

Comparison of the Response of the Right and Left TMJs after Treatment Using Twin Block Appliance, Magnetic Resonance Imaging Study

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Received: June 04, 2018; Published: July 12, 2018

DOI: 10.31080/ecde.2018.17.00747

Abstract

Ten children showing Class II Div. 1 malocclusion were selected to take part in MRI investigation to study the effects of Twin-block functional appliances on the temporomandibular joints. All the included children showed no features of temporomandibular disorders. Twin-block appliance was selected to treat all the children in the. The effects on both TMJs were recorded and evaluated using MRI. Two MRI were taken to the same patient, one before appliance delivery and another one after 8 months of the treatment. There were no significant difference between the right and left TMJs either before or after the treatment concerning the sagittal concentricity or the eminence angle. Significant difference was recorded concerning the sagittal disc position between the right and left TMJ either before or after the treatment.

Keywords: TMJs; Twin Block Appliance; Magnetic Resonance Imaging

Introduction

Class II Division 1 malocclusion has high prevalence among young children and commonly seen during daily orthodontic practise. Various types of functional appliances, such as: Activator, Bionator, Frankel and Herbst appliance, are used for the correction of skeletal Class II and occlusal disharmonies.

Twin-block functional appliance, is one of the most popularly used appliances in orthodontics for treating class II division 1 malocclusion. It was developed by William J Clark [1].

Yildirim., *et al.* [2] believes that the use of Twin-block appliance during active skeletal growth will result in displacement of the condyle in the glenoid fossa, thus stimulating the growth of the condyle.

The effect of repositioning the mandible anteriorly using functional appliances on both sides of the TMJ needs further studies to compare the effect between the right and the left sides [3].

Accordingly this study was conducted in order to compare the response of the right and left TMJs related to Clark Twin-block (CTB) functional appliance therapy using MRI.

Materials and Methods

Ten patients with Class II Division 1 skeletal malocclusion with overjet greater than 5 mm were selected for this clinical study. All patients were females in the prepubertal growth period, with a mean age of 11years 7 months. None of them had received orthodontic, orthopedic, or surgical treatment. All patients had normal maxillary but underdeveloped mandibular growth (retrognathic mandible), and no features of temporomandibular joint disorders.

MRI was performed at the Medical Imaging Department, using a 1.0 Tesla with bilateral TMJ coils, both sides of the TMJ was imaged.

The pre-treatment images were recorded in maximal intercuspation, while the post-treatment images were recorded in unstrained retruded position, this was necessary to overcome the posterior open bite developed in patients treated with twin-block [4].

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

Sagittal concentricity

- Condylar concentricity was evaluated using the method described by Pullinger, *et al* [5]. The condylar position 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.

Sagittal disc position

- The method of defining disk position given by Chintakanon., *et al.* [6] was a variation of that used by Drace and Enzmann [7], who defined a so-called 12o'clock position in determining disk position relative to the condylar head.
- The intersecting point between a line parallel to the PC-line passing through the condylar center and the roof of the fossa was constructed and referred to as the 12o'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., *et al.* [8] is 25.7° to -18.7°.

Eminence Angle

- It was measured as the angle between a line tangential to the posterior surface of the ramus and the a tangent to the posterior slope of the articular eminence.

Statistical analysis of the MRI measurements

- All MRI parameters were measured. The data was tabulated and analyzed by SPSS software.
- Paired t test was used to assess the difference in the rate of change of the different variables in the treatment group. Statistical significance was set at $P < .05$.

Results

The following tables compares the mean, standard deviation (SD), maximum and minimum records measured from the MRIs of the right and left TMJ before and after the treatment.

Sagittal concentricity

	Right TMJ before treatment	Left TMJ before treatment	Right TMJ after treatment	Left TMJ after treatment
Mean	-0.1400	-0.9800	3.210	1.300
Max.	20	20.00	20	20.00
Min.	-20	-25.00	-16.60	-33.00
SD	18.46	19.45	14.82	18.72
P Value	0.5035		0.3035	

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

Sagittal Disc position

	Right TMJ before treatment	Left TMJ before treatment	Right TMJ after treatment	Left TMJ after treatment
Mean	14.10	12.20	12.10	10.40
Max.	27.00	23.00	31.00	26.00
Min.	4.00	2.00	-1.00	-3.00
SD	7.534	7.021	10.05	8.847
P Value	0.0119		0.0381	

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

Eminence angle

	Right TMJ before treatment	Left TMJ before treatment	Right TMJ after treatment	Left TMJ after treatment
Mean	36.90	36.20	38.10	37.70
Max.	51.00	47.00	54.00	50.00
Min.	23.00	24.00	25.00	26.00
SD	9.158	7.815	9.678	8.070
P Value	0.4481		0.6424	

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

Discussion

Most of the previous studies as Chavan, *et al.* [4], Ruf and Pancherz [9], Kinzinger, *et al.* [10], Chintakanon, *et al.* [6] studied the effect of the functional appliance using MRI only on one side of the TMJ either the right or the left one. Although it was found that there was a difference between the right and the left TMJ either in the condyle-fossa relationship or in the disc position [11-13].

Disc displacement is commonly bilateral and both joints should be studied when MRI is utilized. Recent large studies had shown bilateral internal derangements to be 3 times more common than unilateral internal derangement [14,15].

Sagittal concentricity, sagittal disk position and the eminence angle were recorded from each MRI both before and after treatment.

Sagittal concentricity

This was used to study the condylar position in the sagittal direction within the joint.

Pullinger, *et al.* [5] described a method that was used in this study to evaluate the condylar position.

He stated that the condyle is positioned anteriorly when the result is positive, positioned posteriorly when the result is negative and is considered concentric when the result is zero.

In the current study, the results were similar for both joints considered together and separately. Although there was a slight difference between the right and the left TMJ measurements before starting the treatment, but the results were statistically insignificant. After the treatment the difference between the mean of the right and left TMJ increased but still was statistically insignificant. This results came in agreement with those of Vitral, *et al.* [16], Rodrigues, *et al.* [12], Whyte, *et al.* [11].

Sagittal disc position

Disc displacement is commonly bilateral and both joints should be studied when MRI is utilized. Recent large studies have shown bilateral internal derangements to be 3 times more common than unilateral internal derangement [14,15].

When comparing the right and left sagittal disc position before starting the treatment with the twin block appliance in the current study, it was found that there is a significant difference between the measurements of each side but still within the normal range of Silverstein, *et al.* [8].

After using the twin-block appliance for treating class II division 1 skeletal cases with mandibular retruded mandibles for 8 months, it was found that the disc position in the sagittal direction of both sides of the TMJ showed significant difference, also it was recorded that the discs in both sides moved in the same direction and moved within the normal ranged described by Silverstein, *et al.* [8].

Eminence angle

At the inferior aspect of the squamous part of the temporal bone, the glenoid fossa is located and composed of the glenoid fossa and the articular eminence, the condyle-disc complex slides during different mandibular movements on that articular eminence.

The anterior limit of the glenoid fossa is formed by the articular eminence and is convex in shape. The flatness or steepness of the articular eminences vary among people and it dictates the path along which the condyle moves as well as the degree of rotation of the disc over the condyle [17,18].

Using twin-block appliance for mandibular advancement results in that the condyle is positioned against the articular eminence, thus changes in the eminence angle may be expected in correspondence to such contact.

In this study, no significant changes were found when comparing the records before and after the treatment. Also when comparing the records of the right and left TMJ together, before and after the treatment, no significant changes were noticed. These findings are similar to those stated by Chintakanon, *et al.* [6], as he also found no significant changes in the eminence angle after using twin-block appliance for treating cases for a 6 month period.

Conclusions

- There were no significant difference between the right and left TMJ either before or after the treatment concerning the sagittal concentricity or the eminence angle.
- Significant difference was recorded concerning the sagittal disc position between the right and left TMJ either before or after the treatment.

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Volume 17 Issue 8 August 2018

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