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Dento-Skeletal Effects of Twin Block Appliance and Face-Bow on Early Treatment of Severe Class II Division 1 Malocclusion

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ABSTRACT: A sample of 12 patients (4 boys and 8 girls) with skeletal Class II malocclusions due to mandibular deficiency aged from 8-12 years were selected for this study. Each patient was instructed to wear his Twin Block appliance for one weak then face-bow was added to the appliance through an activator tubes embedded in the premolar region of the upper compartment of twin block appliance, the force was 400-500gm/side, An expansion screw was also added to the palatal acryl of the upper part which was opened by the clinician according to presence or absence of posterior cross bite. Cephalometric and cast variables was measured before and after treatment to evaluate the dento-skeletal changes produced by treatment. Data were entered and analyzed using:SPSS software for windows (version 21) and Boxplot graphs were created by STATA/MP software (version 14.0) for windows (32-bit). Statistical significance of the obtained results was judged at the 5% level.

Results: Mandibular advancement with significant increased SNB ($p<0.001$), decreased ANB ($p<0.0005$), Maxillary growth restraining effect with Non-significant decrease in SNA ($p=0.103$),An increase in total anterior facial height ($p=0.045$), Upper incisor retroclination by decreased (U1-SN) measurement ($p=0.002$), Lower incisors proclination with increased (L1-MP) measurement ($p=0.012$), A significantly decreased overjet ($p<0.0005$), Lower lip was protruded significantly in relation to E-line ($p<0.001$), and a significant increase in inter-molar width ($p=0.013$).

Conclusion: The Twin block appliance with face-bow had skeletal effects in the sagittal plane by restraining maxillary growth and stimulating the forward growth of the mandible which was effective in early treatment of skeletal Class II malocclusion due to mandibular retrognathism.

Key words: *Twin Block, Functional Appliance, Growth modification, Class II division 1 malocclusion, Head gear, Face bow.*

I. INTRODUCTION

Etiology of Class II malocclusion may be dental or skeletal disharmony, Dental problems of habits, premature loss of primary molars or congenitally missed permanent teeth. Skeletal Class II malocclusion has more genetic predisposition, it results either from anteroposterior and/or vertical jaw discrepancy resulting from abnormal size and/or position of one or both jaws[(1)].

Class II division 1 represents about 10-15% of the Arab population according to a national survey study made in the Middle East,[(1)] and 21% of the Egyptian population according to an epidemiological study of dental occlusion[(2)]. However, It was concluded that 75% of class II malocclusion was due to mandibular retrognathia[(3,4)].

Orthodontic treatment aims largely to correct dental irregularities, while if there is a major skeletal discrepancy, orthodontics must be accompanied by dentofacial orthopedics treatment in growing patients or orthognathic surgery in adults to achieve a pleasing facial profile by correcting relationship of dentoskeletal subunits.[(5)]

There are numerous types of removable and fixed functional appliances designed for the treatment of skeletal Class II Division 1 malocclusions of growing patients as Activator, Frankel, Bionator and Herbst appliance. The choice of the appliance is made according to the clinician's preference, type of the discrepancy and pattern of growth.[(6)]

Twin-block is a functional appliance designed by Clark in 1977; it is composed of two bite-blocks that cause a functional mandibular forward displacement with the use of occlusal inclined plane. Upper and lower bite blocks are constructed for full time wear. All functional forces including the forces of mastication are applied to the dentition which is a great advantage of twin block appliance. The patients are allowed to easily eat even when

the appliances in the mouth. Compared to other functional appliances, Twin Block allows movement forward andin lateral excursions more comfortably without interfering normal function. Twin blocks can correct arches relationships in mild and moderate cases without any orthopedic extra-oral traction forces.(7)

For cases with severe skeletal discrepancy, an extra oral orthopedic force by face bow can be added to support the action of Twin block by restraining the maxillary growth and allowing the mandible to catch up with it. Indications of such treatment are maxillary prognathism, mandibular retrognathism, and high vertical growth patterns. Such functional orthopedic system can help in controlling the uncertain treatment outcome which is may be related to pure functional therapy.(7)

The growing interest in early management of class II malocclusion cases has necessitated knowing the treatment modalities, and effect of adding face-bow to the functional appliance. Hence the objective of this study was to evaluate dento-skeletal effect of twin Block appliance and Face-bow in early treatment of skeletal Class II malocclusion.

II. MATERIAL AND METHODS

A sample of 12 patients (4 boys and 8 girls) with skeletal Class II malocclusions due to mandibular deficiency aged from 8-12 years were selected for this study. Extra and intra oral photographs, Panoramic, lateral Cephalomtric X-rays records were taken from patients before and after treatment. In addition to hand wrist x-ray which was taken for patients aged 10-12 years.Twin block appliance construction started by a rubber base impression and a wax bite registered with the mandible advanced about 5mm from the original centric occlusion. The cast is put into an articulator using the registered wax bite for appliance construction.

The Twin block consisted of two removable parts, upper and lower components (figure.1). The upper part was modified by adding activator tubes at the premoal region to engage face bow. Adams clasps were used to retain the upper appliance. Adding ball-ended clasps in the labial or buccal segments may be added to increase the retention of the appliance. To accommodate a functional protrusion of the mandible from its retruded position, a midline expansion screw provides compensatory lateral expansion of the maxilla. Labial bows are included to control labiolingual tipping of the upper incisors.Retention is often obtained in the lower arch using interdental ball clasps in the lower incisor region combined with buccal segments clasps. After construction of the twin block appliance, a high pull head gear and extra oral face bow was used in all patients together with the twin block appliance engaged into activator tubes (figure.2). The force of the face bow was 400-500g/side to gain an orthopedic effect in restraining maxillary growth.(8)

The patient was instructed to put on TB appliance for 24 hours/day and face-bow from 12-14 hours. Another wax bite is taken when the mandible reaches the full activation of the first one, this process may be repeated in over-jets more than 11 mm till the full overjet is corrected.

Cephalometric and cast variables were measured before and after treatment to evaluate the dento-skeletal changes produced by treatment (figure.3) (Table1-3). Data were entered and analyzed using: SPSS software for windows (version 21) and Boxplot graphs were created by STATA/MP software (version 14.0) for windows (32-bit). Statistical significance of the outcomes was measured at the 5% level.

III. RESULTS

Measurements before and after treatment were collected and compared to each other. Post treatment results showed considerable improvement in patients' soft tissue profile (figure.4) anddecreased overjet (figure.5)**.** Mandible had advanced sagittally without increase in the vertical dimension (facial height)**.**

There was a statistical significant increase in SNB (P=0.004) and significant decrease in ANB ($p<0.0005$) due to mandibular advancement. There was non statistical significant decrease in SNA (p=0.103) yet it means restriction of maxillary growth. Lower anterior facial height AFH had increased significantly (p=0.003). A significant difference decrease was obvious in overjet ($p<0.0005$)**.** Upper incisor inclination had significantly decreased U1-SN (p=0.002) in contrast to increased labial tipping of the lower incisors L1-MP (p=0.012) and L1-NB (p=0.001)**.** Lower lip was significantly moved forward in relation to E-line (p=0.001). Inter molar width was also increased significantly (p=0.013).

IV. DISCUSSION

Early treatment of Class II by functional appliances creates dentoalveolar and skeletal changes. Furthermore, management of growing individuals with large overjet by functional appliances diminishes the probability of need for late orthognathic surgery. These appliances have skeletal effects look like those produced from different phenomena: relocation and remodeling of the glenoid fossa, accelerated and enhanced condylar growth and neuromuscular adaptation. Therefore, functional appliances have been suggested to manage skeletal descrepancies, like deficiencies of the mandibular growth.(9)

Correction of vertical and anteroposterior skeletal discrepancies usually is suitable in the late mixed dentation stage, as perfect usage of the patient's growth potential can be made.[10]

The subjects of this study were selected in the age of 8- 12 years (mean age of 10 years) to introduce several benefits including better utilization of the patient growth potential, decreased need of teeth extractions as part of the orthodontic treatment, orthognathic surgery, less risk for adverse iatrogenic effects, better patient compliance, and more stable outcomes. This study was designed in order to evaluate the skeletal, dentoalveolar and soft tissue changes that followed correction of Class II division 1 malocclusion by Twin block appliance and extra-oral force. The addition of face-bow in this study was to restrict growth of the maxilla thus reducing the overall treatment time.

The combined Twin block and face-bow was tolerated by the patients because most of them put on the face-bow and head gear at the evening during sleeping. At the beginning of treatment, all patients were instructed to wear the intraoral components throughout the day except for the time of eating in the first two weeks to reduce the amount of discomfort then at the early evening and during sleep they were instructed to wear the intraoral components in addition to headgear and face-bow. During first week, most patients complained of discomfort. However, no pain was reported by any patient during the treatment period. There was little irritation in a limited number of patients lingual to lower incisors; this problem was solved by relieving the flange of the lower appliance lingual to the lower incisors. Fracture of the appliance at the middle area of lower appliance and distortion of labial bow were noted in some cases, these could be explained by losing the appliance from the patient's mouth during sleep and the way of insertion and removal of the appliance.

Skeletal effects on maxilla in the present study after treatment of individuals with Class II division 1 malocclusion by Twin block appliance with face-bow revealed a restriction effect on the forward growth of the maxilla. This is due to the distal reactive force generated on the maxilla as result of mandibular advancement by the Twin block appliance in addition to the Headgear force applied by face-bow on upper appliance. The SNA angle showed no statistical significant change but there is still decrease in SNA value (82.4 ± 3.2: 81.4 ± 2.7). Small restrain of maxillary growth was also reported by Toth and Mcnamara[11], Clark[12], and V. D'ANT et al[13] while Parkin et al[14] reported significant restrain on the maxilla.

In this study, the management of growing patients presented significant increase in the SNB angle and total mandibular length (Go-Gn mm). This can be attributed to the adaptive response to the new forward position of the mandible, which might be an outcome of condylar growth stimulation. The forward position of the mandible caused stretching and elongation of tendons and muscle fibers which in turn led to pull muscule attachments at bone surfaces andpromotes bone remodeling processes, this was all due to action of interaoral appliance with support of extra oral force by face bow. This was in agreement with Parkin et al.[14], Illing et al[15], Baysal et al[16], V. D'ANT et al[13], Clark[12], and Robert et al[17]

Dentoalveolar effects ofthis study showed a very significant reduction in the overjet after the lateral cephalometric x-ray and the cast analysis. The overjet was corrected by skeletal changes (forward growth of mandible) and uprighting the upper anterior teeth with slight proclination of the lower incisors. Regarding the position of maxillary incisors, there were a noticeable change in the axial inclination of the maxillary incisors, measures of upper incisors angulations (U1-SNº and U1-NAº) was decreased significantly, this might be due to the force generated on the maxillary incisors by labial bow and a the distal force in the upper component of the twin block by face-bow, this finding agreed with Parkin[14], Illing[15], and V. D'ANT[13]. Also, the distance from the incisal edge of the maxillary incisors to the palatal plane (U1-PPmm) showed significant increase, these indicated palatal tipping with extrusion of maxillary anterior teeth. These findings were in line with the results of Toth and Mcnamara[11] outcomes but in contrast to Baysal et al[16].

The position of lower incisors in Class II treated with functional devices is critical. Excessive labial proclination of lower anterior teeth is an unwanted effect becuase it reduces the potential for orthopedic effect. Slight but significant increase in the axial inclination of the lower incisors was observed in this study as (L1/NBº) and (L1-MPº). These results were in agreement with Illing et al[15], Parkin et al[14], lee et al[17], Baysal et al[16], khoja et al[18], and Toth and Mcnamara[11].

This study reported significant changes in the upper inter-molar width. This increase could be due to the expansion screw that was added to the upper component of Twin block appliance which in turn contributed to increase inter-molar width.

V. CONCLUSION

1) The Twin Block with face-bow was an effective device in the treatment of growing patient of class II division 1 relationship due to mandibular retrusion.
2) The appliance had skeletal effects in the sagittal plane by retraining maxillary growth and stimulating mandible to grow forward.
3) The overjet was reduced due to the increased forward growth of the mandible, palatal tipping of upper incisors.

4) The appliance changed the vertical dimension of the face.
5) The pronounced improvement in the facial profile followed the changes in the underlying hard tissue structures.

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Figure.1 Twin Block appliance fitted in a patient's mouth

Figure.2 Extra oral photograph of a patients wearing face-bow and headgear

Figure.3 Lateral cephalometric x-rays before and after treatment

Figure.4 Pre- and Post-treatment extra-oral photographs

Figure.5 Intra-oral photograghs before and after treatment

Table (1): skeletal measurements changes before and after treatment.

Parameter	Timing		Statistic	P
	Pre-treatment	Post-treatment		
SNA	82.4 ± 3.2	81.4 ± 2.7	t = 1.812	0.103
SNB*	73.5 (70.75 – 74.25)	75.25 (74 - 78)	Z = -2.848	**0.004**
ANB	8.95 ± 1.7	5.05 ± 1.07	t = 7.490	**<0.0005**
Wits*	2.0 (0.75 – 3.0)	-2.0 (-2.25 - -0.75)	Z = -2.098	**0.036**
Maxillary length	46.75 ± 6.6	47.1 ± 6.5	t = -2.333	**0.045**
Mandibular length	62.2 ± 4.7	63.1 ± 4.7	t = -3.143	**0.012**
FMA	30.5 ± 6.2	31.6 ± 5.5	t = -1.118	0.102
SN-MP	38.2 ± 5.6	37.9 ± 3.9	t = 0.314	0.761
TAFH	99.2 ± 7.8	102.6 ± 7.9	t = -2.325	**0.045**
AFH	52.8 ± 3.1	55.1 ± 3.5	t = -4.116	**0.003**
PFH*	56 (53.75 – 64.25)	58 (55 – 56.25)	Z = -2.911	**0.004**

*p≥0.05 nonsignificant. *p ≤ 0.05 (significant).*

Table (2) dentoalveolar measurements changes before and after treatment.

Parameter	Pre-treatment	Post-treatment	Statistic	P
Overjet	11.1 ± 1.5	3.8 ± 1.4	t = 14.107	**<0.0005**
Overbite	4.55 ± 1.8	3.9 ± 1.4	t = 1.145	0.282
U1-SN	111.1 ± 7.8	103.6 ± 7.9	t = 4.338	**0.002**
U1-NA*	27.5 (20.75 – 32.5)	21.5 (17.5 – 24)	Z = -2.670	**0.008**
U1-NA mm*	4.5 (4.0 – 7.6)	3.0 (2.75 – 4.0)	Z = -2.677	**0.007**
U1-PP mm	24.3 ± 3.1	25.3 ± 3.2	t = -3.115	**0.012**
U6-PP mm*	15.5 (15 – 18.25)	16 (15 – 19.25)	Z = -1.119	0.263
L1-MP	95.9 ± 8.2	99.4 ± 5.5	t = -3.131	**0.012**
L1-NB	27.0 ± 5.2	32.6 ± 4.55	t = -5.068	**0.001**
L1-NB mm	5.2 ± 1.8	6.6 ± 1.9	t = -6.021	**<0.0005**
U1-L1	113.2 ± 8.2	118.7 ± 9.8	t = -1.624	0.139

Table (3): The results and statistical analysis for the study casts variables before and after management.

Parameter	Pre-treatment	Post-treatment	Statistic	P
Inter-canine width*	32.9 (30.4 – 36.6)	32.6 (31.4 – 37.8)	Z = -1.886	0.059
Inter-molar width	51.6 ± 2.2	52.4 ± 2.5	t = -3.082	**0.013**
Arch length	79.5 ± 4.9	78.9 ± 5.3	t = 1.434	0.185

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