Cephalomteric changes in airway dimensions with twin block therapy in growing Class II patients

Santhana Krishnan Vinoth, Ashwin Varghese Thomas[1], Ramya Nethravathy

Department of Orthodontics, Vivekanandha Dental College for Women, Elayampalayam, Tiruchengode, Namakal, [1]Department of Orthodontics, Ree Mookambika Institute of Dental Sciences, Kanyakumari, Tamil Nadu, India

Address for correspondence:
Dr. Santhana Krishnan Vinoth, E-mail: drvino1ortho@gmail.com

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ABSTRACT

Introduction: Myofunctional appliances are commonly used for correction of skeletal Class II malrelationship. These appliances influence craniofacial and nasopharyngeal dimensions. **Objectives:** The present study was done to evaluate changes in airway with twin block therapy. **Materials and Methods:** Cephalometric assessment of airway was done in 25 growing children in the age group of 11-13 years with Class II skeletal pattern. All the patients were treated with twin block appliance. Pre and post treatment lateral cephalograms were taken to evaluate the changes in different airway and craniofacial dimensions during the treatment period. The average treatment duration was 14.5 months. **Results:** Airway: A significant increase was observed in upper and lower pharyngeal width and area of bony nasopharynx. Craniofacial dimension: There was a significant increase in effective mandibular length, ramal length and mandibular plane angle. There was an increase in SNB angle, which resulted in decreased ANB angle. **Conclusion:** There was a definite improvement in airway dimension following twin block therapy

KEY WORDS: Airway, craniofacial dimension, twin block appliance

Class II division one malocclusion and dental crowding are the two most common indications for orthodontic treatment in children at school age. The Class II division one malocclusion may involve different dental and skeletal components.

The growth and function of nasal cavities, the nasopharynx and the oropharynx are closely associated with the normal growth of skull.[1] The size of nasopharynx increases in conjunction with the growth of the cranial base and forward development of mid face.[2]

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Mouth breathing is associated with adenoid facies or long face syndrome. The reason for these features may be reduced nasorespiratory function for, e.g., enlarged adenoids or nasal abnormalities. Improvement in dentofacial features is reported after adenoidectomy[3,4] or nasal correction due to improved airway functions. The other treatment modalities to improve nasorespiratory functions are myofunctional appliances.

Linder-Aronson and Woodside[5] concluded that sagittal depth of bony nasopharynx increases in small, steady increments up to 16 years of age in females and 20 years of age in males.

In McNamara[6] reported that upper pharyngeal width of 5 mm or less is used as an indicator of possible airway impairment. However, a lower pharyngeal width of greater than 15 mm suggests anterior positioning of tongue, either as a result of habitual posture or due to an enlargement of the tonsils Fransson *et al*.[7] reported nightly use of a mandibular

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positioning device for 2 years by Obstructive sleep apnea (OSA) patients and snorers was found to increase their airway passages because of an increase in pharyngeal area.[8]

Therefore, the aim of this study was to cephalometrically evaluate airway changes with successful twin block therapy in growing Class II patients.

Materials and Methods

This study was conducted and samples were collected from authors private practice in order to evaluate the effect of twin block therapy on airway.

Inclusion criteria

1. Class II skeletal pattern due to a retrognathic mandible (SNB < 80)
2. ANB angle greater than 4°
3. Cervical vertebral maturation Stage 2 or 3 (before peak mandibular growth)
4. Full complement of dentition for the age

Exclusion criteria were subjects with previous history of orthodontic treatment, syndromes and craniofacial abnormalities and history of respiratory disorders and adenoidectomy.

Treatment was considered to be successful when the patient completed treatment with a pleasing profile and by using Photographs, lateral caphalogram and casts.

These parameters were evaluated by a team of two orthodontists who examined pre-treatment and post-treatment photographs, models, and cephalograms. Only those patient cases that were agreed upon by the three panelists were taken for this study. The final sample consisted of 25 growing children in the age group of 11-13 years (12 males and 13 females). One pre-treatment and one-post treatment lateral cephalogram of each patient was obtained. The lateral cephalograms were taken in standardized head position with the same cephalometric X-ray unit (Planmeca PM 2002 CC Proline, Helsinki, Finland) and 8 × 10" Cephalometric film (EVG-1 Ektavision Kodak, Eastman Kodak Co, Rochester, NY). Single operator traced all the cephalograms randomly in order to reduce the bias.

The radiographic cephalometric landmarks used in the study are: Na – nasion, S – sella, Ba – basion, Or – orbitale, Po – porion (anatomic), Ar – articulare, PNS – posterior nasal spine, Ptm – pterygomaxillary fissure, AA – anterior arch of atlas [Figure 1].

Sagittal relation measurements

The following measurements are performed to evaluate sagittal relationship of jaws: SNA, SNB, ANB. Point A to N perpendicular, Pogonion to N perpendicular, Effective maxillary length: (Co to point A), Effective Mandibular length: (Co to Gn) [Figure 2].

Vertical relation measurements

The following measurements are performed to evaluate vertical relationship of jaws: Mandibular plane angle (Sn-GoGn), Y-axis angle, Facial axis angle (Ba-N–Ptm Gn) [Figure 3].

Airway linear measurements

Upper pharyngeal width:[6] It is measured from a point on the posterior outline of the soft palate to the closest point on pharyngeal wall. Lower pharyngeal width:[6,9] It is measured from the point of intersection of the posterior border of the tongue and the inferior border of the mandible to the closest point on the posterior pharyngeal wall [Figure 4] (1 - Upper pharyngeal width, 2 - Lower pharyngeal width).

Airway area measurements

Area of upper airway:[1,10] The area of bony nasopharynx frequently defined as trapezoid demarcated by the following lines: AA-PNS, The pterygoid vertical passing through PNS, Line passing through AA parallel to pterygoid vertical, And

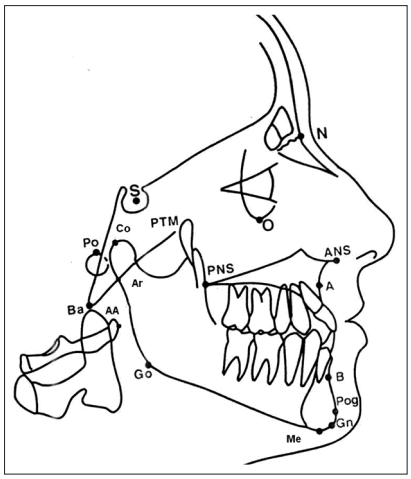


Figure 1: Various cephalometric points

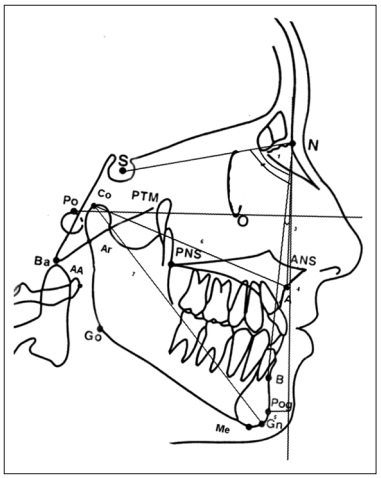


Figure 2: Sagittal relation measurements

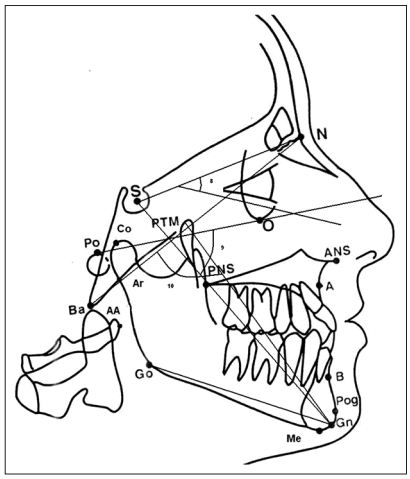


Figure 3: Vertical relation measurements

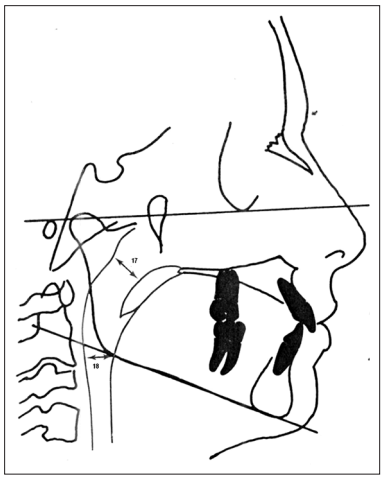


Figure 4: Airway linear measurements

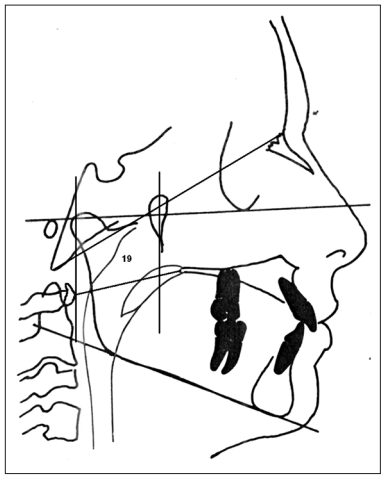


Figure 5: Airway area measurement

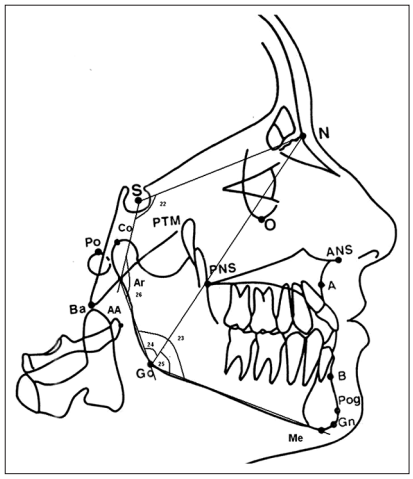


Figure 6: Functional analysis

section of the Ba-N line between the pterygoid vertical and vertical erected through point AA [Figure 5].

Functional analysis

The following measurements are done to evaluate the functional analysis of jaws: [Figure 6] (1) Saddle angle, (2) Gonial angle, (3) Upper gonial angle, (4) Lower gonial angle, (5) Articular angle.

The mean, standard deviation and mean standard error were calculated for pre-treatment and post treatment. For each cephalometric parameter paired sample *t*-test was used to measure the changes during treatment.

Results

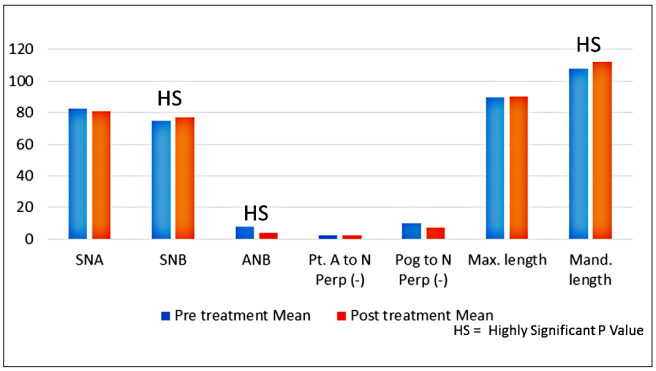
During treatment skeletal malrelationship improved as the mandible grew forward during the treatment. The change in SNB angle was on average 880°, which was very highly significant since *P* value is 0.001 [Graph 1]. The change in ANB value was on average –1.40°, which was very highly significant since *P* value is < 0.001.

The change in effective mandibular length on average 4.22 mm value, which was very highly significant since *P* value is 0.003. The change in Sn-Go Gn value from pre-treatment to post treatment was on average 1.28° which was highly significant since *P* value is 0.003 [Graph 2].

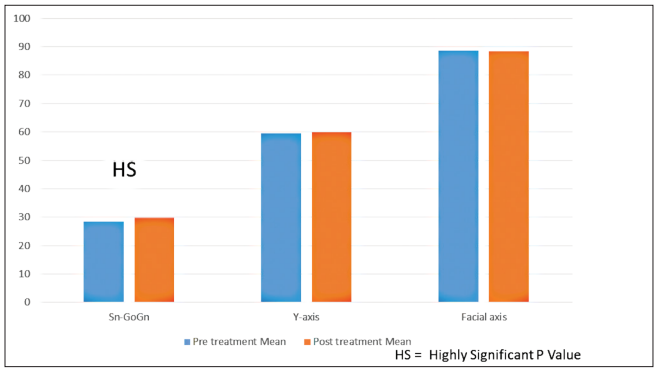
The change in upper pharyngeal width value from pre-treatment to post-treatment on average was 1.08 mm (highly significant). The change in lower pharyngeal width value from pre-treatment to post treatment was 1.62 mm, which was highly significant.

The change in area of bony nasopharynx value from pre-treatment to post treatment was on average 24.6 mm^2, which was highly significant ($P = 0.003$) [Table 1]. The change in ramal height value from pre-treatment to post treatment was 1.66 mm, which was very highly significant since *P* value is 0.001.

The change in width of ramus was not significant [Table 2]. The change in lower gonial angle value from pre-treatment to post treatment was on average 1.64° which was highly significant ($P = 0.006$) [Table 3].



Graph 1: Mean cephalometric values of pre-treatment, post-treatment in sagittal relation



Graph 2: Mean cephalometric calues of Pre-treatment, Post-treatment and Difference in Vertical Relation

Table 1: Mean cephalometric values of pre-treatment, post-treatment and difference of nasopharyngeal measurements

No.	Parameter	Pre-treatment	Post-treatment	Difference	*P* value	Inference
		Mean	Mean	Mean		
1	Upper pharyngeal width	12.02	13.1	1.08	0.002	HS
2	Lower pharyngeal width	9.32	10.94	1.62	0.003	HS
3	Area (bony nasopharynx)	553.73	578.35	24.6	0.003	HS

Table 2: Mean cephalometric values of pre-treatment, post-treatment and difference of Ramal measurements

No.	Parameter	Pre-treatment	Post-treatment	Difference	*P* value	Inference
		Mean	Mean	Mean		
4	Ramal Width	32.8	34.01	0.86	0.09	NS
5	Ramal Height	50.01	52.8	1.66	0.001	VHS

Table 3: Mean cephalometric values of pre-treatment, post-treatment and difference of functional analysis measurements

No.	Parameter	Pre-treatment	Post-treatment	Difference	*P* value	Inference
		Mean	Mean	Mean		
6	Saddle angle	124	123.2	-0.28	0.561	NS
7	Gonial angle	127	129	1.18	0.059	NS
8	Upper gonial angle	56.02	56.56	-0.66	0.11	NS
9	Lower gonial angle	71.03	73.9	1.64	0.006	HS
10	Articular angle	139.23	140.12	0.84	0.201	NS
11	Bjork sum	394	396.56	1.58	0.014	S

Discussion

Myofunctional appliances are the choice of treatment where Class II skeletal pattern is due to retrognathic mandible. These appliances reposition the tongue and mandible to a new position leading to different changes in airway dimensions. Several studies,[7,11] have reported that modifications of myofunctional appliances are effective in treatment of obstructive sleep apnea by improving the airway.

Since nasorespiratory evaluation becomes an important part of complete orthodontic diagnosis and treatment planning, the present study is carried out to evaluate the effect of twin block appliance on airway and craniofacial dimension.

In this study, we use cephalometric parameters to establish whether the twin block Therapy was successful. This success was established by evaluating the change in cephalometric factors like SNA, SNB, ANB, N perpendicular to Point A, N perpendicular to Point B, maxillary length and mandibular length between pretreatment and post-treatment along with clinical factors like reduction of overjet and achievement of Class I molar relation at the end of treatment. These parameters were evaluated by a panel of two orthodontists with records including lateral cephalograms, patient casts and treatment photographs to reduce bias.

Effect on maxilla

The result shows that there is minimal inhibition of maxillary

growth as evidenced by −0.48 degree reduction in SNA angle and 58 mm increase in effective mid facial length. These findings were similar to Mills and McCulloch[12] and Schaefer *et al*.[13] who reported a mean decrease of SNA angle by 9° and 1° respectively.

Effect on mandible

The results here show that twin block appliance successfully influenced the position of mandible as evidenced by 0.88° increase in SNB angle and 4.22 mm increase in effective mandibular length. These findings were similar to Mills and McCulloch[12] who reported 6.5 mm increase in effective mandibular length. While Schaefer *et al*.[13] reported effective mandibular length increased by 7 mm.

The findings of the present study dictates that skeletal discrepancy in sagittal direction is mainly corrected due to efficient mandibular repositioning and minimal inhibition of maxillary growth as evidenced by reduction in ANB angle largely due to the increase in SNB angle.

Effect on pharyngeal dimension

The result of this study shows that there is significant increase in upper pharyngeal width, lower pharyngeal width and in the area of bony nasopharynx. Liu *et al*.[14,15] have reported a similar increase in the retro-palatal airway space after use of mandibular repositioner in obstructive sleep apnea patients. The explanation of increased airway in the present study could be the new pattern of function dictated by the appliance, which leads to the development of a correspondingly new morphologic pattern.

However, the limitation of this study is that the airway is a 3D space and the lateral cephalogram is a 2D representation of a 3D space. The use of contemporary imaging techniques like Cone beam computerized tomography (CBCT), Computerized tomography (CT) would give a more accurate picture but was beyond the scope of this study. Moreover, these newer imaging techniques would require the patient to be exposed to more ionizing radiation which would have been undesirable and unethical. Further scope of this study would include would the 3D evaluation of this respiratory space with the patient in vertical standing postion.

The increased airway and improved sagittal relation between jaws due to myofunctional therapy indicates that it is an important mode of correction for patient suffering from airway obstruction with retrognathic mandible. It may reduce the probability of patient undergoing surgical correction for airway obstruction at later date.

Conclusion

There is a significant increase in the upper pharyngeal width, lower pharyngeal width and the Area of bony nasopharynx with successful twin block therapy.

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