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Interocclusal Appliance Effect on Clinical Findings and Disc Location in Internal Derangement

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Abstract: Improvement of clinical signs like pain and mandibular movements restriction with capturing the natural disc location are among the main purpose of occlusal appliance therapy for the patients affected by internal derangement. The aim of this investigation was to determine the disc location and clinical findings in internal derangement patients treated by an interocclusal appliance. A total of 15 patients affected by internal derangement were selected on the basis of defined including and excluding criteria for treatment using a maxillary stabilization appliance. Patients were under detailed assessment in three occasions of before treatment, 2 and 6 months after the treatment. This was to determine the disc location in magnetic resonance imaging view and the effect of appliance on clinical findings like joint pain and mandibular movements restrictions. Descriptive statistical analysis and Friedman non-parametric test were used to analyse the data (SPSS ver. 12.0). Improvements in clinical findings were observed in all (100%) patients after 2 months from the beginning of treatment and continued to be at 60% rate at the end of treatment. This improvement was found to be statistically significant when compared to other treatment sequences ($p<0.001$). Disc shape remained unchanged after treatment. Statistical analysis did not show any significant difference between disc location before and after treatment. Stabilization appliance improves clinical findings without disc recapturing. Continuous use of the appliance until 6 months increase, the treatment success rate in comparison to 2 months use.

Key words: Interocclusal appliance, clinical findings, disc location, internal derangement, TMD, TMJ

INTRODUCTION

Internal derangement is a type of TMJ disorder associated with a dysfunctional condyle disk complex (Farrar, 1978). It is commonly associated with anterior and medial displacement or dislocation of the disc. It may be associated with clinical sounds, catch and/or lock during jaw movements, limitation of jaw movements and even occasionally with pain (Okeson, 1988). Dislocation is categorized as reversible with recapturing or reduction of the disc and irreversible without the two in internal derangement disorder (Carlson *et al*., 1998; Wilkes, 1978; Katzberg and Westesson 1991; Orsini *et al*., 1999). History with a precise clinical examination of patients remain as gold standards for differential diagnosis of patients with internal derangement yet (Dworkin and LeResche, 1992; Kenworthy *et al*., 1997; Okeson, 1988). However, clinical examination of temporomandibular joint has been supplemented by magnetic resonance imaging in the past 2 decades (Hansson *et al*., 1989; Schwaighofer and Tanaka, 1990; Tasaki and Westesson, 1993). This diagnostic modality has the distinct advantage of depicting both soft and hard tissue, thus a clinical diagnosis of anterior disc dislocation can be confirmed easily (Liedberg *et al*., 1996; Katzberg and Westesson, 1991). Reversible type pf treatment strategies are performed due to the severity of signs and symptoms in patients requiring treatment and multifactorial etiology of the disorder. One of the most common approaches in this field is performed by

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the fabrication of an interocclusal acrylic appliance (Tsuga *et al*., 1989; Goharian and Neff, 1980; Clark, 1984; Nassif and Al-Chamdi, 1999). Elimination or reduction of joint symptoms (pain, restriction of mandibular movements) and re-establishment of a normal condyle-disc relationship are considered as two important criterias for selection the type of interocclusal appliances. Centric or stabilizing appliances and anterior positioning types are the most commonly used appliances.

Several studies have reported varying degrees of success when using these appliances. While some reports suggest that anterior positioning appliance could be more efficient in releaving the j oint symptoms that resulting in normal condyle disc relationship (Davies and Gray, 1997; Grimm and Gage, 1991; Anderson *et al*., 1985; Lundh *et al*., 1985, 1988; Santacatterina *et al*., 1998; Kurita *et al*., 2001, 1998; Simmons and Gibbs, 1995).

Stabilization appliances are recommended as the first treatment option in the internal derangement cases in the fear of any permanent alteration of condylar position causing forward joint position (Davies, 2008; Mohamed *et al*., 1997).

It is also believed, however that normal relationship of condyl disc is never attainable in dislocated joints (Manzione *et al*., 1984; Kirk, 1991; Ornstein, 1993; Eberhard *et al*., 2002; Manco and Messing, 1986). The aim of this investigation was to evaluate the effect of an interocclusal appliance on clinical findings and disc location in internal derangement.

MATERIALS AND METHODS

Patients with a diagnosis of internal derangement who were referring to Postgraduate Prosthodontics Department, Shaheed Beheshti Dental School, Tehran, Iran were selected and assigned for this investigation. They were then further assessed by a set inclusion criteria. These criterias include patients with intracapsular pain depicted differential diagnosis of manipulation test of Okeson without pain rise in jaw protrusion against resistance with unilateral separator (Carlson *et al*., 1998) in addition to a minimum 3 of the following 4 criterias:

- History of joint sound or catching
- A sudden restriction of jaw opening (<35 mm of maximum opening without assistance of dentist)
- Restriction of eccentric movement to the contralateral side (normal range of 7 mm)
- Deflection of jaw in protrusive movement

Exclusion criteria were in the other hand, masticatory muscle disorders alone, growth disorders, inflammatory disorders of TMJ, chronic mandibular hypomobility, structural incompatibility of the articular surfaces. The project was formally approved by review board of the Shaheed Beheshti Dental Research Center's for all subjects. History taking and clinical examinations were performed by assessment of the joints and muscles, manual inspection of joint sounds and pain, restriction, deviation and deflection based on Okeson and Dwarkin (Carlson *et al*., 1998; Dworkin and LeResche, 1992).

Data was recorded from every clinical evaluation made by the operator and 2 independent investigators who have been calibrated before for this purpose.

In order to record the form and location of the disc and condyle disc relationship, a series of preliminary sagital magnetic resonance images were acquired in open and close mouth positions for each joint before splint insertion.

Scans were performed in T1 weighted protocol in close and open mouth positions stabilized by a mechanical hand made mouth opener to reduce blurred images in MRI, (Gyroscan ACS-NT-Phillips, Netherlands).

Magnetic resonance imaging (sagital oblique) parameters included: TE 20 (ms), TR 480 (ms), Matrix field of view 140 (mm), slice thickness 3 (mm), acquisition time 7.3 (min). MRI evaluation was performed and data were then recorded in the forms papers without any information from clinical examination in double blind sequence.

Disc location in closed position was classified as normal, anterior or posterior which is based on the position of posterior band of disc to head of condyle. In this regard when the thickest part of posterior band of the disc was located between 12 and 1 o'clock, this was recorded as normal position, otherwise, it was considered as anterior or posterior location. In open position in anterior or posterior dislocated disc in close mouth position, if condyles bypass the thickest part of the disc in maximum opening, disc dislocation was diagnosed with reduction while otherwise disc dislocation without reduction was verified for each joint (Fig. 1-3).

Disc shape was also evaluated in closed mouth position and normal shape was described biconcave lens-like configuration. Based on the above mentioned criteria, 15 patients (14 females and 1 male) were allocated for this study.

Stabilization appliance was fabricated with defined criteria for all patients using a heat processed acrylic resin (Meliodent, Heraous, Kulzer, UK) (Fig. 4a-d). Patients were advised to use their appliances 24 h a day with the exception of meal times (Davies, 2008). First follow up visit was monitoring at 2 weeks for assessing the correct use of appliance. Patients were reviewed at 2 and 6 months

Fig. 1: MRI sagittal view of condyle-disc complex in closed (left) and open position (right) at normal status

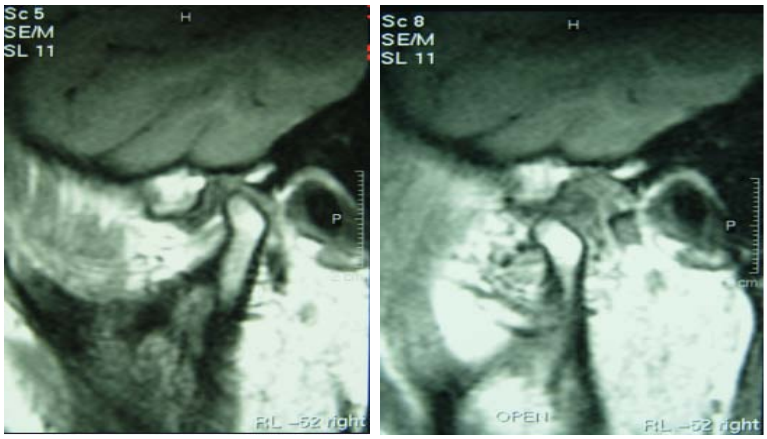

Fig. 2: MRI sagittal view of condyle-disc complex in closed (left) and open position (right) at reversible status

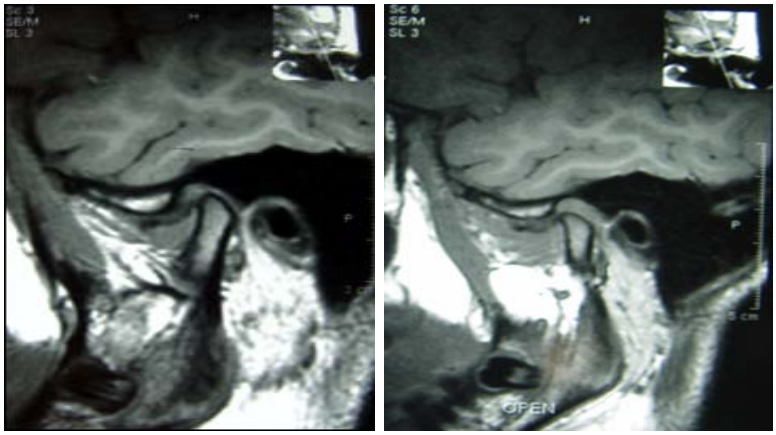

Fig. 3: MRI sagittal view of condyle-disc complex in closed (left) and open position (right) at irreversible status

subsequently. Individuals were requested to report any problem or complication encountered. Improvements in subjective and objective criterias (pain, restriction) were recorded as the effect of appliance at 2 months review program. In addition, an occlusal adjustment of appliance was also performed if necessary.

Reduction of joint pain, chronic pain and improvement of restriction of mandibular movements were considered as success criterias at this sequence of treatment. Joint pain assessed by clinical palpation of lateral pole and posterior attachment (criteria between 0 and 3, 0 without pain, 1 mild, 2 moderate and 3 severe).

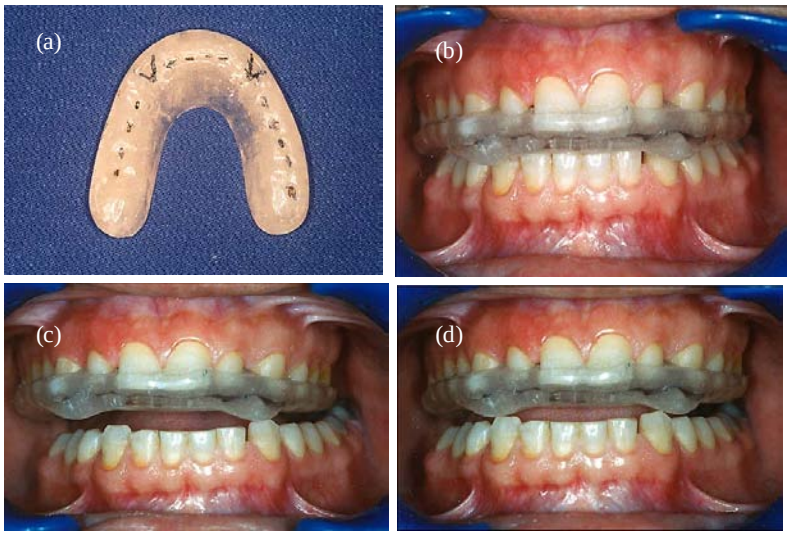

Fig. 4: Stabilization appliance with; a) even contacts, b) centric occulsion, c) laterotrusion, d) protrusion

Improvement of the degree of chronic pain was evaluated through the classification criteria between 0 (best) and 4 (worst) defined earlier (Dworkin and LeResche, 1992). Those patients who demonstrate worsening of their sings and symptoms after 2 months review reserved anterior positioning appliance and new magnetic resonance imaging while the use of appliance was continued for those who felt improvements until the end of treatment program (6 months). Recordings were repeated at 6 months recall (end of treatment) in order to enable a comparison of the two steps of assessment. Magnetic resonance imaging for all patients was also conducted at the end of treatment.

Criteria for treatment success at 6 months evaluations were observed in comparison to 2 months regimen program including complete elimination or reduction of pain and complete submission or improvement of restriction during opening and eccentric movement in 6 months sequence. Descriptive statistical analysis and Friedman nonparametric test were used to analyse the data with the significance level of $p<0.05$.

RESULTS AND DISCUSSION

From the total of 15 patients 14 were female with only 1 male. The average age of patients was 31.07 with a range of 18-53 years. Degree of chronic pain (Farrar, 1978), showed dramatic decrease of chronic pain at 3 times sequences ($p<0.001$). This value was 3 before treatment which reduced to 1.83 and 1.2 in 2 and 6 months, respectively. Distribution of the degree of pain from palpation at right and left lateral pole showed also significant differences before and after treatment

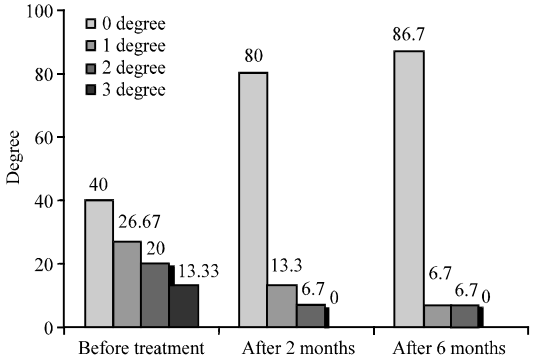

Fig. 5: Distribution of the degree of pain from palpation of right (R) and left (L) lateral pole at 3 time sequences assessed before and after treatment

($p<0.001$) (Fig. 5 and 6). Distribution of the degree of pain from palpation at right and left posterior attachment region was found to be improved with a statistically significant difference when compared to other treatment sequences ($p<0.001$) (Fig. 7 and 8).

Significant differences were also found between the level of maximum mouth opening without assistance and eccentric mandibular movements in all 3 times observations of before treatment, 2 and 6 months after treatments ($p<0.001$) (Table 1 and 2). The disc location in sagittal view with closed mouth position did not show any significant difference ($p>0.05$). The disc shape, however, remained unchanged after treatment (23 cases normal and 7 cases deformed). In open position, further assessments showed that 11 joints as being normal, 7 joints with disc dislocation and reduction. This was while 12 joints were without reduction. Only one single case

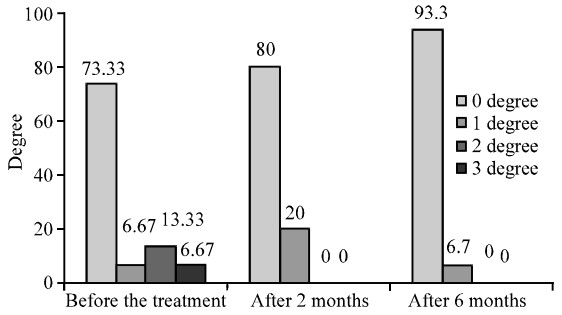

Fig. 6: Distribution of the degree of pain from palpation of left lateral pole at 3 time sequences assessed before and after treatment

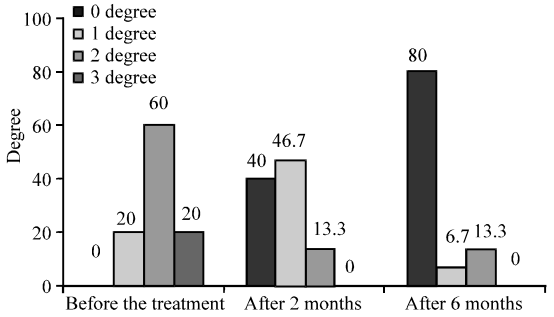

Fig. 7: Distribution of the degree of pain from palpation of right posterior attachment region at 3 time sequences assessed before and after treatment

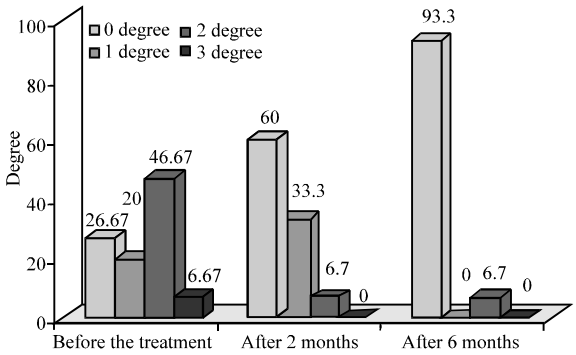

Fig. 8: Distribution of the degree of pain from palpation of left posterior attachment region at 3 time sequences assessed before and after treatment

Table 1: Maximum mouth opening without dentist assistance at 3 time sequences assessed before and after treatment

Statistical analysis	Before the treatment	After 2 months	After 6 months
Mean	29.80	35.870	39.00
Min.	22.00	30.000	30.00
Max.	35.00	40.000	47.00
Standard deviation	3.95	3.620	4.50

Table 2: Amount of mandibular lateral movements at 3 time sequences assessed before and after treatment

	Right side			Left side		
Statistical analysis	Before the treatment	After 2 months	After 6 months	Before the treatment	After 2 months	After 6 months
Mean	6.93	8.60	9.13	5.67	8.20	9.20
Min.	3.00	6.00	7.00	3.00	6.00	7.00
Max.	11.0	11.0	12.0	10.0	12.0	12.0
Standard deviation	2.25	1.55	1.55	2.29	1.74	1.70

was late shifted to normal joint group from original joint with disc dislocation and reduction group. Statistical analysis didn't reveal any significant difference in disc location before and after the treatment, in these groups. Results of initial assessment also showed that 7 patients had deflection to the right and the same number to the left with 1 of the patients having deviation to the right during mouth opening prior to the treatment. This rate remained unchanged after 2 and 6 months follow up. Seven patients, however still represented the right deflection while 5 patients had left side deflection and 2 patients had right side deviation with only 1 patient having left side deviation.

Based on the results of the present study, a surprising 100% success rate was observed following 2 months appliance use with 60% success rate in comparison to the 2 months treatment outcome. Since a well defined including criteria was used precisely in the current investigation, all selected patients were considered as having internal derangement. Differential diagnosis help to fulfill this purpose in association to the MRI evaluation of reducible and non-reducible disc which increases this precision. Improvement of clinical outcome (pain and range of mandibular movement) was observed in patients using stabilization splints. Similar findings have been reported earlier with interocclusal appliances (Tsuga *et al*., 1989; Goharian and Neff, 1980; Clark, 1984; Simmons and Gibbs, 1995; Davies, 2008; Carrano and Caffesse, 1978; Schmitter *et al*., 2005; Conti *et al*., 2006).

To date, several different reasons are enumerated for the decrease in clinical complications following occlusal appliance therapy. These are including changes in neuromuscular behavior (Schindler *et al*., 2000), decreased loading of temporomandibular joint (Stegenga *et al*., 1990), cognitive awareness and placebo effect (Kreiner *et al*., 2001) reduction of teeth effect on joint position (Grimm and Gage, 1991), establishment of new equilibrium between muscles (Okeson *et al*., 1983) increasing the vertical dimension of occlusion (Shoji, 1995) formation of a retrodiscal fibrosis and establishment of a pseudodisc (Isberg *et al*., 1986; Pereira *et al*., 1996). Diversity in different factors of study set up and measurements, classification and evaluation criteria makes comparisons of similar studies to each other

slightly complicated (Okeson, 1988; Tsuga *et al*., 1989; Kurita *et al*., 1991; Linde *et al*., 1995). There was no significant effect on joint sounds except in mouth opening (left side) ($p<0.05$) on 2 months treatment sequence. Sustained and retained joint sounds have already been reported similar to result of current study (Okeson, 1988; Tsuga *et al*., 1989; Conti *et al*., 2006; Isberg *et al*., 1986; Pereira *et al*., 1996; Kurita *et al*., 1991; Linde *et al*., 1995; Boero, 1989).

Relief of asymptomatic joint sounds should not be considered as a success criteria because presence of joint sounds after treatment (splint therapy) could effect on the treatment outcome by reducing evaluation scores (Okeson, 1988; Tsuga *et al*., 1989). Resistance of joint sounds would suggest that discal ligament do not tighten or shorten during the adaptation process of treatment (Okeson, 1988). The presence of joint sounds in epidemiologic studies have been reported to be relatively common. Many studies referred to the presence of joint sounds in a range of 28-50% in adults (Boero, 1989; Rieder *et al*., 1983).

Progression of intracapsular disorders occur in 7-9% of patients as determined by joint sounds (Salonen *et al*., 1990; Konomen *et al*., 1996; Randolph *et al*., 1990). Results also revealed that the disc form and location as being remained unchange during and after the treatment, despite improvements in clinical finding. MRI findings demonstrated that disc capturing had occurred in only one out of 7 joints diagnosed with reversible disc dislocation. All of the other 12 joints were diagnosed as cases with irreversible dislocation and remained unchanged. Similar to some earlier reports (Manzione *et al*., 1984; Ornstein, 1993; Eberhard *et al*., 2002; Manco and Messing, 1986). Kirk (1991) believed that the disc capturing is only a clinical term and in fact no actual change occurs in intra-articular anatomic relationships. This is due to an inflammatory adhesion of displaced disc and its morphological changes.

No deterioration was detected in sings and symptoms after 2 months recall. Therefore, none of the patients received any anterior positioning appliance. Earlier long term studies have also revealed that anterior positioning appliances are not as effective as once thought for joint dysfunction and recapturing the disc (Kirk, 1991; Randolph *et al*., 1990; Chen *et al*., 1995) and even their continuous use could cause consequences including dental instability (Davies, 2008; Mohamed *et al*., 1997). Shmitter (2005) reported stabilization splints to be more effective than distraction splints for improvement of pain and limitation of mandibular movements particularly prior to surgical treatment of anterior disc displacement without reduction. As few other studies have also reported the disc dislocation is seen even in asymptomatic patients (Roberts *et al*., 1991; Musgrave *et al*., 1991; Westesson *et al*., 1989; Rebeiro *et al*., 1997). It should also needed to be considered that there are other responsible factors in producing pain and dysfunction independent of the disc dislocation (Ornstein, 1993; Barclay *et al*., 1999). No correlation was observed between clinical remission of symptoms and positive radiographic findings of the current study.

Even if the first purpose of appliance therapy is considered as the reduction of pain and dysfunction in internal derangement cases then current findings could support suggestions about the priority of stabilization appliances usage before invasive and irreversible therapy (Tsuga *et al*., 1989; Davies, 2008; Mohamed *et al*., 1997; Schmitter *et al*., 2005; Ash, 1986). Since the return of symptoms must be evaluated in long term bases, well defined clinical trials with standardized criteria are needed for patient selection and outcome evaluations which should be considered as the intention of the future research.

CONCLUSION

Stabilization appliances could decrease symptoms of internal derangement without disc recapturing. These appliances as a reversible and conservative type of treatment demonstrate significant effect on clinical problems. Continuous use of appliance for 6 months, improves symptoms in comparison to 2 months use.

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