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TREATMENT OF INTERNAL DERANGEMENT OF TEMPOROMANDIBULAR JOINT USING DIFFERENT TYPES OF OCCLUSAL SPLINTS

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ABSTRACT

Purpose of study: This study aimed to evaluate masticatory muscle function by using electromyography and compare the final outcome of treatment of ADDWR by using centric and anterior repositioning splint.

Patient and methods: this study was conducted on 20 patients with mean age of 29.5±3.4 complaining of anterior disc displacement with reduction of TMJ. Patients were randomly divided into two groups: I- centric splints, II- anterior repositioning splints. All patients were assessed by evaluating TMJ pain and muscle palpation, interincisal distance, joint sounds and visual analogue scale (VAS). This clinical examination was done before treatment and at 15, 30, 90, and 180 days after treatment. Also, electromyography evaluation of masseter and temporalis muscles was performed preoperative and at 3 and 6 months after treatment.

Result: In both groups, joint pain, joint click, muscle pain and interincisal distance were improved significantly. Also, significant improvement in mean amplitude and duration of masseter and temporalis muscles was achieved. There was no significant statistical difference between both groups.

Conclusion: The treatment of anterior disc displacement with reduction of TMJ with either of the two types of splint was acceptably successful and a significant reduction in the leading symptoms could be achieved. The use of occlusal splint is efficient to improve the electrical activity of the masseter and temporalis muscles.

INTRODUCTION

Internal derangement (ID) of TMJ may be defined as a disturbance in normal relationship between disc and condyle that interferes with the smooth movement of the joint and result in catching, clicking, popping or locking. There are various stages of ID; anterior disc displacement with reduction (ADDWR) and anterior disc displacement

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without reduction (ADDNR)[1,2]. ADDWR is a common noninflammatory temporomandibular disorder (TMD) that may cause mandibular movement disorders, such as clicking of joint, intermittent closed lock, limitation of mouth opening. These disorders may affect the life qualities of patients[3]. Previous research[4,5] has shown that DDWR presents in about 15%-25 % of patients in a TMD clinic.

Electromyography assessment of masticatory muscles represent important tool that help the differential diagnosis and provide substantial data for management of the suggested therapy and management of suggested therapy [6]. Muscle fatigue thought to be the important factor causing pain in patient with TMD. It is attributed to chronic hyperactivities or chronic disuse of the masticatory muscles [7,8].

Occlusal splint is considered one of the most effective conservative therapies. The most common types of splints used for treatment of ADDWR are centric and anterior repositioning splints (ARS) [9]. Purpose of centric splint (CS) as outlined by the American Academy of Orofacial Pain guidelines is to "provide joint stabilization, protect the teeth, redistribute the occlusal forces, relax the elevator muscles, and decrease bruxism." Additionally, it is stated that "wearing the appliance increases the patient's awareness of jaw habits and helps alter the rest position of the mandible to a more relaxed, open position" [10]. The intent of ARS, is to alter the maxillomandibular relationship so that a more anterior position assumed by the mandible. It was supposed that by altering the mandibular position in this manner, the anteriorly displaced disks could return back to its normal position (recaptured) [11].

This study aimed to evaluate masticatory muscle function by using electromyography and compare the final outcome of treatment of ADDWR by using centric and anterior repositioning splint.

PATIENT AND METHODS

Patients suffering from disc displacement with reduction of TMJ were included in this study. The patients were selected from those attending outpatient clinic of Oral and Maxillofacial Surgery Department, Faculty of Dental Medicine, Al-Azhar University. All patients informed about the study and signed an informed consent form.

The patients were included in this study if they had TMJ pain and clicking sounds in TMJ. Patients were excluded from the study if they had congenital malformation in TMJ region, had previous surgical treatment in TMJ or had any current systemic disease.

Grouping of patients:

The patients were randomly divided into two groups.

Group (1): Ten patients were treated by centric splint (figure 1).

Group (2): Ten patients were treated by anterior repositioning splint(figure 1).

I- Clinical examination

1- Assessment of TMJ pain

The TMJ was palpated by index finger bilaterally. The degree of the pain was evaluated and recorded along a four-point scale starting with grade 0 (No pain) to grade IV (severely affected). Also, Patients was asked to mark their pain (during chewing, and rest position) level on a visual analogue scale (VAS) (a 100 mm VAS).

2- Assessment of masticatory muscle tenderness

Tenderness of masseter and temporalis muscles were evaluated by palpating each muscle bilaterally. Pain recorded in score from 0 to 3. The grades of pain for each palpated muscle were summated and divided by two (right and left) to give the pain index for each muscle.

Fig. (1) Centric splint.

Fig. (2) Anterior repositioning splint.

3- Assessment of interincisal distance

Interincisal distance was evaluated by measuring the vertical distance between the incisal edges of the upper and lower central incisors.

Clinical examination was done before treatment and at 15, 30, 90, and 180 days post treatment.

II- Radiographic evaluation

Orthopantogram was performed for all patients preoperatively to evaluate osseous structure of TMJ. Magnetic resonance image of TMJ was performed bilaterally to confirm the diagnosis of ADDWR.

III- Electromyography evaluation

The electromyography evaluation of masseter and anterior temporalis muscles was performed bilaterally before treatment, at 3 months and 6 months after treatment.

Splint fabrication

Centric splint was constructed throughout the following steps. Impressions of both arches were made. The impressions quickly poured. Face bow was used to mount the upper cast on Hanu fully adjustable articulator. The casts were mounted on the articulator according to interocclusal bite record. The incisal pin of the articulator is adjusted to provide a space of 3 mm between the most posterior teeth. A clasp by which the splint is retained was adapted on upper first molar. Then the splint was waxed, the wax was covering the occlusal and incisal edge of the maxillary teeth and their palatal surface. The articulator was closed together until the incisal pin contacts the incisal table, establishing the vertical dimension of occlusion of the splint. The wax was trimmed and the occlusion adjusted. Contacts were established between the flat surface of the splint and all opposing teeth. Once, the maxillary cast was removed from the articulator invested in a flask, the wax boiled out, and then the mould packed with clear acrylic resin which was processed. The splint cleaned, trimmed and polished. The finished splint was smooth and indentation was placed on its occlusal surface to which the cusp tips and the incisal edges of opposing dentition are fitted. Mark occlusal contacts with thin articulating paper. Lateral and protrusive movements were checked for interferences. Lip seal was checked. Patient was instructed in the care and maintenance.

Anterior repositioning splint was fabricated in the same step as centric splint. During mounting, the casts mounted on the articulator according to correct centric relation and vertical dimension. Patient asked to open his mouth until the joint noise occurred and instructed to bite on occlusal wafer. The occlusal wafer was transferred onto the articulator to fix the articulator forward to a relationship where the joint noise occurred. The incisal pin of the articulator is adjusted to provide a space of a roughly 3 mm between the most posterior teeth.

All patients were instructed to wear the splint 24 hour a day except at meal time.

Statistical analysis

Data were presented as means and standard deviation values. *Student's t-test* was used to compare between the two groups. ***Paired t-test*** was used to study the changes by time in each group. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with SPSS 14.0® (Statistical Package for Scientific Studies) for Windows.

RESULT

The present study was conducted on 20 patients (16 female and 4 male) with a mean age of 29.5±3.4 years (range 18– 40 years).

Pain score was decreased significantly throughout all follow up periods in the both groups figure (3). There was no statistically significant difference between mean joint pain score of the two groups though all periods.

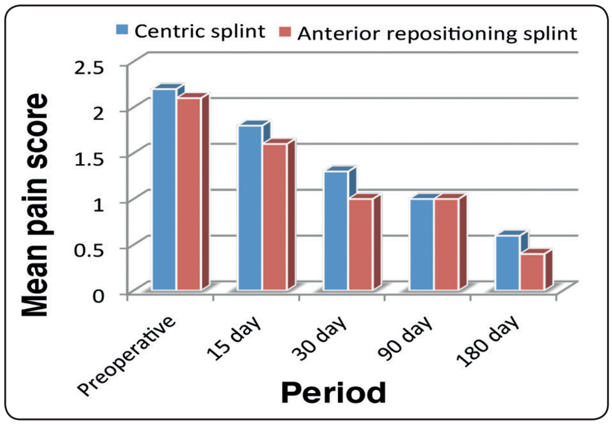

Fig. (3) Show mean joint pain scores of the two groups

There was a statistically significant decrease in mean VAS during function and rest throughout all observational periods in both groups without significant difference between group figure (4).

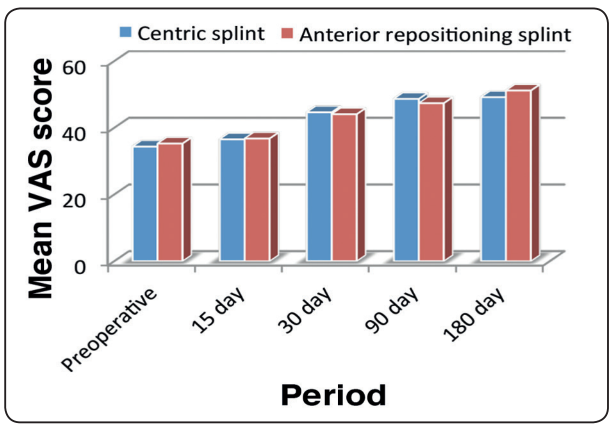

Fig.(4) Show mean VAS of the two groups

In group I, the mean masseter muscle pain score was 2±0.5 before treatment, while it was 1.7±0.5, 1.1±0.3, 0.9±0.3, and 0.6±0.5 at 15, 30, 90, and 180 days post treatment respectively. The mean temporalis muscle pain score was 2.6±0.5 before treatment, while it was 1.9±0.3, 1.4±0.5, 1±0, and 0.4 ±0.5 at 15, 30, 90, and 180 days post treatment respectively. In group II, the mean masseter muscle pain score was 2.2±0.4 before treatment, while it was 1.6±0.5, 1.1±0.3, 1±0, and 0.4±0.5 at 15, 30, 90, and 180 days post treatment respectively. The mean temporalis muscle pain score was 2.6±0.5 before treatment, while it was 1.7±0.5, 1±0, 1±0, and 0.7±0.5 at 15, 30, 90, and 180 days post treatment respectively.

Statistical analysis of these results demonstrated significant improvement in muscle tenderness throughout all periods without statistical difference between groups.

When evaluating the click sound of the joint, there was significant improvement in both groups. For groups I and II, joint noises were eliminated after 3 months in 40.0% (p=0.04) and 50.0% p=0.02, respectively. At 6 months after treatment the click sound eliminated in 60.0% and 70.0% in group I and group II respectively figure (5).

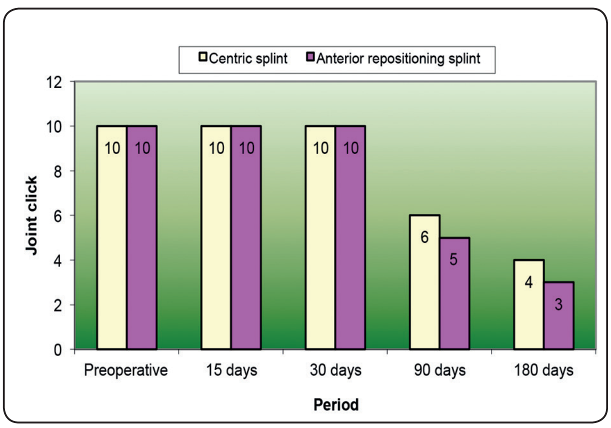

Fig.(5) Show the incidence of the two groups

There was a statistically significant increase in mean active interincisal distance through all periods in both groups without statistically significant difference between groups Table (1) figure (6).

TABLE (1) Show changes in interincisal distance in both groups before and after treatment.

Period \ Group	Centric splint group	Anterior repositioning splint group	*P*-value
	Mean ± SD	**Mean ± SD**	
Preoperative	34.4 ± 2.9	35.3	**0.487**
15 day	36.6 ± 3	36.8	**0.865**
30 day	44.7 ± 2.6	44.1	**0.618**
90 day	48.7 ± 2.2	47.4	**0.264**
180 day	49.2 ± 1.7	51.2	**0.350**

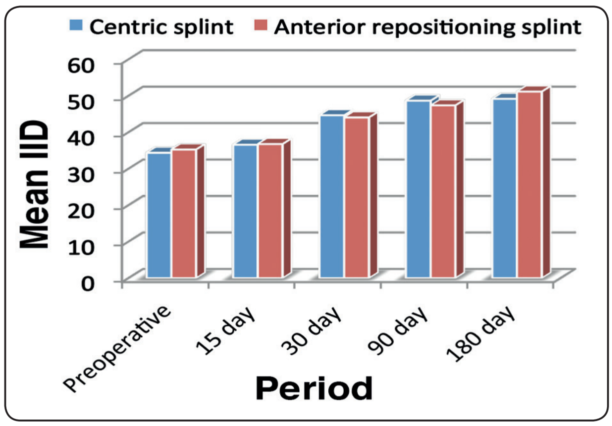

Fig.(6) Mean interincisal distance in both groups.

In group I, the mean amplitude of masseter muscle was 156.9±15.1, 298.3±20.7, and 482.2±17.2 μv before treatment, and at 3, and 6 months after treatment respectively. The mean duration of masseter muscle was 13.2±1, 9.1±1, and 4.1±0.8 msec before treatment, and at 3, and 6 months after treatment respectively.

The mean amplitude of temporalis muscle was 119.5±11.1, 289.4±21.4and 471.7±26μv before treatment, and at 3, and 6 months after treatment respectively. The mean duration of temporalis muscle was 12.8±0.5, 8.2±0.6, and 3.7±0.7 msec before treatment, and at 3, and 6 months after treatment respectively.

In group II, the mean amplitude of masseter muscle was 123.8±35.4, 298.2±41.1, and 484.2±12 µv before treatment, and at 3, and 6 months after treatment respectively. The mean duration of masseter muscle was 13.1±1, 7.8±0.6, and 3.7±0.7 msec before treatment, and at 3, and 6 months after treatment respectively.

The mean amplitude of temporalis muscle was 162.4±28.4, 320.4±52.4, and 494.9±37 µv before treatment, and at 3, and 6 months after treatment respectively. The mean duration of temporalis muscle was 14.1±1.2, 8.4±0.8, and 3.9±0.9 msec before treatment, and at 3, and 6 months after treatment respectively.

By mean of paired t-test it was found that, there was a statistically significant increase in mean amplitude of masseter and temporalis muscles while there was a statistically significant decrease in mean duration through all periods with the two muscles in both groups figures (7 and 8). There was no statistically significant difference between the mean amplitude and duration of the two muscles in the two groups through all periods.

In both treatment groups there was larger equilibrium between right and left side and between the temporalis and the masseter muscles on the same side were found.

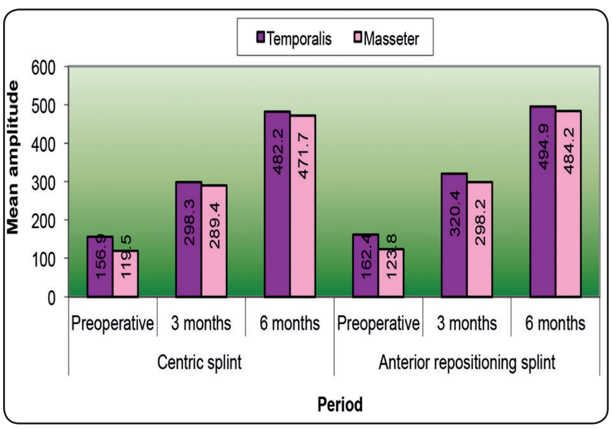

Fig.(7) The mean amplitude of temporalis and masseter muscles in both groups

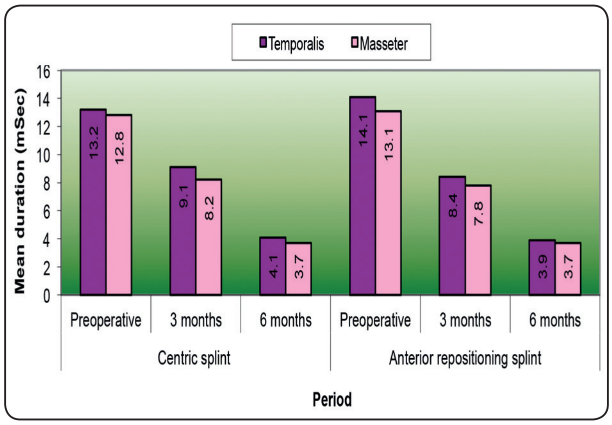

Fig.(8) The mean duration of temporalis and masseter muscles in both groups

DISCUSSION

Patients with TMD usually presented with decreased amplitude of motor unit action potential (MUAP), this is compatible with myopathy that might result from a reduced number of muscle fibers and their degeneration and regeneration [(12)]. The mastication muscles of adolescents with TMD, especially those with a greater severity of signs and symptoms, exhibit higher MNF and MDF of the electromyographic signal, indicating hyperactivity of these muscles while at rest and during maximum activity [(13)]. The motor unit capable of producing larger forces post-treatment tends to have action potential with larger amplitude. Improvement in the masseter and temporalis MUAP parameters resulted from decreased loading of the muscles may be a factor in the therapeutic effect of the splint therapy[(14)]

The efficacy of the splint may be due to several factors. First, an inhibitory effect of the occlusal support which results in reduction of pain and improvement of the joint symptoms where the reduction of the bite force is accompanied by reduction on the joint load. Second, all splints cause occlusal decoupling and this can cause reorientation of established neuromuscular reflex mechanisms. A part from factors, successful treatment with splint may be by psychological effects, such as an increase in the cognitive consciousness for oral habits, a placebo [(9, 15)].

Centric splint has shown to be effective in treatment of ADDWR; however, anterior repositioning splint is recommended by some authors since the direction of pull of lateral pterygoid muscle is anterior and medial, in derangement the disc is usually dislocated forward and inward. Conceptually, keeping the mandible forward with splint would recapture the normal disc condyle relation.

In group I and II there was a significant decrease in the joint pain and there is no statistical significant difference between both groups. This is in accordance with the study of Tecco et al [16].

In the present study the mean value of VAS during rest in both groups was 1.7 while during function it was 5.6 for centric splint group and 8.3 for anterior repositioning group. This is in accordance with the study of Lundh H et al [17].

Ekberg et al [18], presented study based on self assessment of temporomandibular pain using the VAS over 10 weeks to determine the effect of centric splint in comparison with placebo splint in patient with temporomandibular disorder of arthrogenous origin . A significant decrease in severity of TMJ pain was observed in the splint group, suggesting that the centric splint is effective in TMD of arthrogenous origin.

The current study showed that centric and anterior repositioning splints are effective in reducing the masticatory muscle pain that associated with TMD. However, there was no statistical significant difference between groups. This in agreement with[19].

This study demonstrated significant improvement in joint sound without significant difference between both groups. The improvement in joint sound may be due to morphological changes in the disc, especially in its posterior area, removing the mechanical obstruction for translation, and consequently decreasing the joint noise. This result requires more precise diagnostic tolls as magnetic resonance image (MRI). These results are in agreement with Conti PCR [19].

In the present study, the mean active mouth opening after 6 months was 43.2mm and 42.2mm for centric and anterior repositioning splint groups respectively. In their study with 74 patients, Schmitter et al [20] showed with non-reducing disc that after 6 months of centric splint therapy, mean active interincisal distance was 43.4 ± 7.0mm, on other hand mean active interincisal distance for repositioning splint group after 6 months was 40.0mm ± 7.0mm.

The current study shows that in both treatment groups there was a significant reduction in the electrical activities of the analyzed muscles at the different follow up intervals and larger equilibrium between right and left side, and between the temporalis and the masseter muscles were found. There was no significant statistical difference between both treatment groups.

When the activities of the temporal muscles are relatively larger than the activities of the masseter muscles, the bite force will provoke a larger load on each joint. From practical point of view, the occlusal splint not only can reduce temporomandibular pain but can diminish the relative activities of the temporal muscle and increment muscular symmetry[20].

The reduced electrical activities may be explained by an inhibitory effect of the occlusal support, and it is a first factor in the reduction of acute pain: the smaller the bite force, the smaller the joint load. Interocclusal appliance interposed between the occlusal surfaces, interrupts propriceptive information from mechanoreceptors located within periodontal ligament enabling the muscle to return a balanced activity.

The results of this study are in accordance with a previous studies. In the study of Tecco S et al [16] Khalifa FA et al [21], there was a significant reduction in electrical activity of the masseter muscle after 3 months of treatment.

The existence of an asymmetric muscular activities in patient with temporomandibular disorders has been supported by Clark et al [22], Holmegren et al [23]

The increased symmetry in muscle activities has been reported by Ferrario VF et al [24], Humsi et al [25], Naeije and Hansson [26], Visser et al [27], and Abekura et al [28].

CONCLUSION

The treatment of anterior disc displacement with reduction of TMJ with either of the two types of splint was acceptably successful and a significant reduction in the leading symptoms could be achieved. The use of occlusal splint is efficient to improve the electrical activity of the masseter and temporalis muscles.

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