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Research Article

Effect of Twin Block Appliance on the TMJ: Magnetic Resonance Imaging Study

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Abstract

Thirteen children displaying Class II Division 1 malocclusion were involved in a magnetic resonance image investigation to evaluate the effects of Twin-block functional appliances on the temporomandibular joints. None of these children had clinical signs or symptoms of temporomandibular disorders. All the children were treated with a Clark Twin-block appliance for 8 months. The treatment effects were evaluated radiographically using MRI. MRI was taken before starting the treatment and another MRI was taken after an observation period of 8 months. The sagittal concentricity showed that the condyle moved insignificantly to a more anterior position after using the twin block appliance. The sagittal disc position moved insignificantly to a more posterior position to its pre-treatment position. There was insignificant changes related to the changes in the eminence angle. So it is concluded that the twin block functional appliance can be used for the treatment of skeletal class II with mandibular deficiency with no significant TMD risk.

Keywords: *Twin Block Appliance; TMJ; Magnetic Resonance Imaging*

Introduction

Class II Division 1 malocclusion is one of the most frequent problems in the orthodontic practice. Various types of functional appliances (e.g. Activator, Bionator, Frankel and Herbst appliance) are used for the correction of skeletal Class II and occlusal disharmonies.

During the last years Twin-block functional appliance, the originally developed by William J Clark, has gained increasing popularity. The appliance consists of maxillary and mandibular acrylic plates with bite blocks that posture the mandible forward on closure. Over the last decade clinical experience has shown that the Twin-block can be effective in the treatment of skeletal class II cases with mandibular deficiency.

The placement of the functional appliance results in a displacement of the condyle in the glenoid fossa and stimulates the growth at the condylar cartilage [1]. Functional appliances have been used for more than 100 years in the field of orthodontics and dentofacial orthopedics for the correction of mandibular retrognathia preferably during active skeletal growth.

The purpose of functional therapy is to change the functional environment of the dentition to promote normal function. Most of the functional appliances are designed to enhance the forward growth of the mandible by encouraging a functional displacement of the mandibular condyles downward and forward in the glenoid fossa. This is balanced by an upward and backward pull in the muscles supporting the mandible. Adaptive remodeling may occur on both articular surfaces of the temporomandibular joint to improve the position of the mandible relative to the maxilla [2].

MRI, a multiplanar imaging technique, has the advantage of giving an accurate assessment of both the bony and the soft tissues. This technique is believed to be non-invasive, radiation free. Moreover, it gives more superior contrast resolution than any other imaging modality. MRI is considered the imaging modality of choice for assessment of internal derangements of the temporomandibular joint [3].

Concerns have been expressed regarding temporomandibular joint (TMJ) adaptation subsequent to functional appliance correction of Class II Division 1 malocclusions by anterior repositioning of the mandible [4].

The objective of this study was to use MRI to study the changes in the TMJ after treatment with the Clark Twin-block (CTB) functional appliance.

Materials and Methods

The sample

- The sample consisted of 13 patients who were selected from the outpatient clinic of Orthodontic Department, Faculty of Dentistry, Minia University.
- They were 13 growing females with a mean age of 11.7 years.
- The skeletal maturational stage for each patient was assessed from the lateral cephalometric x-ray using CVM. (Cervical Vertebral Method)
- All subjects were treated by using twin block appliance.

Ethics regulation

This study was approved by the Ethics Committee of the Faculty of Dentistry, Minia University.

A detailed description of the treatment procedure was explained for each patient's parents, and a written consent in Arabic was signed by the parents.

Criteria of selection

All subjects were selected to fulfil the following criteria:

- Growing females with age range between 10 - 13 years old.
- Class II Division 1 malocclusion with skeletally retruded mandible.
- Overjet greater than 5 mm
- None of them had received orthodontic, orthopedic, or surgical treatment.
- No signs or symptoms of temporomandibular joint disorders.
- All patients should be free from any systemic disease, chronic medication uptake, bad oral hygiene and pathological conditions that contraindicate the start of orthodontic treatment.

Patient's drop-outs

Three patients discontinued the treatment at different times; one disappeared after delivery of the appliance and two patients stopped coming at the follow-up visits after 5 months of treatment.

Methods

For all the patients, routine diagnostic records like case history, clinical examination, study models, cephalogram, orthopantomogram (OPG), and photographs were taken. To study the temporomandibular joint changes, MRI was performed.

MRI was performed at the Magnetic Resonance Imaging Center, using a 1.0 Tesla with bilateral TMJ surface coils.

Corrected sagittal images were recorded in a maximal intercuspation position at pretreatment (R1) and in an unstrained retruded position at the end of 8-month observation period (R2). This was necessary because most of the CTB-treated children displayed posterior open bites [2].

Measurements from the MRI included sagittal concentricity, sagittal disk position and the eminence angle.

Sagittal concentricity

Sagittal concentricity was evaluated using the method described by Pullinger Solberg., *et al* [5]. This denotes the position of the condyle within the joint in sagittal direction. It was calculated from the narrowest anterior and narrowest posterior interarticular joint spaces using the formula:

$$[(P-A)/(P+A)] \times 100 = \%\ \text{displacement}$$

Positive values indicated an anterior position, negative values indicated a posterior position, and a zero value was referred as to concentric.

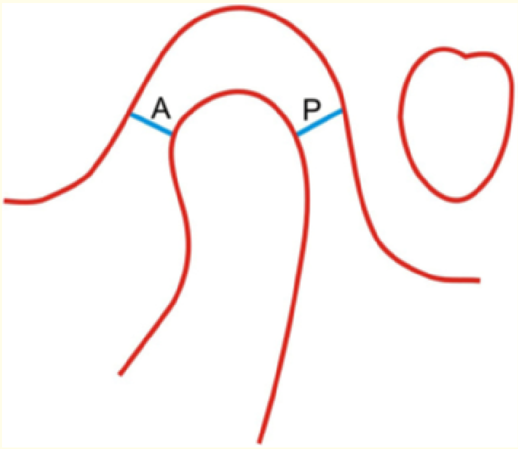

Figure 1: *Method of measuring sagittal concentricity.*

Sagittal disk position

The sagittal position of the articular disk was assessed in the parasagittal MRIs of all patients involved in the present study by the method of defining disk position given by Chintakanon, Sampson., *et al* [6]. This was a variation of the method used by Drace and Enzmann [7], who defined the so-called 12 o'clock position in determining disk position relative to the condylar head.

The intersecting point between a line parallel to the posterior condylar line passing through the condylar center and the roof of the fossa was constructed and referred to as the 12 o'clock position in the glenoid fossa.

The position of the posterior bands of the disk was then measured as the angle relative to the 12 o'clock position. The position of the posterior band was used to classify the disk position into three categories: anterior displacement, normal, and posterior displacement.

The normal range for sagittal disk position given by Silverstein Dunn., *et al.* [8] is 25.7° to −18.7°.

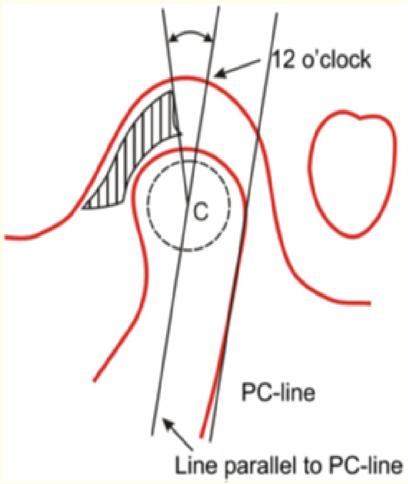

Figure 2: *Method of measuring sagittal disc position.*

Eminence Angle

The steepness of the articular eminence was measured as the angle formed by a line tangential to the posterior slope of the articular eminence and related to the tangent to the posterior surface of the ramus (PC-line).

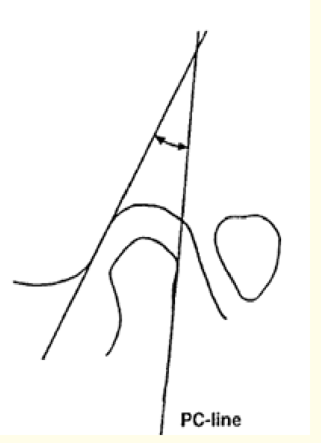

Figure 3: *Method of measuring articular eminence angle.*

Statistical analysis of the MRI measurements

All data were collected, tabulated and subjected to statistical analysis. Statistical analysis was performed using Prism software version 5 for windows.

The measurements were described by the Mean, Standard Deviation (SD), Maximum and Minimum.

Paired samples t- test was used to study the changes after the observation and treatment period for all variables.

Results

In this study MRI was performed on the patients before and after treating them with twin block functional appliance. MRI of each side of the joint was recorded separately.

Right TMJ

Sagittal concentricity

	Right TMJ before treatment	Right TMJ after treatment
Mean	-0.1400	3.210
Max.	20	20
Min.	-20	-16.60
SD	18.46	14.82
P Value	0.3013	

Table 1: *Comparing the Mean, Maximum (Max), Minimum (Min), and Standard deviation (SD) of sagittal concentricity of right TMJ before and after treatment.*

Sagittal disc position

	Right TMJ before treatment	Right TMJ after treatment
Mean	14.10	12.10
Max.	27.00	31.00
Min.	4.00	-1.00
SD	7.534	10.05
P Value	0.3798	

Table 2: *Comparing the Mean, Maximum (Max), Minimum (Min), and Standard deviation (SD) of sagittal disc position of right TMJ before and after treatment.*

Eminence angle

	Right TMJ before treatment	Right TMJ after treatment
Mean	36.90	38.10
Max.	51.00	54.00
Min.	23.00	25.00
SD	9.158	9.678
P Value	0.0659	

Table 3: *Comparing the Mean, Maximum (Max), Minimum (Min), and Standard deviation (SD) of eminence angle of right TMJ before and after treatment.*

Left TMJ

Sagittal concentricity

	Left TMJ before treatment	Left TMJ after treatment
Mean	-0.9800	1.300
Max.	20.00	20.00
Min.	-25.00	-33.00
SD	19.45	18.72
P Value	0.4411	

Table 4: *Comparing the Mean, Maximum (Max), Minimum (Min), and Standard deviation (SD) of sagittal concentricity of left TMJ before and after treatment.*

Sagittal disc position

	Left TMJ before treatment	Left TMJ after treatment
Mean	12.20	10.40
Max.	23.00	26.00
Min.	2.00	-3.00
SD	7.021	8.847
P Value	0.3951	

Table 5: *Comparing the Mean, Maximum (Max), Minimum (Min), and Standard deviation (SD) of sagittal disc position of left TMJ before and after treatment.*

Eminence angle

	Left TMJ before treatment	Left TMJ after treatment
Mean	36.20	37.70
Max.	47.00	50.00
Min.	24.00	26.00
SD	7.815	8.070
P Value	0.0522	

Table 6: *Comparing the Mean, Maximum (Max), Minimum (Min), and Standard deviation (SD) of eminencs angle of left TMJ before and after treatment.*

Discussion

Sagittal concentricity

In the present study, initial MRIs showed that most of the condyles were nonconcentric, with anteriorly positioned condyles equal in number with posteriorly positioned condyles. This finding did not support the claim of Witzig and Yerkes [9] that mandibular retrognathic patients possess distally positioned condyles as a result of forward head posture.

This finding is in agreement with Pullinger Solberg., *et al.* [5] and Chintakanon Sampson., *et al.* [6] who also found that in patients with class II division 1 malocclusion, the condyles can generally be situated in a more anterior position within the glenoid fossa.

In the current study, after treating the patients using the twin block appliance, the condyle tended to move more anteriorly than before treatment. Two cases, before treatment showed posterior position of the condyles and became concentric after treatment. Even with the condyles that remained in a posterior position, their post-treatment position was more anterior than before treatment.

Sagittal disc position

After 8 month of treatment with the twin block appliance, the sagittal disc position of the right and left TMJ showed a significant difference in their measurements but still within the normal range and both of the discs moved in the same direction.

Ruf and Pancherz [10] and Chavan Bhad., *et al.* [2] noted that a slight tendency towards anterior disk displacement is more frequent in class II malocclusion, which was in agreement with the pretreatment records of this study, in which all the cases showed the disc in an anterior position. Wadhawan Kumar., *et al.* [3] found that all the cases treated in his study showed normal disc position with no tendency for anterior displacement, this was in contrast to the findings in the current study.

Comparison between pretreatment and after 8 months disk position showed posterior movement from its initial pretreatment position in 70% of treated cases but was within the physiologic range. These findings are in accordance with Pancherz Ruf., *et al.* [11]; Chintakanon Sampson., *et al.* [6]; Ruf and Pancherz [12]; Chavan Bhad., *et al* [2]. The other 30 % of the cases the disc position moved to a more anterior position than the pretreatment position, but this change was insignificant and the disc position remained within the normal range stated by Silverstein Dunn., *et al* [8].

These findings are in contrast to Foucart Carpentier., *et al.* [13], who found that the mean position of the posterior band of the disk was located anteriorly after treatment with the Herbst appliance. This was because of anterior disk displacements found in 4 cases after treatment in their study.

Thus, it could be argued according to the results of the current study that functional appliance therapy does not cause pathological displacement of the articular disc.

Eminence angle

In the present study, the eminence angle did not change significantly during the course of treatment. The right and left eminence angle measurements either before or after treatment using the twin block appliance showed insignificant changes in their measurements. These findings are supported by Chintakanon Sampson., *et al.* [6], who also did not find any statistically significant change in eminence angle following Twin Block therapy for 6 months Kuroe and Ito [14] suggested that remodeling in the glenoid fossa is less obvious than the remodeling at the condyle. Ruf and Pancherz [10] also observed that, in most subjects, the amount of the glenoid fossa remodeling was smaller than the amount of condylar remodeling.

Conclusions

From the results of this study, it could be concluded that:

- The sagittal concentricity showed that the condyle moved insignificantly to a more anterior position after using the twin block appliance.
- The sagittal disc position moved insignificantly to a more posterior position to its pre-treatment position.
- There was insignificant changes related to the changes in the eminence angle.
- So it is concluded that the twin block functional appliance can be used for the treatment of skeletal class II with mandibular deficiency with no significant TMD risk.

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