

Assessment of the condylar response in prepubertal and postpubertal patients treated by Twin Force Bite Corrector appliance; A CBCT comparative study

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Abstract

Objective: This study was directed to assess the condylar response in prepubertal and postpubertal patients treated by Twin Force Bite Corrector appliance.

Materials and Methods: A total sample of twenty orthodontic patients were selected (11 females – 9 males), the sample patients were divided into three groups; Group I: Include ten prepubertal growth spurt orthodontic patients (6 females – 4 males) who are at stages CVMS I and II according to modified cervical vertebral maturation stage (CVMS) by Bacetti(115). There were four patients at CVMS I and six patients at CVMS II. Group II: Include ten post-pubertal growth spurt orthodontic patients (5 females – 5 males) who are at stages CVMS III, IV, V according to modified cervical vertebral maturation stage (CVMS) by Bacetti(115). There was one patient at CVMS III, two patients at CVMS IV and seven patients at CVMS V. The patients in both groups will be treated with fixed orthodontic appliance combined by the twin force bite corrector as fixed functional orthopedic appliance. A Cone Beam Computerized Tomography was taken at two time points; before installation of TFBC (T1) and after its removal (T2) to assess the condylar volume in prepubertal and postpubertal patients treated by the Twin Force Bite Corrector appliance.

Results: In the current study the mean increase of the condylar volume in Group I after removal of the TFBC was statistically significantly higher than that in Group II

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(P-value <0.001, Effect size = 3.162).

Conclusions: The condylar volume showed significant increase with the Twin Force Bite Corrector when used in the prepubertal patients and non-significant increase when used in the postpubertal patients.

Introduction

Skeletal class 2 malocclusion is one of the most common problems in an orthodontic practice.⁽¹⁾ The skeletal and dental features of this type of malocclusion are characterized by mandibular retrusion and/or maxillary protrusion.⁽²⁾ The frequency of this malocclusion is reported to constitute 12% to 49% of all orthodontic disorders.^(3, 4)

Because the mandible is too small and/or too retruded in patients with skeletal Class II malocclusions, the aim of the orthodontic/orthopedic treatment should be to bring the mandible forward, stimulate the growth of the condyle and remodel the glenoid fossa.⁽⁵⁻⁸⁾

Much of the discussion surrounding Class II treatment was centered on whether functional appliances are capable of achieving a permanent increase in mandibular length.⁽⁹⁾ Numerous studies and case reports have high lighted the effectiveness of fixedfunctional appliances in correcting Class II malocclusion.⁽¹⁰⁾ Recently, the use of fixed, rather than removable, functional appliances has been advocated; the fixed appliance ensures that a constant anterior positioning of the mandible is maintained during the treatment period.⁽¹¹⁾ Furthermore, evidence has indicated that use of a one-phase protocol in the permanent dentition is more efficient than use of a two-phase protocol since similar occlusal results are achieved in a shorter treatment time.^(12, 13)

In 2004, Jeff Rothenberg introduced the Twin Force Bite Corrector (TFBC) as a new fixed intermaxillary appliance with a built-in

constant force for Class II correction.⁽¹⁴⁾ The TFBC consisted of two telescopic systems with internal coil springs. The appliance is attached to maxillary and mandibular fixed appliance archwires and is screwed to the mesial of the maxillary molars and to the distal of the mandibular canines using a specialized, provided screwdriver.⁽¹⁵⁾ Following a clinical trial with a force gauge, the Twin Force Bite Corrector applies an average compression force of 210 g.⁽¹⁶⁾

In adult non growing patients, there are two treatment modalities; either compensation of the dentition to camouflage the underlying skeletal problem or surgical correction of the underlying skeletal discrepancy.⁽¹⁷⁻¹⁹⁾ However, when considering the fact that skeletofacial growth continues many years after cessation of body height growth and that the adult TMJ is capable of remodeling after the age of 20 years or can be reactivated at this later age, it will be possible to widen the range of growth adaptation with fixed functional orthopedic appliances to include the children, adolescents, post adolescents, and young adults.⁽²⁰⁻²³⁾

Are there any differences in the condylar volume in prepubertal and postpubertal patients treated by Twin Force Bite Corrector appliance?⁽²⁴⁾ The lack of evidence about this in the orthodontic literature raised the need for current study.

Materials and methods

This prospective clinical study was conducted on 20 orthodontic patients of both sexes (11 females – 9 males). Their age was ranged from (11 - 18) years .The patients were selected from those who attended the orthodontic clinic, faculty of dental medicine, Al-Azhar University, boys branch. The number of patients was dependent on a power study.⁽¹⁹⁾

The inclusion criteria were (1) Skeletal

class 2 malocclusion due to mandibular retrusion with increased overjet ($SNA=82\pm 4$, $ANB=\geq 4^\circ$). (2) Mandibular arch with minimum (up to 4mm) or no crowding. (3) All permanent teeth are erupted (3rd molar not included). (4) Good oral and general health. (5) No systemic disease or regular medication that could interfere and/or affect orthodontic teeth movement. (6) No previous orthodontic treatment.

The patients were divided into two equal groups according to their skeletal maturation stages:

- Group I: Include ten prepubertal growth spurt orthodontic patients (6 females – 4 males) with a mean age of 12 ± 0.63 years. The patients are at stages CVMS I and II according to modified cervical vertebral maturation stage (CVMS) by Bacetti⁽²⁵⁾. There were four patients at CVMS I and six patients at CVMS II.
- Group II: Include ten post-pubertal growth spurt orthodontic patients (5 females – 5 males) with a mean age of 15.82 ± 1.33 years. The patients are at stages CVMS III, IV, V according to modified cervical vertebral maturation stage (CVMS) by Bacetti⁽²⁵⁾. There was one patient at CVMS III, two patients at CVMS IV and seven patients at CVMS V.

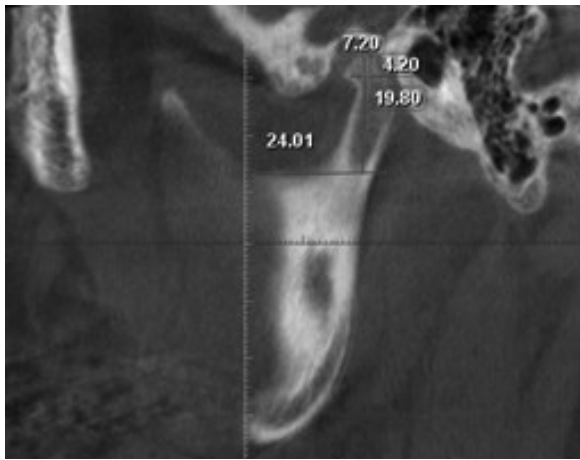
Orthodontic records:

A Cone Beam Computerized Tomography was taken at two time points; before installation of TFBC (T1) and after its removal (T2) to assess the condylar volume in prepubertal and postpubertal patients treated by the Twin Force Bite Corrector appliance.

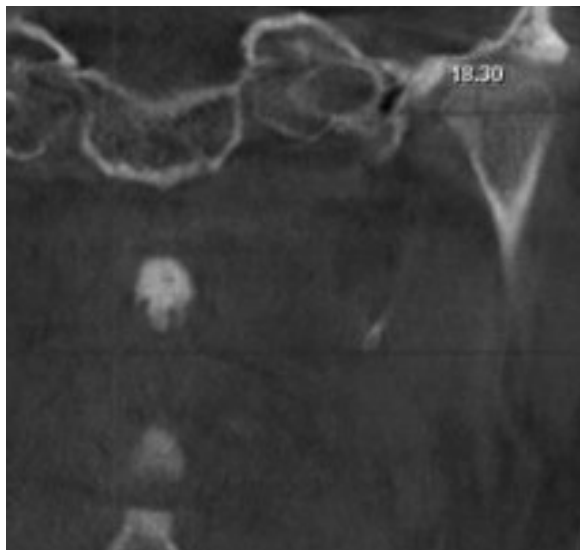
CBCT record:

CBCT images (closed TMJ view projection for both right and left sides) were taken by using Planmeca Romexis MD 3D Extraoral Imaging System. Pretreatment and post-treatment images were taken while the patients were sitting in an upright position with the Frankfort horizontal plane parallel to the ground. They were instructed to breathe normally through the nose and to avoid swallowing during the scanning process. CBCT datasets were acquired by software with reconstruction slice thickness of 0.2 mm and 728 X 728 matrix. The CBCT was made by high resolution scan that was made with isotropic voxel size set at 200mm and 10 X 20 cm field of view.

The condylar volume was assessed in the current study by two dimensional method which was described by Hilgers in 2005⁽²⁶⁾. Two-dimensional sagittal slice was selected in which the condyle and glenoid fossa were clearly noticed. From this slice the condylar length was measured in the sagittal plane from the line extending from the posterior mandibular condyle point (PCo) to the anterior mandibular condyle point (ACo). Both these points are located 4 mm inferior to the superior mandible condyle (SCo) on either side of the condyle. Condylar width, which is the linear distance between the medial and lateral mandible poles, was measured in the coronal plane. Condylar height was measured as a perpendicular linear distance from superior mandible condyle (SCo) to a line constructed between the most inferior point of the sigmoid notch (InfSig) perpendicular to the tangent of the posterior surface of the ramus in the sagittal plane. (Fig. 1) The condylar volume can be calculated by multiply height by length by width.^(27,28)



(A)



(B)

Figure 1: linear measurements of condyle; (A) height and length, (B) condylar width

Statistical analysis:

Numerical data were explored for normality by checking the data distribution and using Kolmogorov-Smirnov and Shapiro-Wilk tests. All data showed normal (parametric) distribution except amounts of change in the condylar volume measurement which showed non-normal (non-parametric) distribution.

Results

Demographic data

There was no statistically significant difference between gender distributions in the two groups; this is presented in the table (1).

Table (1): Frequencies (n), percentages and results of Fisher's Exact tests for comparison between gender distributions in the two groups.

	Group I (n = 10)	Group II (n = 10)	P-value
Gender [n (%)]			1.000
Male	4 (40)	5 (50)	
Female	6 (60)	5 (50)	

* : Significant at $P \leq 0.05$

I. Condylar volume:

Comparison between condylar volumes at the right and left sides revealed non-statistically significant difference between the two sides, so the mean of the two sides was used for the comparisons.

A. Changes within each group (Table 2, Fig. 2):

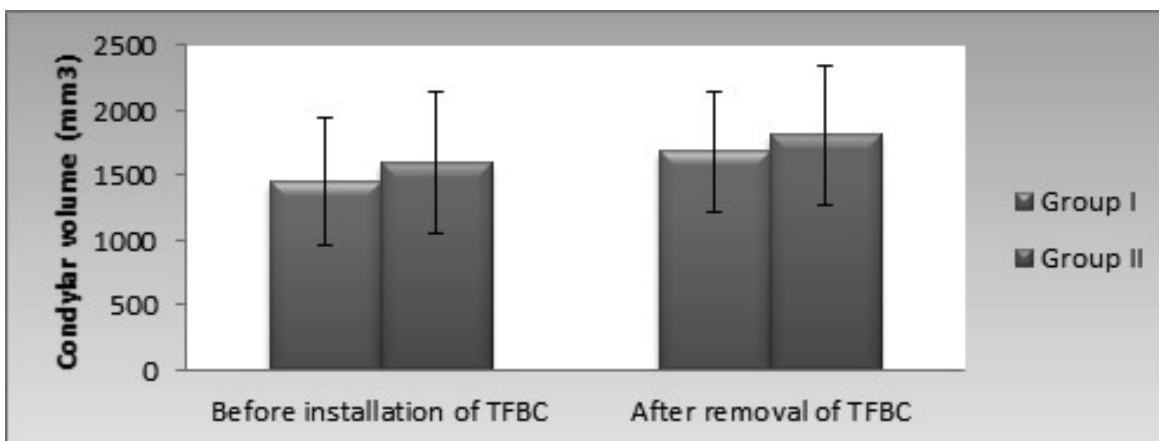
Group I (prepubertal): in this group there was a statistically significant increase in condylar volume after removal of TFBC (P -value < 0.001 , Effect size = 0.814) while in Group II (postpubertal) there was no statistically significant change in condylar volume after removal of TFBC (P -value = 0.119, Effect size = 0.130).

Table (2): Mean, standard deviation values and results of repeated measures ANOVA test for the changes in condylar volume within each group

Group	Before installation of TFBC		After removal of TFBC		P-value	Effect size (Partial Eta Squared)
	Mean	SD	Mean	SD		
Group I	1522.6	486.1	1746.7	465.4	<0.001*	0.814
Group II	1437.2	412.5	1478.4	423.3	0.119	0.130

*: Significant at $P \leq 0.05$

Figure (2): Bar chart representing mean and standard deviation values of condylar volume measurement in the two groups



B. Comparison between the two groups (Table 3, Fig. 3):

Either before installation or after removal of TFBC, there was no statistically significant difference between mean condylar volume in the two groups, I and II, (P -value = 0.692, Effect size = 0.009 and P -value = 0.217, Effect size = 0.083 respectively). The mean increase of the condylar volume in Group I after removal of the TFBC was statistically significantly higher than that in Group II (P -value <0.001, Effect size = 3.162).

Table (3): Results of repeated measures ANOVA test for comparison between the two groups and Mann-Whitney U test for comparison between mean changes in the two groups.

Time	Group I		Group II		P-value	Effect size
	Mean	SD	Mean	SD		
Before installation of TFBC	1522.6	486.1	1437.2	412.5	0.692	Partial Eta Squared = 0.009
After removal of TFBC	1746.7	465.4	1478.4	423.3	0.217	Partial Eta Squared = 0.083
Change	223.9	110.4	41.3	23	<0.001*	d =3.162
Change (Median, Range)	185.7 (122.6 – 487.2)		38.4 (13.3 – 76.8)			

*: Significant at $P \leq 0.05$

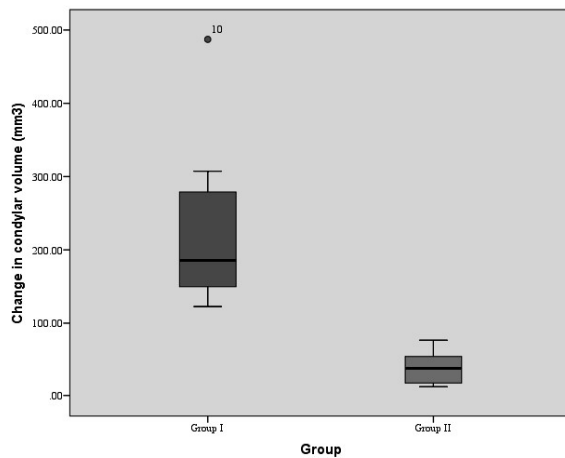


Figure (3): Box plot representing median and range values of changes in condylar volume in the two groups (Circle represents outlier).

Discussion

CBCT is more reliable than conventional computed tomography because of lower radiation exposure. It is possible to scan the complete head within few seconds with an effective dose of 50 mSv with CBCT, while the conventional computed tomography uses 2000 mSv.

In Group I; there was a statistically significant increase in condylar volume after removal of TFBC because of nature of growing patients, and also the twin force bite corrector enhance the condylar growth in this skeletal maturation stages (prepubertal patients). This was also recommended by Baccetti et al. ⁽²⁹⁾ This finding was in accordance to that found in previous studies. ^(19,30,31)

The statistical significant increase in condylar volume in Group I after removal of TFBC reflected on correction of the skeletal background inform of significant increase in total mandibular length and ramus height, and more posterior direction of condylar growth. These changes also reflected on correction of molar relationship.

While in Group II; there was no statistically significant change in condylar volume after

removal of TFBC due to the nature of non-developing patients (little amount of growth remained in most patients enrolled in this group). This finding is similar to that found in the other study. ⁽³²⁾

However it was revealed that the increase in mandibular prognathism was accomplished by the Herbst therapy seems in particular to be as a result of condylar and glenoid fossa remodeling in young adult patients (11.5-17.5 years) and also in adolescent and young adult in another study. ^(33,34) This difference in findings might be related to the appliance itself since the Herbst is a rigid FFA while the TFBC is a hybrid or semi-rigid appliance.

By comparing amount of change in condylar volume between the two groups, Group I showed statistically significant higher mean increase in condylar volume than Group II due to the fact that the patients in Group I were developmentally younger than those in Group II predisposing them to greater condylar growth during treatment. This finding was similar to that reported in other study as they stated that the sagittal condylar growth in the patients treated by the Herbst appliance at peak of growth was twice that observed in patients treated 3 years after peak of growth. ⁽³²⁾

Conclusion

The condylar volume showed significant increase with the Twin Force Bite Corrector when used in the prepubertal patients and non-significant increase when used in the postpubertal patients.

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