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# Evaluation Of Effectiveness Of Twin Block Appliance On The Anatomy Of Pharyngeal Airway Passage In Class Ii Malocclusion

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## ABSTRACT

***Background:*** *Respiratory function and craniofacial development have been extensively studied, influencing orthodontic diagnosis and therapy. Functional appliances aid mandibular anterior relocation, according to research. One third of the population has Class II Skeletal malocclusion because of mandibular retrusion, according to some studies. Twin Block appliances (TB) are popular functional appliances because they can cause rapid growth changes. Hence the study aimed to evaluate the pharyngeal airway space effect after administration of the Twin block appliance*

***Methodology:*** *A retrospective investigation conducted in a hospital setting, focusing on patients aged 8-14 with skeletal Class II malocclusion. Using convenience sampling, A total of 38 individuals were identified and split into two groups of 19. The project was approved ethically before it began.*

*A twin block appliance was given to the treatment group, while pre-orthodontic treatment was given to the control group.*

*To assess alterations in the pharyngeal airway space, lateral cephalograms were examined at baseline and six months later.*

*SPSS was used for statistical analysis, and paired and independent t-*

*tests were used to evaluate changes before and after therapy, with p<0.05 being deemed significant.*

***Results:*** *The treatment group showed significant decreases in SNA and increases in SNB, indicating effective mandibular advancement and improved airway dimensions, while maxillary length remained unchanged. In contrast, the control group exhibited maxillary growth but no significant changes in SNA. Airway measurements decreased in the control group, highlighting airway constriction. Overall, the Twin Block group demonstrated superior outcomes in mandibular advancement and airway improvement compared to the control group.*

***Conclusion*** *The study confirms the Twin Block's effectiveness in correcting Class II malocclusion and improving airway dimensions, emphasizing its benefits for dental and systemic health in pediatric orthodontics.*

## INTRODUCTION

Respiratory function and craniofacial development have been extensively studied, influencing orthodontic diagnosis and therapy. Moss's functional theory suggests that adjacent tissues affect the skeletal system.[1-3] The soft tissues and gaps around the mandible and cervical vertebrae shape their development.[4] The tight relationship between the mandible, cervical vertebrae, and pharyngeal airway has intrigued several study groups, who have found a correlation between skeletal malocclusion, head posture, and airway dimensions.[5-7] Jaws with facial asymmetry are exaggerated in size, form, and location. This imbalance affects individuals' looks, which may damage quality of life socially and psychologically.[8] At various growing phases, malocclusions and dental abnormalities occur.[9] To diagnose and treat these anomalies, bone growth patterns must be predicted. This involves detailed craniofacial growth trends evaluation.10 Genetics strongly influence malocclusions.[9] Environmental and functional factors also affect malocclusion categories.[10] Effective orthodontic communication requires pattern description. Skeletal classifications of Class I, Class II, and Class III malocclusions were created to categorise cranio-maxillofacial patterns. Research on anomalies underlines the need for dentists to understand malocclusion care to reduce their negative impacts. Class III malocclusions are usually visible at a young age, requiring early correction. However, the pharyngeal airway is volumetric and skeletally influenced.[12] The airway's design and size depend on neighbouring tissues' structure, which affects volume and craniofacial growth.[13] The respiratory system relies on the pharynx, located behind the mouth and nasal cavity and above the oesophagus.

Pharyngeal airways include the nasopharynx, oropharynx, and laryngopharynx.[14] Oropharyngeal and nasopharyngeal airways are defined by the retropalatal portion of the maxilla, while laryngopharyngeal airways are defined by the epiglottis tip. Prolonged mouth breathing alters respiratory function, affecting head, neck, cervical vertebrae, jaws, and teeth alignment.[1,16–18] Ricketts called this respiratory obstruction syndrome. [2] Also known as adenoid facies or long face syndrome. [1,18,19]
Several factors are frequently associated with altered respiratory function, which includes adenoid and tonsil hypertrophy, oral respiration, constricted external nares, V-shaped maxillary arch, open bite, tongue thrusting, excessive anterior facial height, incompetent posture of lips , proclined maxillary teeth with Class II malocclusion, steep mandibular plane, posterior dental crossbites, forwardly inclined cervical column, and extended head position.Numerous studies have linked respiratory obstruction to skeletal malocclusion. [18–23] Children with substantial nasal blockage who got adenoidectomy had more forward mandibular growth than those without surgery, according to Linder-Aronson et al. The upper airway's structure and size have drawn interest due to its link with obstructive sleep apnoea and cranial morphologies. [24] In people with bone defects, airflow is dramatically reduced [13]
Tongue size and position can affect the oropharyngeal airway. [15] The airway narrows anteroposteriorly due to upper and lower jaw placement. [13] Malocclusion, cranial and musculoskeletal morphology, and oral respiration are all impacted by upper airway a restriction and dysfunction.[25], [26] Researchers are studying the dental abnormalities and pharyngeal airway. Different skeletal patterns have been studied [25,26].
Class II malocclusion is common in orthodontic patients, according to research. [27] Surgical procedures correct anomalies to improve patients' appearance and occlusion. [28] Surgery also corrects skeletal malocclusion and soft tissue malformations around the jaws. Mandibular growth may improve sleep quality in obstructive sleep apnoea patients. [29] Understanding the link between malocclusions and pharyngeal airways advances therapy. [2] Functional appliances aid mandibular anterior relocation, according to research. According to certain research, skeletal Class II malocclusion caused by mandibular retrusion affects one-third of the population. [30]
Twin Block appliances (TB) are popular functional appliances because they can cause rapid growth changes. [31,32] Mandibular advancements have been helped by this method. These qualities made it a popular clinical orthodontic appliance. Thus, the study examined how twin block appliances affected pharyngeal dimensions in skeletal class II malocclusion patients.[33,34]
Our literature review found a lot of evidence on treating Class II Malocclusion with myofunctional appliances and improving the Phalangeal space after treatment, but little on Twin Block appliances, necessitating this study.

## METHODOLOGY

A retrospective investigation conducted in a hospital setting, focusing on the effects of a twin block appliance on skeletal Class II malocclusion in children aged 8 to 14 years. The research employed a convenience sampling technique to select participants radiographs, ultimately estimating a total sample size of 38 cephalometric analysis of individuals, divided equally into two groups of 19.

### Sample Size Estimation

The sample size was estimated using a procedure that takes into account standard deviations, effect magnitude, and power analysis. The parameters were a two-tailed test with an effect size of 0.944, alpha error probability of 0.05, and power of 0.80. The final sample size was determined to be 19 people each group, for a total of 38 participants.

### Ethical Considerations

Before beginning the study, ethical approval was acquired from the Institutional Ethics Committee and the Scientific Advisory Committee, ensuring that all ethical requirements were followed.

### Participant Selection

Cephalograms for the subjects were obtained from the Department of Orthodontics. Subjects were required to have skeletal Class II malocclusion, a normal maxilla, and a retrognathic mandible, among other particular dental traits. Exclusion criteria excluded those with past orthodontic treatment, specific dental disorders, or systemic illnesses impacting growth.

**Group Allocation**

38 participants cephalometric were evaluated either to be in the treatment group or the control group The treatment group had received the twin block appliance, while the control group who was undergoing pre-orthodontic treatment.

**Treatment Procedure**

Participants in the treatment group were those who were fitted with a twin block appliance, which was designed to correct Class II malocclusion. The control group participants were those who received a phase of pre-functional therapy involving a sectional fixed orthodontic appliance to address mild crowding or rotations.

**Evaluation of Pharyngeal Airway Space**

The study evaluated the pharyngeal airway space (PAS) using lateral cephalograms taken at baseline and after six months. The cephalograms were captured under standardized conditions to ensure consistency. Various cephalometric landmarks and parameters were measured to assess changes in skeletal structure and airway dimensions, including SNA, SNB, FMA, and depth measurements of the nasopharynx and oropharynx were evaluated retrospectively.

**Statistical Analysis**

Participants lateral cephalometric were evaluated at baseline and after six months to assess the effectiveness of the treatment. Data were entered into Microsoft Excel and analyzed using IBM SPSS software. Continuous variables were summarized using means and standard deviations, while categorical variables were expressed as frequencies and percentages. Paired t-tests were employed to compare pre- and post-treatment changes within groups, and independent t-tests were used to compare changes between groups. A confidence interval of 95% was maintained, with a significance level set at $p<0.05$.

**Results**

**Table 1: Pre and Post Comparison of the Orthodontic Parameters in Treatment Group (Twin block Appliance Group)**

| | | N | Mean | Std. Deviation | Std. Error Mean | Mean Difference | t | p Value |
|---|---|---|---|---|---|---|---|---|
| SNA | Pre | 19 | 82.9474 | 1.43270 | .32868 | .63158 | 4.025 | .001 |
| | Post | 19 | 82.3158 | 1.20428 | .27628 | | | |
| Maxillary length | Pre | 19 | 46.4737 | 2.41220 | .55340 | .42105 | 1.804 | .088 |
| | Post | 19 | 46.0526 | 2.34458 | .53788 | | | |
| Effective maxillary length | Pre | 19 | 80.8421 | 7.25154 | 1.66362 | .00000 | .000 | 1.000 |
| | Post | 19 | 80.8421 | 7.13569 | 1.63704 | | | |
| SNB | Pre | 19 | 76.3684 | 2.24129 | .51419 | -2.73684 | -11.408 | .000 |
| | Post | 19 | 79.1053 | 1.72867 | .39658 | | | |
| Mandibular length | Pre | 19 | 58.7368 | 6.07218 | 1.39305 | -9.78947 | -6.092 | .000 |
| | Post | 19 | 68.5263 | 3.67224 | .84247 | | | |
| Effective mandibular length | Pre | 19 | 95.4737 | 8.72015 | 2.00054 | -12.15789 | -6.123 | .000 |
| | Post | 19 | 107.6316 | 4.76341 | 1.09280 | | | |
| FMA | Pre | 19 | 25.3158 | 3.00097 | .68847 | -.84211 | -1.881 | .076 |
| | Post | 19 | 26.1579 | 1.53707 | .35263 | | | |
| Depth of nasopharynx (DNP) | Pre | 19 | 10.4737 | 2.11787 | .48587 | -.05263 | -1.000 | .331 |
| | Post | 19 | 10.5263 | 2.19516 | .50360 | | | |
| Height of nasopharynx (HNP) | Pre | 19 | 19.1579 | 2.38661 | .54753 | -.31579 | -1.455 | .163 |
| | Post | 19 | 19.4737 | 2.67433 | .61353 | | | |
| Depth of oropharynx(DOP) | Pre | 19 | 10.2632 | 2.37679 | .54527 | -2.73684 | -8.034 | .000 |
| | Post | 19 | 13.0000 | 2.53859 | .58239 | | | |
| Depth of Hypophaynx (DHP) | Pre | 19 | 13.3684 | 2.96668 | .68060 | -2.57895 | -6.125 | .000 |
| | Post | 19 | 15.9474 | 3.17059 | .72738 | | | |
| Soft palate length (SPL) | Pre | 19 | 32.2632 | 3.67940 | .84411 | 2.15789 | 8.408 | .000 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Post | 19 | 30.1053 | 3.60393 | .82680 | | | |
| Soft palate thickness (SPT) | Pre | 19 | 5.6316 | 1.38285 | .31725 | -1.68421 | -10.940 | .000 |
| | Post | 19 | 7.3158 | 1.41628 | .32492 | | | |
| Soft palate inclination (SPI) | Pre | 19 | 46.3158 | 4.78484 | 1.09772 | 2.94737 | 2.626 | .017 |
| | Post | 19 | 43.3684 | 6.10292 | 1.40011 | | | |
| PPWT 1 | Pre | 19 | 16.7895 | 3.73540 | .85696 | -.21053 | -.940 | .360 |
| | Post | 19 | 17.0000 | 3.90157 | .89508 | | | |
| PPWT 2 | Pre | 19 | 11.2632 | 2.20711 | .50635 | -.05263 | -.325 | .749 |
| | Post | 19 | 11.3158 | 2.08307 | .47789 | | | |
| PPWT 3 | Pre | 19 | 6.2105 | 2.22558 | .51058 | -.05263 | -1.000 | .331 |
| | Post | 19 | 6.2632 | 2.23214 | .51209 | | | |
| PPWT 4 | Pre | 19 | 5.6316 | 2.29033 | .52544 | -.26316 | -1.424 | .172 |
| | Post | 19 | 5.8947 | 2.25819 | .51806 | | | |
| PPWT 5 | Pre | 19 | 4.7105 | 1.90989 | .43816 | -.28947 | -1.312 | .206 |
| | Post | 19 | 5.0000 | 2.23607 | .51299 | | | |
| PPWT 6 | Pre | 19 | 4.3684 | 1.42246 | .32633 | -.26316 | -1.424 | .172 |
| | Post | 19 | 4.6316 | 1.49854 | .34379 | | | |

**Pre and Post Comparison of the Orthodontic Parameters in the Treatment Group (Twin Block Appliance Group)**

The treatment group demonstrated a statistically significant decrease in SNA (p = 0.001), reflecting minimal posterior repositioning of the maxilla. Yet, neither maxillary length nor effective maxillary length significantly changed. On the other hand, SNB considerably increased (p < 0.001), reflecting forward mandibular repositioning. Likewise, mandibular length and effective mandibular length considerably increased (p < 0.001), reflecting skeletal mandibular advancement.

The FMA angle had a minor increase (p = 0.076), but not significant. Of pharyngeal airway measures, depth of oropharynx (DOP) and depth of hypopharynx (DHP) increased significantly (p < 0.001), demonstrating better airway sizes. Soft palate length (SPL) reduced significantly (p < 0.001), whereas soft palate thickness (SPT) increased (p < 0.001), demonstrating structural adaptations of the airway. Soft palate inclination (SPI) reduced significantly (p = 0.017), showing a change in position.

Posterior pharyngeal wall thickness (PPWT) at various levels did not reveal any significant changes except for PPWT 4, 5, and 6, which revealed slight but non-significant increases.

**Table 2: Pre and Post Comparison of the Orthodontic Parameters in Control Group (Participants undergoing Class II Corrections)**

| | | N | Mean | Std. Deviation | Std. Error Mean | Mean Difference | t | p Value |
|---|---|---|---|---|---|---|---|---|
| SNA | PRE | 19 | 83.7895 | 2.74021 | .62865 | -.10526 | -.176 | .862 |
| | POST | 19 | 83.8947 | 2.66447 | .61127 | | | |
| Maxillary length | PRE | 19 | 47.1053 | 2.68524 | .61604 | -4.36842 | -6.968 | .000 |
| | POST | 19 | 51.4737 | 1.54087 | .35350 | | | |
| Effective maxillary length | PRE | 19 | 81.0000 | 4.38432 | 1.00583 | -5.26316 | -4.610 | .000 |
| | POST | 19 | 86.2632 | 3.34734 | .76793 | | | |
| SNB | PRE | 19 | 78.1579 | 3.48430 | .79935 | -36.73684 | -.997 | .332 |
| | POST | 19 | 114.8947 | 160.13047 | 36.73645 | | | |
| Mandibular length | PRE | 19 | 59.9474 | 4.24884 | .97475 | -4.05263 | -4.890 | .000 |
| | POST | 19 | 64.0000 | 3.55903 | .81650 | | | |
| Effective mandibular length | PRE | 19 | 96.2632 | 4.53189 | 1.03969 | -7.78947 | -5.291 | .000 |
| | POST | 19 | 104.0526 | 5.87342 | 1.34746 | | | |
| FMA | PRE | 19 | 22.6316 | 3.51521 | .80645 | -1.47368 | -2.111 | .049 |
| | POST | 19 | 24.1053 | 3.46241 | .79433 | | | |
| Depth of nasopharynx (DNP) | PRE | 19 | 15.2895 | 4.09375 | .93917 | -.10526 | -.399 | .695 |
| | POST | 19 | 15.3947 | 4.13850 | .94944 | | | |
| Height of nasopharynx (HNP) | PRE | 19 | 19.3158 | 2.35826 | .54102 | -.42105 | -1.166 | .259 |
| | POST | 19 | 19.7368 | 1.99561 | .45782 | | | |
| Depth of oropharynx(DOP) | PRE | 19 | 10.7368 | 2.74554 | .62987 | 1.21053 | 4.296 | .000 |
| | POST | 19 | 9.5263 | 1.98238 | .45479 | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth of Hypophaynx (DHP) | PRE | 19 | 16.0000 | 3.00000 | .68825 | 1.15789 | 4.512 | .000 |
| | POST | 19 | 14.8421 | 3.05983 | .70197 | | | |
| Soft palate length (SPL) | PRE | 19 | 31.8947 | 3.61931 | .83033 | -2.36842 | -4.606 | .000 |
| | POST | 19 | 34.2632 | 2.95977 | .67902 | | | |
| Soft palate thickness (SPT) | PRE | 19 | 6.1579 | 1.42451 | .32681 | .94737 | 5.295 | .000 |
| | POST | 19 | 5.2105 | 1.08418 | .24873 | | | |
| Soft palate inclination (SPI) | PRE | 19 | 46.1579 | 6.16679 | 1.41476 | -2.15789 | -3.415 | .003 |
| | POST | 19 | 48.3158 | 5.36504 | 1.23082 | | | |
| PPWT 1 | PRE | 19 | 15.6316 | 2.52125 | .57842 | 1.00000 | 4.359 | .000 |
| | POST | 19 | 14.6316 | 1.92095 | .44070 | | | |
| PPWT 2 | PRE | 19 | 11.7895 | 3.13721 | .71973 | 1.15789 | 3.755 | .001 |
| | POST | 19 | 10.6316 | 2.75299 | .63158 | | | |
| PPWT 3 | PRE | 19 | 7.7368 | 3.67940 | .84411 | .36842 | .742 | .468 |
| | POST | 19 | 7.3684 | 4.03058 | .92468 | | | |
| PPWT 4 | PRE | 19 | 3.1053 | .80930 | .18567 | .47368 | 3.375 | .003 |
| | POST | 19 | 2.6316 | .76089 | .17456 | | | |
| PPWT 5 | PRE | 19 | 3.6842 | .74927 | .17189 | .52632 | 2.970 | .008 |
| | POST | 19 | 3.1579 | .83421 | .19138 | | | |
| PPWT 6 | PRE | 19 | 3.5789 | 1.21636 | .27905 | .39474 | 2.535 | .021 |
| | POST | 19 | 3.1842 | 1.12065 | .25709 | | | |

**Pre and Post Comparison of the Orthodontic Parameters in the Control Group (Class II Correction Group)**

In the control group, SNA was unchanged, which indicated that there was no considerable skeletal repositioning of the maxilla. Maxillary length and effective maxillary length increased significantly ($p < 0.001$), indicating growth of the maxilla. SNB exhibited a strange change that may be due to data inconsistency. Mandibular length and effective mandibular length increased significantly ($p < 0.001$), indicating mandibular growth but to a lower degree than in the treatment group.

FMA angle was slightly greater ($p = 0.049$), which was statistically significant. Between right and left pharyngeal airway parameters, depth of oropharynx (DOP) and depth of hypopharynx (DHP) showed significant reduction ($p < 0.001$), reflecting constriction of the airway. Soft palate length (SPL) and soft palate inclination (SPI) were significantly higher ($p < 0.001$, $p = 0.003$, respectively), reflecting positional changes. Soft palate thickness (SPT) was significantly reduced ($p < 0.001$).

PPWT values decreased significantly for PPWT 1, 2, 4, 5, and 6 ($p < 0.01$), indicating a reduction in pharyngeal wall thickness, potentially compromising airway dimensions.

**Table 3: Comparison of the Mean Change in Orthodontic Parameters between Treatment and Control Group.**

| Groups | | N | Mean | Std. Deviation | Std. Error Mean | Mean Difference | t | p Value |
|---|---|---|---|---|---|---|---|---|
| SNA (Mean Change) | Treatment | 19 | -.6316 | .68399 | .15692 | -.73684 | -1.194 | .240 |
| | Control | 19 | .1053 | 2.60117 | .59675 | | | |
| Maxillary length | Treatment | 19 | -.4211 | 1.01739 | .23341 | -4.78947 | -7.159 | .000 |
| | Control | 19 | 4.3684 | 2.73273 | .62693 | | | |
| Effective maxillary length | Treatment | 19 | 0.0000 | 1.56347 | .35869 | -5.26316 | -4.398 | .000 |
| | Control | 19 | 5.2632 | 4.97597 | 1.14156 | | | |
| SNB | Treatment | 19 | 2.7368 | 1.04574 | .23991 | -34.00000 | -.923 | .362 |
| | Control | 19 | 36.7368 | 160.62753 | 36.85048 | | | |
| Mandibular length | Treatment | 19 | 9.7895 | 7.00459 | 1.60696 | 5.73684 | 3.173 | .003 |
| | Control | 19 | 4.0526 | 3.61284 | .82884 | | | |
| Effective mandibular length | Treatment | 19 | 12.1579 | 8.65553 | 1.98571 | 4.36842 | 1.767 | .086 |
| | Control | 19 | 7.7895 | 6.41681 | 1.47212 | | | |
| FMA | Treatment | 19 | .8421 | 1.95116 | .44763 | -.63158 | -.761 | .451 |
| | Control | 19 | 1.4737 | 3.04354 | .69824 | | | |
| Depth of nasopharynx (DNP) | Treatment | 19 | .0526 | .22942 | .05263 | -.05263 | -.196 | .846 |
| | Control | 19 | .1053 | 1.14962 | .26374 | | | |
| Height of nasopharynx (HNP) | Treatment | 19 | .3158 | .94591 | .21701 | -.10526 | -.250 | .804 |
| | Control | 19 | .4211 | 1.57465 | .36125 | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth of oropharynx(DOP) | Treatment | 19 | 2.7368 | 1.48482 | .34064 | 3.94737 | 8.929 | .000 |
| | Control | 19 | -1.2105 | 1.22832 | .28180 | | | |
| Depth of Hypopharynx (DHP) | Treatment | 19 | 2.5789 | 1.83533 | .42105 | 3.73684 | 7.578 | .000 |
| | Control | 19 | -1.1579 | 1.11869 | .25664 | | | |
| Soft palate length (SPL) | Treatment | 19 | -2.1579 | 1.11869 | .25664 | -4.52632 | -7.876 | .000 |
| | Control | 19 | 2.3684 | 2.24129 | .51419 | | | |
| Soft palate thickness (SPT) | Treatment | 19 | 1.6842 | .67104 | .15395 | 2.63158 | 11.149 | .000 |
| | Control | 19 | -.9474 | .77986 | .17891 | | | |
| Soft palate inclination (SPI) | Treatment | 19 | -2.9474 | 4.89301 | 1.12253 | -5.10526 | -3.963 | .000 |
| | Control | 19 | 2.1579 | 2.75405 | .63182 | | | |
| PPWT 1 | Treatment | 19 | .2105 | .97633 | .22399 | 1.21053 | 3.776 | .001 |
| | Control | 19 | -1.0000 | 1.00000 | .22942 | | | |
| PPWT 2 | Treatment | 19 | .0526 | .70504 | .16175 | 1.21053 | 3.476 | .001 |
| | Control | 19 | -1.1579 | 1.34425 | .30839 | | | |
| PPWT 3 | Treatment | 19 | .0526 | .22942 | .05263 | .42105 | .843 | .405 |
| | Control | 19 | -.3684 | 2.16565 | .49684 | | | |
| PPWT 4 | Treatment | 19 | .2632 | .80568 | .18484 | .73684 | 3.175 | .003 |
| | Control | 19 | -.4737 | .61178 | .14035 | | | |
| PPWT 5 | Treatment | 19 | .2895 | .96200 | .22070 | .81579 | 2.882 | .007 |
| | Control | 19 | -.5263 | .77233 | .17718 | | | |
| PPWT 6 | Treatment | 19 | .2632 | .80568 | .18484 | .65789 | 2.722 | .010 |
| | Control | 19 | -.3947 | .67862 | .15569 | | | |

**Comparison of the Mean Change in Orthodontic Parameters Between Treatment and Control Groups**
The treatment group showed more reduction in SNA, but not statistically significant ($p = 0.240$). Changes in maxillary length and effective maxillary length were significantly different ($p < 0.001$), where the control group demonstrated growth in the maxilla and the treatment group did not have a significant change.
Mandibular length and effective mandibular length grew much more in the treatment group compared to the control group ($p = 0.003$ and $p = 0.086$, respectively), validating greater mandibular advancement with the Twin Block appliance.
Among the airway measurements, the treatment group had an increased DOP and DHP significantly ($p < 0.001$), and the control group had these measurements decrease, indicating improvement of the airway in the treatment group and limitation in the control group. All measurements of the length, thickness, and inclination of the soft palate were also significantly different between the groups ($p < 0.001$), again pointing towards the positive changes in airway in the Twin Block group.
For PPWT, notable differences at various levels were found ($p < 0.01$), with the treatment group experiencing mild increments and the control group experiencing declines.

## DISCUSSION
Skeletal Class II malocclusion, predominantly caused by mandibular retrusion, represents a significant clinical condition affecting nearly one-third of the population.[30] Apart from its dentofacial implications, this condition is increasingly recognized for its impact on the upper airway, particularly the pharyngeal airway passage (PAP), and is linked to breathing difficulties including obstructive sleep apnea (OSA). [35] Functional appliances such as the Twin Block aim to modify mandibular position and have shown potential not only in skeletal correction but also in functional enhancement of the airway. This study investigates the skeletal and soft tissue changes induced by twin block therapy and their implications for airway morphology.
Mandibular retrusion displaces the tongue and soft palate posteriorly, which narrows the oropharyngeal and hypopharyngeal segments of the airway.[36] This posterior positioning may contribute to nocturnal hypoxia and compromised respiratory function. Studies show that individuals with Class II malocclusion often exhibit narrower pharyngeal dimensions, a thicker and longer soft palate, and a lower hyoid bone position,[37] thereby predisposing them to increased upper airway resistance during sleep.
The Twin Block is designed to advance the mandible and correct sagittal skeletal discrepancies during growth periods. It acts in accordance with Moss's functional matrix hypothesis, which asserts that soft tissue activity drives skeletal growth. [4] By holding the mandible in a forward position, the twin block appliance stimulates

adaptive changes in both the bone and surrounding soft tissues, ultimately leading to increased airway volume and improved muscle tone in the oropharyngeal region.[38]

This research included 38 participants aged 8–14 years with skeletal Class II malocclusion due to mandibular retrusion. Participants were divided into treatment and control groups using random allocation. The treatment group underwent Twin Block therapy for six months, while the control group received pre-functional therapy. Lateral cephalograms were taken at baseline (T0) and post-treatment (T1), and various skeletal and airway parameters were assessed.

Significant skeletal changes were noted in the treatment group. The SNB angle increased (mean difference = -2.74°, p < 0.001), indicating forward mandibular repositioning. Additionally, mandibular length and effective mandibular length significantly improved (mean differences = -9.79 mm and -12.16 mm respectively, p < 0.001). In contrast, the SNA angle saw only a slight decrease (p = 0.001), suggesting limited restraint on maxillary growth. These findings align with studies by [39, 40] which demonstrated the effectiveness of twin block appliances in promoting true mandibular growth rather than mere dental compensation.

Post-treatment, substantial improvements were observed in airway dimensions among the treatment group:

Depth of oropharynx (DOP) and hypopharynx (DHP) increased significantly (p < 0.001).

Soft palate thickness (SPT) also increased, while soft palate length (SPL) and inclination (SPI) decreased (p < 0.001), indicating a more anterior and vertical orientation.

These changes suggest enhanced airway patency and possibly reduced risk of pharyngeal collapse during sleep. [32, 41]

Such findings reinforce the therapeutic potential of twin block appliances in managing both orthodontic and respiratory dysfunction.

The control group did not exhibit significant changes in SNB angle, suggesting minimal mandibular advancement. In fact, DOP and DHP decreased post-treatment (p < 0.001), while SPL and SPI increased, potentially signifying further constriction of the airway due to lack of skeletal advancement. These results underscore the importance of mandibular orthopedic correction in preserving airway function.

Findings from this study are corroborated by prior research:

Jena et al. (2013)[36] demonstrated superior oropharyngeal improvements with twin block over MPA-IV.

Ghodke et al. (2014)[41] confirmed twin block therapy's impact on airway morphology, without compromising soft tissue integrity.

Elfeky & Fayed (2015)[42] used CBCT to validate volumetric airway increases post-twin block therapy.

Batra & Shetty (2022)[40] reported reductions in mouth breathing and snoring, reinforcing the functional benefits of twin block appliances.

The anatomical changes observed have tangible clinical implications. By increasing posterior airway space and improving soft palate orientation, twin block appliances may significantly reduce symptoms of OSA and sleep-disordered breathing (SDB) (Zreaqat et al., 2023).[43] Early orthopedic intervention could thus serve as a non-invasive alternative to CPAP or surgical options in pediatric patients. Furthermore, Twin Block's promote muscular balance and craniofacial stability, which supports long-term skeletal and respiratory health (Solow & Sandham, 2002)[1].

**Limitations:**

1. Short follow-up period (6 months) limits conclusions about long-term stability.
2. Use of 2D imaging (cephalograms) restricts volumetric interpretation of airway changes.
3. Small sample size (n = 38) reduces generalizability.

**Future Recommendations:**

Utilize CBCT or MRI for accurate 3D and volumetric airway analyses (Mao et al., 2023).[44]

Longitudinal studies to track post-treatment changes into adulthood.

Include polysomnography to assess correlations between anatomical changes and sleep quality.

Compare with other appliances such as Herbst and Myobrace to determine relative efficacy.

## CONCLUSION

This study validates the Twin Block as a dual-purpose orthodontic tool: effective for correcting skeletal Class II malocclusion and enhancing pharyngeal airway dimensions. It reaffirms the appliance's capacity to produce functional benefits in respiration and sleep, in addition to skeletal realignment. These findings highlight the appliance's value in both dental and systemic health domains, justifying its continued use and further investigation in pediatric orthodontics.

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