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# Skeletal, Dental and Soft Tissue Effects of Twin Block Appliance in Different Facial Divergence Cases

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## ABSTRACT

### Introduction

Class II malocclusions refer to a discrepancy in the sagittal plane associated with either backward or upward rotation of the jaw. A backwardly positioned mandible is usually managed using a Twin block appliance which contains a bite plane to direct the occlusal forces in a more favorable direction. Our aim was to evaluate skeletal, dental, and soft tissue changes using twin-block appliance therapy in different facial divergence patients.

### Methods

A cephalometric study was conducted among two groups with 15 patients in each group. Group 1 have a Frankfort Mandibular plane Angle (FMA) of 18-25 degree while Group 2 have an FMA of 28 to 33 degree with Class II Division I malocclusion. All of them were treated with twin block appliances with modifications done according to FMA. Cephalometric analysis was done using Dolphin software (Dolphin Imaging 11.95) to evaluate skeletal, dental, and soft tissue changes after twin block therapy.

### Results

Analysis of variance and paired t-test were used to evaluate pre and post-treatment changes in cephalograms. The position of the mandible, maxillomandibular relation, and mandibular length was changed by 3.99 degrees, 5.23 degrees, and 4.04mm respectively in horizontal growers, while by 2.9 degrees, 1.74 degrees, and 1.07mm respectively in vertical growers. An increment in FMA by 4.59 degrees in horizontal growers with good vertical control and a little increment in FMA by 1.07 degrees in vertical growers were seen.

### Conclusions

The twin block appliance is effective in skeletal, dental, and soft tissue correction in patients with different facial divergences.

**Keywords:** cephalometry; class-II; digitization; facial divergence; modified twin block.

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## INTRODUCTION

Class II malocclusion is commonly observed by orthodontists in daily practice. The anteroposterior mandibular discrepancy may be associated with vertical dysplasia.[1] Mandible can either grow more in a vertical or horizontal direction.[2] In addition to variations in facial structure, individuals classified as horizontal and vertical growers exhibit differences in several aspects related to their mandibular muscles' attachment in relation to the occlusal plane, the gonial angle, bite force, and various occlusal characteristics. According to Pepicelli, superficial masseter muscles have more anterior attachment with small cross-section areas leading to a weak and flaccid muscle pattern with reduced bite force associated with long faces compared to brachycephalic faces.[3] The anteroposterior mandibular deficiency and vertical dysplasia can be addressed at growing ages with myofunctional appliances. The primary objective of the myofunctional appliance is to train the muscles to assist in adequate dentofacial development by eliminating abnormal musculature functions.[4] Anderson V activator,[5] high posterior bite blocks,[6] and magnetic appliances[7] had shown promising results in directing the growth of vertical dysplasia. Twin-block appliances are simple bite blocks that are worn full-time; they achieve functional correction of malocclusion by transmitting favorable occlusal forces to occlusal inclined planes covering the posterior teeth.[8] Clark has also described a modified version of the twin block myofunctional appliance for high-angle cases.[9] Therefore, the primary aim of this study is to evaluate the cephalometric changes with a twin block appliance in growing Class II patients with different facial divergences.

## METHODS

It was a prospective observational comparative study. The study was conducted at the Department of Orthodontics and Dentofacial Orthopedics, College of Medical Sciences, Bharatpur, Chitwan, Nepal. The duration of the study was 9 months. The time period of the study extends from January 1st, 2022 to June 30th, 2023. Ethical approval was obtained from the College of Medical Sciences-Teaching Hospital, Institutional Review Committee (COMSTH-IRC), (Ref. No. COMSTH-IRC/2021-153). All the patients were below 18 years of age so parents'consent was taken. Class II Division I malocclusion within the age group of 9 to 15 years, ANB angle of ≥ 5 degrees, Frankfort Mandibular Plane angle(FMA) between 18 to 25 degrees (group 1), and 28 to 35 degrees (group 2), Cervical Vertebral Maturation stage (CVMI) three and four were included in this study while patient's having signs and symptoms of neuromuscular or temporomandibular disorders and have history of previous or current orthodontic treatment were excluded from this study. The sample size was calculated using the formula; $n = 2SD^2 (Z_\alpha + Z_\beta)/d^2$, where, $Z_\alpha = 1.96$ at a 95% confidence level, $Z_\beta = 0.84$ at 80% power, SD (Standard deviation) = 3.20 which is the value of the muscle activity in the postural position of the mandible with the Twin block appliance.[10] Mean difference = 3.78 which is a difference in the mean value of muscle activity at 0 months and one month in anterior temporalis. Therefore, $n = 2 \times 3.20 \times 3.20 \times 7.84 = 3.78 \times 3.78 = 11.24$. Hence, the sample size was calculated as 12 after rounding off. The dropout rate of 25% may be expected. So, the desired sample size was 12+ 3 = 15. Fifteen growing patients were recruited for the study in each group. Pretreatment diagnostic records were taken and analyzed. A treatment plan was established with a twin-block myofunctional appliance. The bite registration was taken 2-3 mm beyond the freeway space, with an average of 7 mm in the premolar region, and at a 3-4 mm interincisal opening in group 1 while 5mm in the premolar region and 2-3mm interincisal opening in group 2. As per Clark's protocol for vertical growers, a twin block was made with an

increased posterior bite block using heat-cured acrylic materials. The inclined plane angle was kept less upright compared and intact till the last erupted molars and disto-ccluso trimming of the upper plate was avoided in follow-ups. While in horizontal growers the inclined plane was 70 degrees and trimming of the upper plate was done to facilitate the eruption of lower molars. A mid-palatal expansion screw was placed for expansion in the upper arch. A long labial bow made up of stainless steel 0.7 inches was used in the upper arch. A delta clasp on the upper first molars and lower first premolars was used for retention. To prevent the lower incisor proclination incisal capping was done. According to Clark's protocol,11 for any discomfort, all patients were followed up after 24 hours and then every four weeks interval. Questionnaires were utilized to record information pertaining to the duration of appliance wear, any challenges or difficulties encountered while using the appliance, as well as any instances of discomfort or pain in the mastication muscles and the temporomandibular joint (TMJ) area. After 10 days, the expansion schedule consisted of one turn twice a week. The duration of the appearance of pterygoid response was recorded for both groups. The high-angle cases showed delayed response to twin block appliances compared to horizontal growers. The treatment with the twin block was divided into different stages. Most subjects completed their active phase during the 6-8 months study period. The Class I molar relation was achieved. With the twin

**Table 1. Cephalometric variable changes of both the groups before(T1) and after(T2) Twin block therapy.**

| Variables | Horizontal growers(N-15) | | Vertical growers(N-15) | |
|---|---|---|---|---|
| | T1 | T2 | T1 | T2 |
| | Mean±SD | Mean±SD | Mean±SD | Mean±SD |
| SNA (degree) | 81.4±3.12 | 80.16±2.63 | 81.33±1.13 | 81.26±1.14 |
| SNB (degree) | 73 .82±2.92 | 77.81±0.77 | 74 .00±1.46 | 76.9±0.77 |
| ANB (degree) | 7.67±1.56 | 2.35±0.83 | 7.07±1.98 | 5.33±1.23 |
| N perpendicular to point A (mm) | 1.67±0.81 | 1±0.31 | 1.32±0.81 | 1.6±0.63 |
| N perpendicular to pogonion (mm) | 8.42±2.33 | 3.28±2.76 | 7.07±1.03 | 5.47±0.91 |
| Mandibular length (mm) | 105.76±3.34 | 109.8±4.47 | 107.32±2.26 | 107.98±3.56 |
| Overjet (mm) | 9.78±1.91 | 2.65±1.2 | 7.6±1.36 | 3.6±0.91 |
| Overbite(mm) | 6.4±1.81 | 2.21±1.21 | 4.1±0.92 | 2.47±0.83 |
| FMA (degree) | 18.73±1.48 | 23.32±1.43 | 30.73±1.48 | 31.8±1.37 |
| SN-Go-Gn (degree) | 126.31±2.02 | 127.31±1.2 | 132.27±2.43 | 132.6±2.29 |
| Y-axis (degree) | 60.32±1.45 | 61.26±1.32 | 56.66±1.75 | 56.86±1.95 |
| Total anterior facial height (mm) | 104.73±2.86 | 110.13±2.25 | 110.73±3.86 | 112.13±2.52 |
| Lower anterior facial height (mm) | 58.62±4.9 | 64.19±4.68 | 65.27±1.53 | 67.4±1.68 |
| Jaraback ratio | 55.97±1.71 | 58.18±1.6 | 58.94±1.71 | 59.82±1.61 |
| Upper incisor to SN (degree) | 115.27±6.9 | 106.22±4.39 | 114.53±4.3 | 109.32±3.9 |
| Lower incisor angle (degree) | 98.53±1.62 | 100.61±1.21 | 100.13±2.23 | 101.8±1.37 |
| Angle of convexity (degree) | 9.43±1.5 | 4.13±1.63 | 6.87±1.5 | 4.13±1.24 |
| Nasolabial angle (degree) | 99.87±2.56 | 103.67±2.19 | 97.17±3.76 | 100.43±2.49 |
| Upper lip to E line (mm) | 3.41±0.8587 | 1.43±0.23 | 1.65±1.28 | 1.83±0.31 |
| Lower lip to E line (mm) | 4.42±1.81 | 1.42±0.45 | 2.92±1.34 | 1.27±0.92 |

block, the sagittal correction was maintained. The appliances were examined for loose fit and discomfort during follow-up visits. The vertical height of blocks was maintained to prevent the supra eruption of molars. All the patients were comfortable with the appliance. At the intervals of 0 months, 6 months, and 9 months, lateral skull radiographs were captured for all patients in both study groups. These radiographs were taken with the Frankfort horizontal plane aligned parallel to the floor, and with the patient's teeth in occlusion. Using Dolphin software (Dolphin Imaging 11.95), lateral cephalograms were traced and analyzed for skeletal, dental, and soft tissue changes after twin block therapy. The same investigator evaluated the cephalometric readings twice.

## RESULTS

Cephalograms were obtained for both groups and evaluated for skeletal, dental, and soft tissue changes. The cephalometric variable changes before and after twin block appliance therapy in horizontal and vertical growers are shown in (Table 1).

The difference in cephalometric variable of both the groups before and after twin block therapy is shown in Table 2.

**Table 2. Difference in cephalometric variable (T2-T1) of both the groups before and after twin block therapy.**

| Variables | Horizontal growers (T2-T1) | | Vertical growers (T2-T1) | |
|---|---|---|---|---|
| | Mean difference | p-value | Mean difference | p-value |
| SNA (degree) | 1.24 | 0.12 | 0.07 | 0.32 |
| SNB (degree) | 3.99 | <0.01 | 2.9 | 0.02 |
| ANB (degree) | 5.32 | <0.01 | 1.74 | 0.02 |
| N perpendicular to point A (mm) | 0.67 | 0.67 | 0.28 | 0.67 |
| N perpendicular to pogonion (mm) | 5.14 | <0.01 | 1.6 | 0.03 |
| Mandibular length (mm) | 4.04 | <0.01 | 1.07 | 0.1 |
| Overjet (mm) | 7.13 | <0.01 | 4 | <0.01 |
| Overbite(mm) | 4.19 | 0.03 | 1.63 | 0.01 |
| FMA (degree) | 4.59 | 0.67 | 1.07 | 0.67 |
| SN-Go-Gn (degree) | 1 | 0.67 | 0.33 | 0.67 |
| Y-axis (degree) | 0.94 | 0.32 | 0.2 | 0.32 |
| Total anterior facial height (mm) | 5.4 | 0.09 | 1.4 | 0.09 |
| Lower anterior facial height (mm) | 5.57 | 0.23 | 2.13 | 0.43 |
| Jaraback ratio | 2.21 | 0.15 | 0.88 | 0.13 |
| Upper incisor to SN (degree) | 9.05 | <0.01 | 5.21 | 0.02 |
| Lower incisor angle (degree) | 2.08 | 0.12 | 1.67 | 0.08 |
| Angle of convexity (degree) | 5.3 | <0.01 | 2.74 | 0.01 |
| Nasolabial angle (degree) | 3.8 | 0. 04 | 3.26 | <0.01 |

Pre-treatment lateral cephalogram of horizontal grower is shown in Figure 1.

The post-treatment lateral cephalogram of

horizontal groweris shown in Figure 2.

**Figure 1.** Pre treatment lateral cephalogram of patient with horizontal growth pattern.

The superimposition of pre and post-treatment lateral cephalogram of horizontal grower is shown in (Figure 3).

**Figure 2.** Post treatment lateral cephalogram of patient with horizontal growth pattern.

The post-treatment lateral cephalogram ofvertical grower is shown in (Figure 5).

The superimposition of pre and post-treatment lateral cephalogram of vertical grower is shown in (Figure 6).

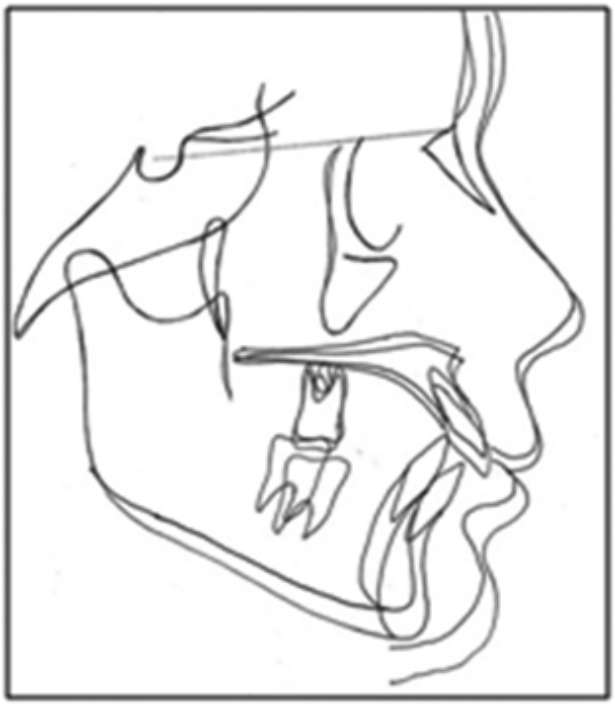

**Figure 3.** The superimposition of pre and post lateral cephalogram of patient with horizontal growth pattern.

**Figure 4.** Pre-treatment cephalogram of patient with vertical growth pattern.

The sagittal skeletal changes detected as a result of Twin-block treatment in horizontal and vertical growers, Mean mandibular length increment was 4.04mm in horizontal growers, which was significant($P<0.01$), compared to 1.07 in verti-

**Figure 5.** Post-treatment cephalogram of patient with vertical growth pattern.

cal growers, which was not significant(P=0.10). Significant anterior movement of the mandibular base (N perpendicular to pog) was observedin

**Figure 6.** The superimposition of pre- and post-lateral cephalogram of a patient with a vertical growth pattern.

both study groups. Horizontal growers exhibited a notable advancement of 5.14 mm ($p < 0.01$), whereas vertical growers demonstrated a comparatively smaller forward movement of 1.6 mm ($p = 0.03$). SNB angles increased significantly in both the groups, it was increased by 3.99 degrees (P<0.01) in horizontal growers compared to 2.9 degrees (p=0.02) in vertical growers.The maxilla-mandibular relation was improved as indicated by a significantreduction of ANB angle in both the groups, it reduced by 5.32degrees (P<0.01) in group 1 while 1.74degrees (P=0.02) in group 2. Maxillary skeletal base (N perp to point A) and SNA shows nonsignificant changes in both the groups, Maxillary skeletal base in horizontal growers changes by 0.67 mm (P=0.67) and SNA by 1.24 degree (P=0.12) compared to 0.28 mm (P=0.67) and 0.07 degree (P=0.32) in vertical growers. There were no significant changes in both groups in the vertical plane. In the horizontal grower, there isan increment in total anterior facial height, lower anterior facial height, and FMA by 5.4mm (P=0.09), 5.57 mm P=0.23), and 4.59 degrees (P=0.67) respectively. Vertical growers showed mild changes in vertical planes with total anterior facial height change by 1.4 mm (P=0.09), lower anterior facial height by 2.13mm (P=0.43), and FMA by 1.07 degrees (P=0.67). There was a significant decrease in upper incisor inclination in both groups, in group 1 it decreased by 9.05 degrees (P<0.01), and in group 2 it decreased by 5.21 degrees (P=0.02). However, there was a nonsignificant increase in lower incisor inclination in both groups, in group 1 it increased by 2.08 degrees (P=0.12), and in group 2 it increased by 1.67degrees (P=0.08). A substantial reduction in lower lip protrusion (Lower lip to E line) was observed in both study groups. Specifically, in group 1, there was a decrease of 3 mm ($p = 0.02$), and in group 2, a reduction of 1.65 mm ($p = 0.04$) was noted. Conversely, no statistically significant alterations were found in upper lip protrusion. In group 1, upper lip protrusion decreased by 1.98 mm ($p = 0.43$), while in group 2, it exhibited a minimal increase of 0.18 mm ($p = 0.56$). The nasolabial angle was significantly increased in both groups. It was increased by 3.8 degrees (P=0.04) in horizontal growers and 3.26 degrees (P<0.01)

in vertical growers after functional correction.

## DISCUSSION

The study was conducted to evaluate the skeletal, dental, and soft tissue changes with twin-block appliances in different facial divergence cases. Growing children in the cervical vertebra maturation index (CVMI) stages 3 and 4, of ages from 9-15 years were enrolled. According to Baccetti and McNamara, CVMI stages 3 and 4 represent the optimal treatment timing in dentofacial orthopedics. In cases of Class II Division 2 malocclusion, the presence of protruding anterior teeth increases the likelihood of trauma, underscoring the importance of early intervention and correction..[12] Twin block appliances are designed for continuous wear throughout a 24-hour period, offering both comfort and patient- friendliness.[13] The pre-treatment and post-treatment lateral cephalograms were digitized, and cephalometric parameters were determined with Dolphin software and rechecked twice manually. A significant increase in SNB angle and mandibular length are the primary cephalometric parameters for correction of Class II in both groups. The increment in mandibular length was greater in horizontal growers compared to long- face cases. This study is similar to a previous study by Mills and McCulloch[14] who reported a 6.5 mm increase in effective mandibular length. Toth and McNamara[15] reported a 3.0 mm increase in mandibular growth. There was a mild change in the SNA angle, indicating little restricting effects on forward maxillary skeletal growth i.e. "Headgear effect". The effect was not significant in horizontal growers. This was in accordance with the study conducted by Lund and Sandler.[16,17] Due to the remodeling of the bone of the anterior maxilla during the retraction of upper anterior teeth there were minor changes in A point after twin block therapy.[18] The maxilla-mandibular relationship (ANB angle) reduction was seen in both groups with more reduction in horizontal growers. This reduction was primarily due to a change in the SNB angle. These findings were in agreement with the study by Clark.[9,11] and Illing et al.[19] The twin block appliance was effective in treating the Class II skeletal discrepancy with a change in position of the mandible during the pubertal growth spurt.[20] Due to a combination of skeletal and dentoalveolar changes with predominant skeletal changes, overjet, and the molar relation was corrected.[18] This study revealed a greater prevalence of skeletal changes as opposed to dental changes. This observation can be attributed to the fact that the treatment was administered during the peak growth spurt phase. The dentoalveolar correction was achieved due to lower incisor proclinationand upper anterior retroclination. IMPA was increased in both groups despite acrylic capping of the lower incisors. Maxillary incisor inclination was corrected with upper lip musculature force during functional treatment[21] and also due to maxillary labial bow effects.[14,16] The high-bite twin block appliance showed adequate vertical control with no change in any vertical facial relationships, Frankfort mandibular plane angle (FMA), and Jarabak ratio. Posterior bite blocks were kept intact without trimming.[22] Vertical control was due to the acrylic block in the posterior region, which causes disocclusion of the teeth, separating the dental intercuspation, and favoring the mandibular growth, thus improving the Class II relationship.[23] Hence, the vertical dentoalveolar development can be controlled without changing the angulation of the mandibular plane as well as favors an additional increment of mandibular growth for correction of Class II relation.[24] The ratio of total anterior facial height to lower facial height remained the same pre- and post-functional treatment with modified twin block appliance. However, in horizontal growers, trimming of the upper block facilitates the eruption of lower molars. The twin block appliance leads to clockwise rotation of the mandible

along with sagittal correction leading to an increase in ramal height and total anterior facial height.[25]

## CONCLUSIONS

The twin block appliance was effective in the correction of skeletal Class II in both groups with different facial divergences. Sagittal correction of the mandible with good vertical control can be achieved with a high bite twin block appliance.

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**Conflict of interest:** None

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