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A New Design of Twin Block Appliance for Treatment of Mandibular Deficiency in Mixed Dentition Stage

[1]El Kattan E., [2]Abou El-Yazeed, M., [3]Aya, E.

[1]Orthodontics Department, Faculty of Oral and Dental Medicine, Cairo University, Egypt.
[2, 3]Orthodontics and Pediatric Dentistry Department, National Research Centre, Cairo, Egypt.

Abstract: The role played by functional appliances in the treatment of children suffering from skeletal Class II division 1 malocclusion mandibular deficiencies especially during early permanent and mixed dentition stage has been still controversial despite their early introduction in this century. A newly innovated device Modified Twin Block was introduced in this study aiming to overcome some of the drawbacks of the traditional appliances used. Fifteen Egyptian girls aged 8 to 11 years with Class II division 1 mandibular deficiencies were included and divided into group 1 (control N=5) and group 2 (treatment subjects N=10). Study models, photographs, panoramas and lateral cephalometric radiographs were recorded before and after six months of treatment. Significant increase in certain linear measurements (Go-Pog, Ar-Pog, N-Me, ANS-Me, S-Go, FHR) as well as angular variables (SNA, SNB), meanwhile decrease in other linear and angular measurements as E-line/U-lip, Overjet, SN/Go-GN, ANB denoting that Modified Twin Block appliance affecting growth potential and pattern of the mandible and face towards a favorable directions in management of children with Class II division 1 mandibular retrognathy.

Key words: Twin Block Appliance, Class II division 1, Mixed dentition

INTRODUCTION

The correction of class II division 1 continues to present a challenge to clinicians practicing pediatric and orthodontic dentistry. For the patient and parents it may be no more than pushing back a few front teeth but for those practicing orthodontics it is recognition of the many factors that contribute to its manifestation (Proffit el al, 1993). The role played by functional appliances in the correction of skeletal pattern, during the treatment of class II division 1 malocclusion has been still controversial despite their early introduction in the century. Beside the effect of the functional appliances on the dentoalveolar process many clinicians believed that the anterior displacement of the mandible with the consequent stretch in muscles also produce a stimulation of condylar growth. Such growth results in permanent forward positioning of the mandible (Calvert, 2010). Recently, anterior relocation of the glenoid fosse has been proposed as another possible treatment result of functional appliances. A variety of functional appliances are available for the treatment of class II division 1. The Twin Block was introduced over 20 years ago and it has achieved wide spread use, particularly in United Kingdom, where it is the most popular functional appliance used for class II correction (Ibitayo *et al*., 2011) . Treatment with Twin Block starts in the beginning of early permanent dentition as premolars are essential for retention of the appliance; this leads to time limitation of its use in mixed dentition stage. The Twin Block appliance works aesthetically using functional principles to free the patient of the restrictions imposed by a one piece appliance as in other functional appliances. With the Twin Block appliance the patient has the advantage of functional treatment with more expected patient cooperation (Mc Namara, 1998). The hypothesis that functional appliances enhance mandibular growth in the treatment of skeletal Class II malocclusion was examined, and a literature search was performed in electronic databases according key words "skeletal Class II malocclusion" and full texts of selected articles were collected by hand-made method, the data were extracted from the articles and the quality of the trials was evaluated and meta-analysis method was used to analyze the data through Rev Man 4.2. Nineteen articles could be qualified for the final analysis, those indices including SNB, Go-Gn, Co-Pg, and Co-Go, demonstrated significant effect of functional appliances on mandibular growth in comparing with those of untreated control group. There were no significant differences between the control and treatment groups for the indices of SNB (Frankel-11) and Go-Me (Mills *et al*., 2009). Due to the importance of early intervention in management of children with class II division 1 skeletal mandibular deficiencies especially during early permanent and mixed dentition stage where's the regular appliance not retentive well and sometimes causing disadvantageous lower incisors proclination; so the idea of this work was emerged to evaluate the effect of a newly modified Twin Block appliance in treatment of class II division 1 malocclusion in mixed dentition dentally and skeletally.

Corresponding Author: Abou El-Yazeed, M., Associate Professor -Department of Orthodontics and Pediatric Dentistry National Research Centre - Dokki –Giza 12311, Egypt
E-mail: mohamedabouelyazied@yahoo.com

SUBJ ECTS AND METHODS

The protocol of this study was firstly subjected to the ethical committee of the National Research Centre, Egypt and after agreement No10/161/2010 a written consent was taken from the parents or the guardian of the selected children. Fifteen girls in mixed dentition stage with their age ranged from eight to eleven years were selected from the Orthodontic Outpatient Clinic, Faculty of Oral and Dental Medicine, Cairo University, Egypt. Subjects were selected with the following criteria; skeletal mandibular deficiency and dental Class II (minimum 1 unit class II molar and canine); no previous orthodontic treatment; no history of major medical disease or craniofacial injuries or syndrome and no extraction or missing permanent dentition. Selected subjects were divided into two groups; Group 1 (control group N = 5) and Group 2 (treatment group N= 10). The following records were taken; upper and lower orthodontic casts were taken with alginate impression material and poured immediately in stone plaster. A wax bite in centric occlusion was done to orient the upper and lower casts during cast trimming; six different extra and intraoral photographic views (facial, profile and smile, right and left sides on occlusion as well as frontal one) as well as panoramic and lateral cephalometric X-ray (before and after 6 months of treatment). For appliance construction the following procedures were used; upper and lower impressions were taken and poured with hard white stone for obtaining the working model. The working bite was taken after that with pink modeling wax; an adequate quantity was softened slightly but firm; and molded to a horse shoe shaped bite block. The surface was then flamed just before insertion to ensure a sharp impression of the occlusal surfaces of the teeth. During taking the bite subjects were instructed to open, protrude the mandible and close very slowly until told to stop closing, at which point (Anterior teeth edge to edge and class one canine relation, provided that thickness of wax at posterior area about 6 mm) movement should stop with the mandible held quite still. The bite block was then removed and was kept in cold water for a minute and replaced in the mouth for checking the position of the teeth in the wax. The working models were then placed on the working bite and firmly seated. Models were then articulated using a standard plane like articulator with the incisor teeth facing towards the hinge of the articulator and the lingual aspect of the models faces outward. Acrylic bite blocks were interlocked at 70 degrees, located at the first deciduous molar and second deciduous molar area, where the upper blocks were facing anteriorly and the lower facing posteriorly and cemented on the occlusal plane using self cure resin. Casts were separated and every cast was put on the vacuum machine using 1.5 mm clear thermoplastic sheet to construct the base of the appliance over the acrylic blocks for the upper and lower. Subject in the treatment group were instructed to wear the appliance (Fig. 2a, b) for 24 hours/day except during eating time (Tumer *et al*., 1999). For each subject a lateral cephalometric film was taken before and after 6 months of treatment (Fig.7a, b) and was traced using special software (V Ceph. Cybermed, Korea) for certain linear and angular measurements which presented in table 1and 2 and was shown in figure 1a and b.

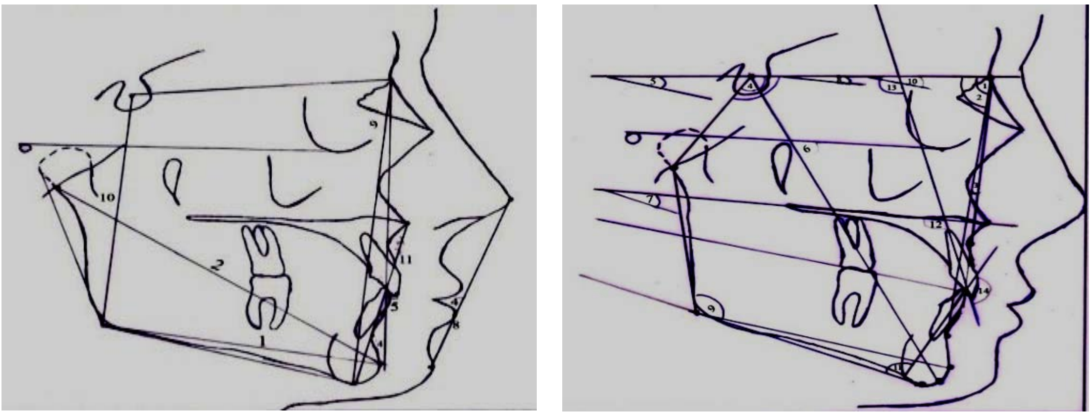
Table 1: Cephalometric linear measurements

Code	Symbol	Title
1	Go–Pog	Mandibular base length
2	Ar–Pog	Mandibular length
3	N⊥/A	Length from N ⊥ to A point
4	N⊥/B	Length from N ⊥ to B point
5	N⊥/$\underline{1}$	Distance from the incisal edge of the upper central incisor to N ⊥
6	N⊥/ $\overline{1}$	Distance from the incisal edge of lower central incisor to N ⊥
7	E line/U lip	Distance from esthetic line to upper lip line
8	E line/L lip	Distance from esthetic line to lower lip
9	N–Me	Anterior facial height
10	S–Go	Posterior facial height
11	ANS–Me	Lower facial height
12	S–Go/N–Me x 100	Facial height ratio

Table 2: Cephalometric angular measurements

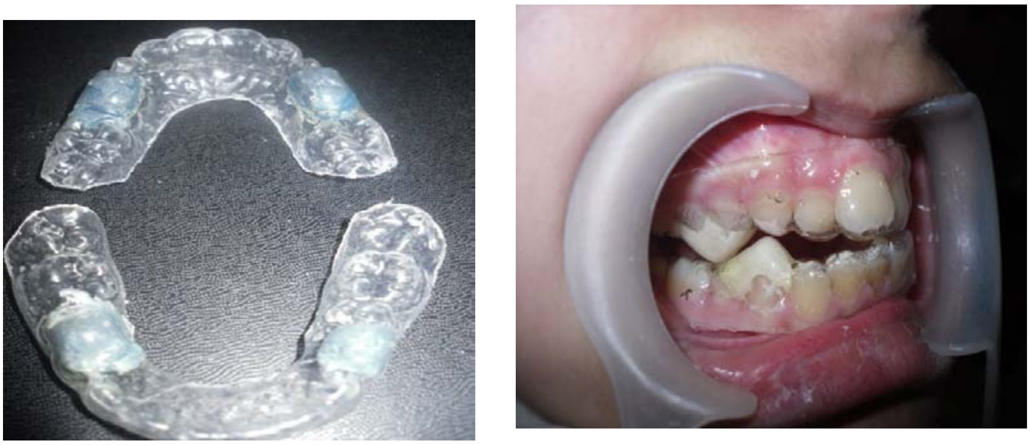
Code	Symbol	Title
1	SNA	Antroposterior position of the maxilla
2	SNB	Antroposterior position of mandible
3	ANB	Difference between SNA and SNB
4	NSAr	Saddle angle
5	SN/GoGA	Mandibular plane angle
6	S–Gn/FH	(y-axis) angle between S-Gn and Frankfort
7	Pal–MP	Angle between mandibular plane and maxillary plane
8	S–N–Pal	Angle between S-N and maxillary plane
9	Ar–Go–Me	Gonial angle

10	Focc–SN	Angle between functional occlusal plane and S-N
11	L1–MP	Angle between the lower incisor axis and palatal plane
12	U1–Pal	Angle between the upper incisor axis and maxillary plane
13	U1–SN	Angle between the upper incisor axis and S-N posteriorly
14	ii angle	Inter incisal angle between the upper and lower central incisor axes



(a) (b)

Fig. 1: Cephalometric linear measurements (a) and angular measurement (b)



(a) (b)

Fig. 2: Modified Twin Block after finishing (a), and in the patient mouth (b)

RESULTS AND DISCUSSION

Discrepancies between the jaws in the development of the occlusion play an important role in the development of class II division 1 malocclusion. Several studies revealed that the majority had a component of mandibular deficiency. Changing the position of the mandible by forcing the patient to function with the lower jaw forward could stimulate mandibular growth, as a result, correcting class II problems (Niu *et al*., 2011). The linear and angular results of this study presented in tables 3, 4. Table 3 shows the mean values of linear measurements before and after the treatment period for both groups. There was statistically significant decrease in E Line/U Lip and there was highly significant increase in Go-Pog (Fig. 3), Ar-Pog, N-Me, ANS-Me, FHR and very highly significant increase in S-GO and a highly significant decrease in overjet. The extent of mandibular base was determined by measuring the distance gonion-pogonion (Go-Pog). In some references the mandibular length was expressed as the distance between condylon and gnathion or pogonion. One of the problems encountered with this measurement was the difficulty in defining the head of the condyle on the cephalogram. Measuring the mandibular length by using the articulare (Ar) point has introduced the possibility of measuring the mandibular length by Ar- pog. In the present study both groups have an increase in the Go-pog and Ar-pog, but the highly significant increase in the treatment group denotes that the Modified Twin Block enhanced the mandibular growth more than control group which depends on natural growth, this was in agreement with the results of Cohen, 1983. The highly significant increase in anterior and posterior facial height as well as facial height ratio in treatment group compared to the control group denotes that Modified Twin Block reorient the growth pattern of the patient from vertical to horizontal by increasing the posterior facial height (S-GO) which leads to change in the discrepancies of the skeletal base; this is in accordance with Trenouth, 2006.

Table 3: Mean and standard deviation of linear measurements in control and treatment groups

Variable	Control Gp. (I)		Treatment Gp. II	
	Before	After	Before	After
	Mean± SD	Mean± SD	Mean± SD	Mean± SD
Go-Pog	67.80±4.21	69.20±3.56*	65.70±3.53	67.80±4.02**
Ar- pog	91.80±6.46	96.20±5.72*	88.80±4.96	93.10±5.24**
N ⊥ /A	0.80±1.92	0.40±5.72	0.50±3.17	-0.20±5.43
N ⊥ /B	-8.20±1.92	-8.80±2.28	-12.00±4.55	-12.20±6.09
N ⊥ /1	7.20±2.49	7.80±2.78	4.70±6.41	4.60±5.46
N ⊥ /$\overline{1}$	0.20±4.44	0.40±5.03	-3.90±6.74	-2.80±7.27
E Line/U Lip	-0.25±1.71	0.00±3.00	3.89±3.59	2.56±3.54*
E Line/L Lip	0.25±3.78	1.00±6.00	3.56±3.28	2.78±3.83
N-Me	110.00±8.09	113.20±8.35**	101.60±8.37	105.30±8.33**
S-Go	67.80±8.47	70.60±8.36**	63.10±5.72	67.10±5.61***
ANS-Me	63.20±5.02	64.80±5.22	59.70±6.36	61.90±6.23**
FHR	61.49±3.98	62.22±3.23	62.19±4.08	63.81±3.61**
Overjet	5.80±2.28	7.00±1.41	9.70±1.95	7.00±2.08***
Overbite	3.20±2.05	4.00±1.00	1.15±2.56	0.50±2.52

SD = Standard deviation *= Significant at $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

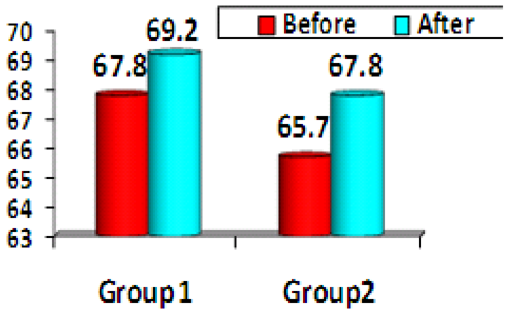


Fig. 3: Mean Go-Pog before and after treatment in both groups

Mean and standard deviations for all the angular variable measurements of both groups were presented in table 4. There was statistically significant increase in angle SNA while in angle SN/Go-Gn significant decrease was noticed. Also there was highly significant increase in SNB (Fig. 4) and a highly significant decrease in ANB angle (Fig. 5).

Table 4: Mean and standard deviation of angular measurements in control and treatment groups

Variable	Control Gp. (I)		Treatment Gp. II	
	Before	After	Before	After
	Mean± SD	Mean± SD	Mean± SD	Mean± SD
SNA	81.50±2.96	81.90±2.75	81.15±5.17	81.70±5.29*
SNB	75.70±2.17	75.90±2.51	72.60±4.01	74.75±3.90***
ANB	5.80±1.26	6.00±0.61	8.55±1.95	6.95±2.19***
N-S-Ar	120.40±6.35	119.80±5.07	129.30±5.38	128.70±6.71
SN/Go-Gn	33.80±2.68	32.60±2.41	35.80±4.73	34.95±5.10*
S-Gn/FH	59.80±3.96	59.90±3.44	62.25±3.27	63.50±4.38
Pal/MP	30.40±3.85	30.00±3.08	27.45±5.36	27.70±7.14
Pal/SN	8.20±3.37	7.40±1.81	10.10±2.89	9.10±3.87
Ar-Go-Me	130.90±7.39	131.00±6.47	126.95±6.99	128.05±5.92
Focc/SN	19.00±2.92	19.40±2.51	26.90±4.65	25.80±4.94
L1/MP	94.20±9.52	95.20±9.88	96.40±10.19	98.70±7.79
U1/Pal	116.40±8.88	115.40±6.19	115.05±5.25	115.85±5.76
U1/SN	110.00±5.79	109.80±5.76	107.30±5.98	107.05±7.41
ii angle	118.20±12.37	117.80±11.80	118.60±11.03	117.10±10.08

SD = Standard deviation *= Significant at $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

The significant increase in SNA angle in the treatment group which expressed the sagittal relationship of the anterior limit of the maxillary apical base to the anterior cranial base may be due to the nature of the appliance (Two separate upper and lower parts) which has no full control on the maxillary arch growth, this is in agreement with Pancherz, 1984 and in contrast with Lund *et al*., 1998. The very high statistically significant increase in SNB angle in the treatment group represent the sagittal relationship between the anterior cranial base and the anterior extent of the mandibular apical base denoting increase in the mandibular growth, this is in accordance with Vargernik *et al*.,1985. The very high significant decrease in values of ANB angle within treatment group despite the increase in SNA angle may be attributed to the highly significant increase in SNB angle; this is in accordance with De Vincenzo *et al*., 1987. The decrease in the mandibular plane angle (SN/Go-Gn) in the treatment group in this study disagree with that of Tumer *et al*., 1999 who concluded in their study that Twin Block increase significantly the mandibular plane due to over eruption of the posterior teeth; this could be attributed to idea that the Modified Twin Block does not permit the eruption of the posterior teeth and acts as posterior bite blocks which leads to anterior rotation of the mandible and decrease the mandibular plane. The present study revealed interesting result about the L1/MP angle; as no statistically increase in the inclination of the lower incisors denoting that the Modified Twin Block has a lesser effect on the lower incisors proclination; this could be attributed to the design of the appliance which capping the lower incisors and prevent its tipping labially, this is in contrast to the result of Mc Namara,1998 who found a highly significant proclination of the lower incisors with the Twin Block appliance.

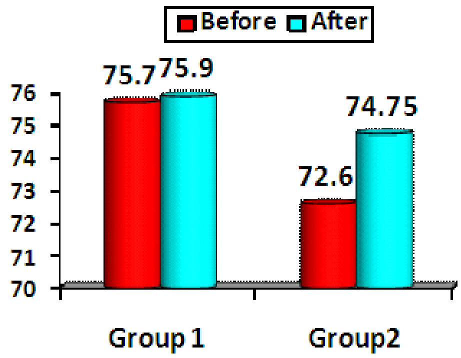


Fig. 4: Mean SNB before and after treatment in both groups

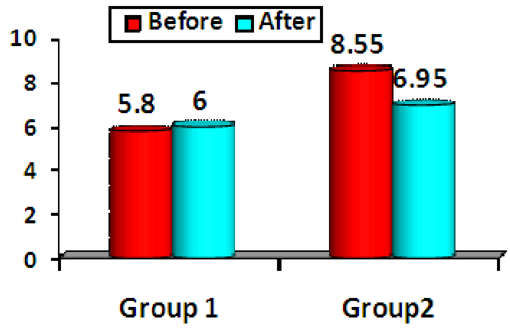
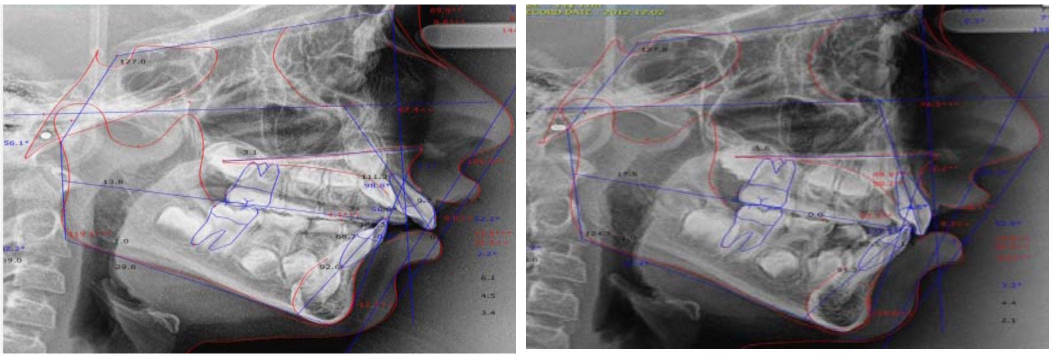


Fig. 5: Mean ANB before and after treatment in both groups

The matter of changes in dentoalveolar structures was contradictory where the insignificant decrease in angular measurement U1-SN and U1-Pal plane was in accordance with that of Mc Namara, 1998, it was in contrast with Tumer *et al*., 1999 who found a significant decrease in the treatment group. The most obvious orthopedic changes in the treatment group were in linear measurement Go-Pog and in angular measurements SNB as well as ANB which denotes increase in mandibular length and success in skeletal advancement (Fig. 7a,b) while figure, 8 presents superimposition of lateral profile tracing before and after six months of treatment of the same patient. The intraoral dentoalveolar changes of a female patient aged 8 years presented in figure 6a and b photographically while figure 7a and b show the lateral cephalometric tracing before and after six months of treatment.

(a) (b)

Fig. 6: Intraoral photographs of a female patient aged 8.5 years before treatment (a) and after six months (b)



(a) (b)

Fig. 7: Lateral cephalometric tracing of the same patient in figure (6) before treatment (a) and after six months (b)

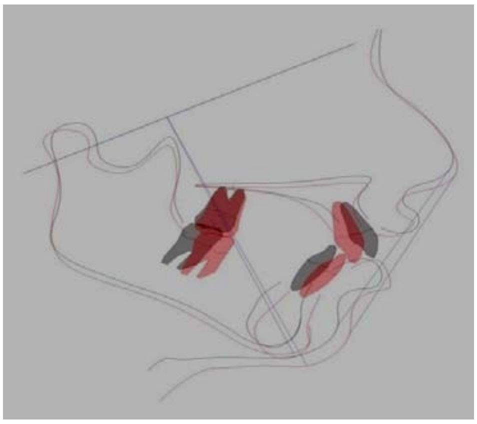


Fig. 8: Superimposition of lateral profile tracing before and after six months of the same patient in figure (6)

Conclusion:

Based on the results of this study, it can be concluded that Modified Twin Block appliance can be used in treatment of class II division 1 deficient mandible being affects growth potential of the mandible and growth pattern of the face toward the favorable directions without causing undesirable proclination in the lower incisors.

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