the end of follow up period (4 months). Other two patients did not respond to 2mm soft splint and they suffered from joint lock at the end of follow up period, so treatment was shifted to arthrocentesis that revealed adequate improvement. One patient neither responded to soft splints of 2 and 4 mm thickness nor to arthrocentesis with a result of joint lock in both treatments at the end of follow up period, so, treatment was shifted to surgical intervention of the joint in form of menisectomy that showed good results. These five patients were excluded from our present study.

3.2. Statistical Results:

3.2.1. Regarding the Mouth Opening:

The statistical analysis of data using ANOVA test showed that there was a significant improvement in the mouth opening between all time intervals with the highest values of improvement from 2 to 3 months postoperative intervals (Table1, Fig.4).

3.2.2. Regarding the Pain levels:

There was a significant improvement in the pain scores between all intervals with the highest values of improvement from 2 to 3 months post-operative intervals. There was a highly negative correlation between improvement of mouth opening and pain scores (r = -8.56) (Table2, Fig.4).

3.2.3. Regarding TMJ Clicking:

TMJ clicking was obvious till 2 months post-operatively with no significant improvement, then it became weak at 3rd month post-operatively with a significant improvement, Then, it was absent at 4th month post-operatively (Table3 &Fig.5).

Table 1: Showing means of **Mouth Opening** during whole follow up intervals

SUMMARY						
Groups	**Number of Patients**	**Sum**	**Average**	**Variance**		
Preoperative	32	833	26.03125	14.74093		
1 M	32	892	27.875	15.46774		
2 M	32	939	29.34375	17.2006		
3 M	32	1065	33.28125	9.305444		
4 M	32	1127	35.21875	4.047379		
ANOVA						
Source of Variation	**SS**	**Df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	1858.775	4	464.6937	38.23878	3.09E-22	2.429999
Within Groups	1883.625	155	12.15242			
Total	3742.4	159				
LSD	**1.726**					

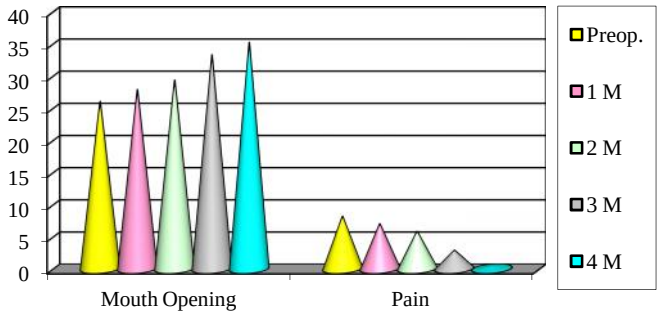

Fig. 4: Showing negative correlation between Pain & Mouth Opening

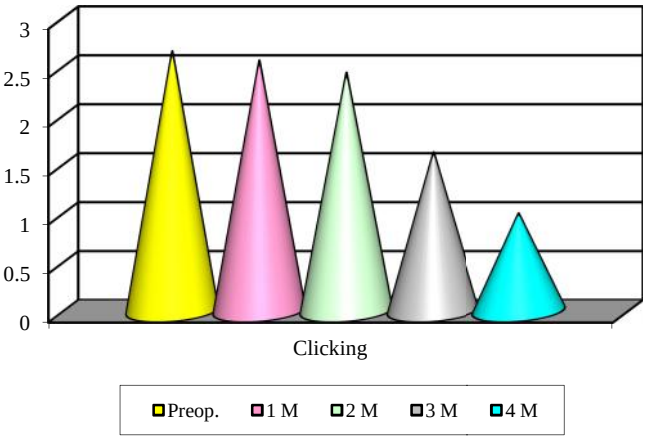

Fig. 5: Showing mean changes of TMJ clicking during whole follow up intervals

3.2.4. Regarding Tenderness of TMJ:

Results showed that there was a significant improvement in the tenderness of the joint after 1 month, from 1 month to 2 months, from 2 months to 3 months where the improvement was statistically insignificant (the improvement reached its peak after 3 months) (Table4, Fig.6).

3.2.5. Regarding muscle tenderness:

Results revealed that there was a significant improvement in the muscle tenderness after 1 month, from 1 month to 2 months, and from 2 to 3 months post-operatively (Table 5, Fig. 7).

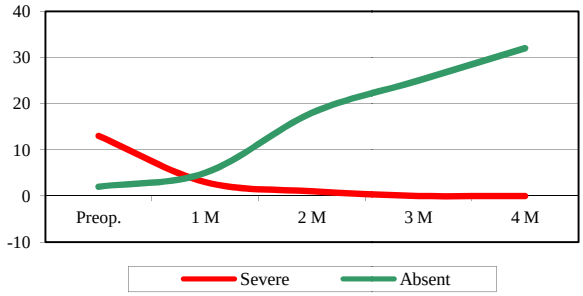

Fig. 6: Showing improvement of TMJ Tenderness during whole follow up intervals

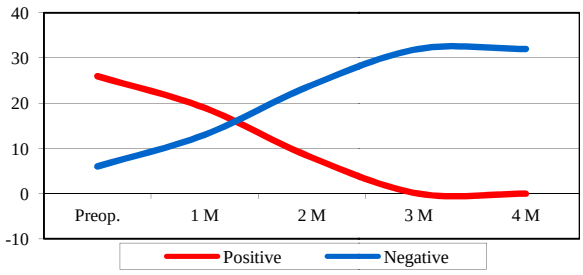

Fig. 7: Showing improvement of Muscle Tenderness during whole follow up intervals

Table2: Showing mean values of **Pain** levels during whole follow up intervals

SUMMARY						
Groups	**Number of Patients**	**Sum**	**Average**	**Variance**		
Preoperative	32	262	8.1875	2.544355		
1 M	32	225	7.03125	3.966734		
2 M	32	187	5.84375	5.103831		
3 M	32	93	2.90625	3.184476		
4 M	32	15	0.46875	0.579637		
ANOVA						
Source of Variation	**SS**	**Df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	1275.225	4	318.8063	103.6496	8.98E-43	2.429999
Within Groups	476.75	155	3.075806			
Total	1751.975	159				
LSD	**0.868**					

Table 3: Showing mean values of **TMJ clicking** during whole follow up interval

SUMMARY						
Groups	**Number of Patients**	**Sum**	**Average**	**Variance**		
Preoperative	32	85	2.65625	0.232863		
1 M	32	82	2.5625	0.254032		
2 M	32	78	2.4375	0.383065		
3 M	32	52	1.625	0.241935		
4 M	32	32	1	0		
ANOVA						
Source of Variation	**SS**	**Df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	66.025	4	16.50625	74.22575	5.01E-35	2.429999
Within Groups	34.46875	155	0.222379			
Total	100.4938	159				
LSD	**0.233**					

Table 4: Showing mean values of **TMJ Tenderness** during whole follow up intervals

SUMMARY						
Groups	**Number of Patients**	**Sum**	**Average**	**Variance**		
Preoperative	32	75	2.34375	0.361895		
1 M	32	62	1.9375	0.254032		
2 M	32	47	1.46875	0.321573		
3 M	32	39	1.21875	0.176411		
4 M	32	32	1	0		
ANOVA						
Source of Variation	**SS**	**Df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	38.0625	4	9.515625	42.71267	4.09E-24	2.429999
Within Groups	34.53125	155	0.222782			
Total	72.59375	159				
LSD	**0.236**					

Table 5: Showing mean values of **Muscle Tenderness** during whole follow up intervals

SUMMARY						
Groups	**Number of Patients**	**Sum**	**Average**	**Variance**		
Preoperative	32	26	0.813	0.157258		
1 M	32	19	0.594	0.248992		
2 M	32	8	0.250	0.193548		
3 M	32	0	0.000	0		
4 M	32	0	0.000	0		
ANOVA						
Source of Variation	**SS**	**Df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	16.85	4	4.2125	35.11597	7.32E-21	2.429999
Within Groups	18.59375	155	0.11996			
Total	35.44375	159				
LSD	**0.172**					

4. Discussion:

The present study was carried out to evaluate the efficacy of soft occlusal splint therapy in the management of TMDs as a conservative treatment modality according to *Dworkin and Truelove (1997)* who mentioned that most patients who have TMDs experience a remission of symptoms over time (usually 2 to 4 weeks) and therefore, these patients can be treated conservatively. Soft occlusal splint therapy was selected for the treatment of TMDs for several reasons. It is relatively simple, reversible, non-invasive and costs less than other treatments. They can be made for maxillary arches and are easily constructed and often inserted immediately at the initial examination, *Wright et al (1995).*

The soft, resilient material may help in distributing the heavy load that occurs during parafunctional activity. A high degree of patient acceptance has been reported with soft splints, *Okeson (2003)*, which is consistent with the findings of our present study.

Patients in the current study were instructed to gradually wear the soft occlusal splint over the first weeks to be habilitated for this new bulk in their mouths and so avoid its rejection. In the current study, the results of the pain levels (VAS) showed that there was a significant improvement in the pain scores between all time intervals with the highest values of improvement from 2 to 3 months postoperative intervals. This is in agreement with the conclusions of *Raphael et al (2003)* who found that occlusal splints had decreased the VAS scores and the number of painful muscles during a six-week follow-up study in patients with myofascial pain. There was also a significant improvement in the mouth opening between all time intervals with the highest values of improvement from 2 to 3 months post-operative intervals with highly negative correlation between improvement of mouth opening and pain scores (r = -8.56). This is in accordance with *Suvinen e t al (1989)* who have also shown 7.4 mm improvement in mouth opening after splint therapy.

The soft occlusal splint therapy (Night Guard) used in the present study has decreased the pain and tenderness in the muscles and joints of the patients, apparently allowing an increase in their maximal mouth opening. This is in agreement with *Block et al (1978)* who also found that after six weeks of using soft splints, 74% patients had complete or almost complete remission of their TMDs symptoms.

In the present study, the results of TMJ clicking revealed that there was a significant improvement at the third month post-operatively, then it was absent in the fourth month post-operative period. Regarding tenderness of TMJ and muscles, the results showed that there was a significant improvement in the tenderness of the joint and muscles after 1 month, from 1 to 2 months, from 2 to 3 months, then, the improvement was statistically insignificant at 3 months post-operatively. These findings are consistent with *Kovaleski et al (1975)* who have also shown a significant reduction in clicking of TMJ, tenderness of TMJ and muscles in response to occlusal splint therapy when patients were followed up for 2 months. *Tsuga et al (1989)* concluded that 87% of their patients had reduced TMJ pain; VAS reduction was seen in 50% and clicking was reduced in 70% of the patients. *Harkins et al (1988)* found that 74% of the patients with soft splints therapy had reduction in facial myalgia and reduction in or elimination of TMJ clicking. These improvements can be explained by the fact that occlusal splints with equal-intensity contacts on all of the teeth, with disclusion of all posterior teeth and condylar guidance in all movements will relax the elevator and positioning muscles and contribute to the reduction of abnormal muscle hyperactivity, *Boero (1989).* When a splint is inserted, there is an adaptation to a new resting postural position. Occlusal splints that increase the occlusal vertical dimension beyond the

freeway space, cause an immediate adaptation to a new freeway space at an increased vertical dimension. Thus, an occlusal splint allows a muscle to function more efficiently during contact and be less active during postural functions. Hence, as the vertical dimension increases from the occlusal contact on the insertion of an occlusal splint, muscular effort decreases resulting in the relaxing of the muscles and hence the TMJ, *Mona et al (2004).* The findings of the present study are also in agreement with *Naikmasur et al (2008)* who conducted a study to compare soft occlusal splint with muscle relaxant and analgesics in management of myofascial pain dysfunction syndrome. The results of this study revealed that there was a progressive decrease in pain scores, number of tender muscles, TMJ clicking and tenderness with various jaw movements and significant improvement in mouth opening in patients on occlusal splint therapy during the follow-up period as compared to the pharmacotherapy group. *Daif (2012)* performed a study to detect the correlation of occlusal splint therapy outcome with the electromyography of the masticatory muscles in TMD with myofascial pain. The study included 2 groups, group A treated with occlusal splint for 6 months and group B acted as a control. Clinical assessment and electromyographic records of the masticatory muscles were performed at the beginning of the study and after 6 months. The results showed that 85% of group A either completely recovered (35%) or clinically improved (50%) while only 20% of group B had a spontaneous improvement. The study concluded that occlusal splint therapy could eliminate or improve signs and symptoms of TMD patients with myofascial pain and it reduces the electromyographic amplitude records of the masticatory muscles. These findings are consistent with the current findings. The results of the present study infer that a soft occlusal splint therapy (Night Guard) is a commonly used conservative treatment modality and is useful in the reduction of pain and tenderness of the muscles and also in an improvement of mouth opening.

In Conclusion: The conventional soft occlusal splint therapy using Night Guards of 2mm thickness is a much safe and effective mode for conservative therapy of patients with TMDs**.** Night Guard is characterized by being reversible, simple, and least cost therapy with adequate patient compliance. So, this study supports using Night Guard as a soft occlusal splint therapy in the management of MPD and TMDs in form of anterior disc displacement with reduction for better long-term results.

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