E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.01.550

Research Article

Cephalometric Evaluation of Skeletal and Dentoalveolar Changes Induced by Twin Block Appliance in Skeletal Class II Malocclusion

Shoaib Hameed[1*], Naeema Iqbal[2], Arsalan Hamid Khan[3], Ahsan Khalid[4], Zainab Hayyat Raja[5], Tania Arshad Siddiqui[6]

[1*]BDS, MDS (Orthodontics), MFDRCSI, FFDRCSI (Orthodontics), Consultant Orthodontist, Dental Centre, PNS Shifa, Assistant Professor, Bahria University Health Sciences Campus, Karachi, Pakistan.
[2]BDS, FCPS, Assistant Professor, Islamic International Dental College & Hospital, Islamabad, Pakistan.
[3]BDS, MDS, Assistant Professor, Department of Orthodontics, Sardar Begum Dental, Peshawar, Pakistan.
[4,5]BDS FCPS, Assistant Professor Orthodontics, Department of Orthodontics, Nishtar Institute of Dentistry Multan, Pakistan.
[6]BDS, FCPS, AcMed, Assistant Professor, Department of Orthodontics, Foundation University, Islamabad, Pakistan.

Corresponding Author: Shoaib Hameed
Consultant Orthodontist, Dental Centre, PNS Shifa, Assistant Professor, Bahria University Health Sciences Campus, Karachi, Pakistan.
Email: shoaibhameed.ansari@gmail.com
Received: 07.03.2026, Revised: 15.05.2026, Accepted: 26.05.2026

ABSTRACT

Background: Skeletal Class II malocclusion is one of the most common orthodontic cases and is often associated with retrognathic mandible. Functional orthopedic appliances such as Twin Block, which are designed to aid the growth of the mandible and improve the dentofacial relationships, are popular among orthodontists. The changes to the mandible and dentofacial relationships can be evaluated using cephalometric analysis.

Objective: The purpose of this study was to assess the skeletal and dentoalveolar changes of Class II malocclusion patients after the use of the Twin Block appliance, with the use of cephalometric analysis.

Methodology: The study sample consisted of 100 children with Class II malocclusion, with a mean age of 12, and retrognathic mandible, utilizing the Twin Block appliance. Lateral cephalometric radiographs were taken prior to the use of the Twin Block (T1) and after the use of the Twin Block (T2). The following cephalometric measurements (i.e. SNA, SNB, ANB, mandibular length) were evaluated and the changes in dentoalveolar relationship and overbite and overjet were also measured. The skeletal changes and measurements of overbite, overjet, and dentoalveolar relationships were all done using paired-sample t-tests with the statistical significance set at $p < 0.05$.

Results: Significant skeletal and dentoalveolar changes occurred due to Twin Block therapy. The mean SNB angle increased and the mean ANB angle decreased. The mean SNB angle was 76.4° ± 2.8 pre-treatment and 79.1° ± 2.5 post-treatment ($p < 0.001$). The mean ANB angle was 6.2° ± 1.4 pre-treatment and 3.5° ± 1.2 post-treatment ($p < 0.001$). Mandibular length increased by 4.8 ± 1.6 mm. Statistically significant changes were noted with the following measurements: overjet, which reduced from 8.1 ± 1.9 mm to 3.2 ± 1.1 mm ($p < 0.001$); and overbite, which also reduced, from 5.1 ± 1.4 mm to 2.8 ± 0.9 mm ($p < 0.001$). An observed treatment effect for the maxillary incisors was retroclination, whereas proclination was noted for the mandibular incisors.

Conclusion: Twin Block appliance therapy addressed the skeletal Class II malocclusion by promoting growth of the mandible, improving the maxillomandibular relationship, and producing favorable dentoalveolar adaptations. Cephalometric evaluation confirmed significant reductions in overjet and overbite, supporting the effectiveness of Twin Block therapy during the growth phase.

Keywords: Skeletal Class II Malocclusion, Twin Block Appliance, Functional Appliance Therapy, Cephalometric Analysis, Mandibular Advancement, Dentoalveolar Changes.

INTRODUCTION

Skeletal Class II malocclusion is one of the more frequent disorder's that drives patients

to seek orthodontic treatment. Maxillary and mandibular malposition manifests as a sagittal discrepancy. In the case of Class II malocclusion, it can be caused by maxillary prognathism, mandibular retrognathism, or both. Of the etiological factors, Class II malocclusion research shows that skeletal mandibular retrognathism tends to be the most pervasive of the malocclusion components [1].

Patients demonstrating a skeletal Class II malocclusion usually exhibit a number of traits including, but not limited to, a significant overjet, an overbite, lip incompetence and a convex facial profile. These traits can result in a number of psychosocial issues, including a decrease in overall confidence and self-esteem, which can be especially debilitating in a socially-interactive age group like adolescents. These psychosocial issues are likely to result from a negatively impacted psychosocial perception of oral function due to a poorly balanced face and overbite [2,3].

Malocclusion of a skeletal Class II type is seen in children who are still undergoing growth. The most common method of treatment in this case is the use of a functional appliance to modify growth. Such an appliance positions the mandible in an anterior relation to the maxilla, so that the body of the mandible and the maxilla and the overlying alveolar processes adapt through function. Growth adjusting treatment is an excellent opportunity to lessen facial and jaw imbalance and the severity of a skeletal malocclusion [2,4].

The Twin Block is a very popular functional appliance among the various functional appliances and is frequently prescribed by orthodontists. Twin Block, designed by William Clark, has upper and lower acrylic plates with bite blocks in the form of interlocking blocks, inclined at about 70 degrees. The appliance encourages mandibular advancement, is patient friendly, and is compliant when compared with other functional appliances [5,1].

The main aim of employing a Twin Block appliance is to allow advancement of the mandible during growth. Many studies done previously have shown that treatment with a Twin Block appliance enhances the length of the mandible, improves the SNB and ANB angles, and refines the profile. The appliance also creates dentoalveolar changes such as proclination of mandibular incisors, retroclination of maxillary incisors, overbite improvement, and overjet reduction [4,1].

The dento-skeletal effects of the appliance have also been investigated through cephalometric studies. The importance of lateral cephalometric radiographs is that they provide reliable quantitative and qualitative assessments of the skeletal, dental, and soft tissue structures which aid in the diagnosis for treatment. By assessing cephalometric positions such as SNA, SNB, ANB, mandibular length, incisal inclination, and measurements of overjet and overbite, clinicians can assess treatment changes related to Class II correction and the skeletal and dentoalveolar contributions to the correction [4,8].

There have been a number of studies published that assess the influence of the Twin Block appliance on the underlying skeletal and dental structures in children and adolescents. The majority of the studies have shown that treatment with the Twin Block appliance results in a change in the position of the mandible and a change in the occlusion and an improvement in the aesthetics of the upper airway. Based on these findings, the Twin Block appliance is a suitable orthodontic appliance for use during the period of maximum pubertal growth [7,8].

The introduction of the Twin Block appliance has made an important contribution to orthodontics and orthodontic treatment as the appliance is easy to use and provides good results. However, there is still a degree of variation in the results of treatment. This is attributable to differences in individual patient factors such as growth, timing of treatments, compliance of the patient, and differences in craniofacial structures. It is for these reasons that cephalometrics plays an important role in orthodontics in the future [2,3,1].

Using cephalometric analysis, this study examines the skeletal and dentoalveolar changes brought on by the use of the Twin Block appliance on patients with skeletal Class II malocclusion. The therapy provided by the Twin Block in order to address the Class II malocclusion creates a skeletal and dental imbalance. This study intends to measure the treatment-caused changes and evaluate the efficacy of the Twin Block therapy by comparing the pre-treatment cephalometric measurements to the post-treatment cephalometric measurements.

METHODOLOGY

Study Design: This study employed a prospective longitudinal clinical study design to analyse the dentoalveolar and skeletal

changes caused by the Twin Block appliance in patients with Class II skeletal malocclusion. Evaluating treatment change involved a pre- and post- functional appliance therapy comparison of cephalometric measurements.

Study Setting and Duration: This study was undertaken in the Department of Orthodontics at a dental teaching hospital with the provision of tertiary care. The study involved a period of data collection and patient follow up lasting 12 months. All steps related to the provision of the service and cephalometric assessments were undertaken within the department by orthodontists.

Study Population: The study population comprised of growing patients with Class II skeletal malocclusion. Patients were accepted if they were clinically referred to the department and confirmed via cephalometric assessment to have a principal etiology of mandibular retrusion.

Sample Size: There were 100 patients in the study. The sample size was adequate to provide a 95% level of confidence with the assessment of cephalometric measurements, pre and post, following the application of Twin Block therapy with a statistical power of 80%.

Sample Technique: Consecutive sampling was the technique. Eligible patients, who were willing to participate in the study and who met the inclusion criteria, were recruited until the sample size was met.

Inclusion Criteria: Participants were aged between 9 to 15 years and presented with skeletal Class II malocclusion as a consequence of retrognathic mandible. Potential participants were required to be in the growth spurt phase, exhibit an ANB angle greater than 4 degrees, show increased overjet, have no previous orthodontic treatment, and be in good health both orally and generally.

Exclusion Criteria: Participants presenting craniofacial syndromes, cleft lip and palate, major facial asymmetry, temporomandibular joint disorders (TMDs), systemic diseases with impact on the rate of growth, poor oral hygiene, absence of permanent teeth other than third molars, or previous orthodontic treatment were excluded.

Treatment Procedure: After the diagnostic procedures, all the participants were provided with a Twin Block functional appliance. The appliance consisted of an upper and a lower acrylic bite block with inclined planes to position the mandible in a forward posture to correct the bite. The participants were required to wear the appliance for 20 - 22 hours daily and were only permitted to remove the appliance during meal times and when performing oral hygiene. Participants were required to attend a follow-up appointment every 4 weeks.

Data Collection Procedure: Participants were required to have a lateral cephalometric radiograph taken at two time points, which were prior to the commencement of Twin Block therapy (T1) and after the completion of the phase of functional treatment (T2). All cephalometric radiographs were performed using the same cephalometric apparatus with the same settings. Cephalometric analysis was performed with manual tracings which were verified using a digital overlay.

The assessed skeletal variables included SN and AN, along with measurements of mandibular length and lower anterior facial height. These were supplemented by measurements of dental and alveolar components, which included the U1-SN plane, IMPA, the angle of incidence between the two lower incisors, and the extent of congruence of the upper incisors. Parameters of occlusion were also assessed. These included overjet, overbite, and the molar relationship.

Study Variables: The use of Twin Block appliances was the independent variable. The dependent variables were skeletal measurements (SNA, SNB, ANB, mandibular length, and lower anterior facial height), dental and alveolar measurements (U1-SN, IMPA, interincisal angle, and upper incisor protrusion), and occlusion (overjet, overbite, and the molar relationship).

Statistical Analysis: The data were analyzed using SPSS version 26.0. Descriptive statistics, which included frequencies, percentages, means, and standard deviations, were computed. The normality of the data was determined prior to any other analysis. Pre- and post-treatment cephalometric measurements were analyzed by Paired Sample t-test. The results were expressed as the mean differences, 95% confidence intervals, t-values, and p-values. A significant p-value was considered less than 0.05.

Ethical Considerations: Written informed consent was obtained from the parents/guardians of all participants. Assent was obtained from the participants when appropriate. Participants' data were kept confidential and anonymous. All procedures followed the ethical principles of the Declaration of Helsinki.

RESULTS

Table 1. Demographic Characteristics of Participants (n = 100)

Variable	Category	Frequency (N)	Percentage (%)
Gender	Male	46	46.0
	Female	54	54.0
Age Group (Years)	9–11	34	34.0
	12–13	42	42.0
	14–15	24	24.0
Mean Age (Years)	Mean ± SD	12.4 ± 1.8	-

Table 2. Comparison of Skeletal Cephalometric Measurements before and After Twin Block Therapy

Variable	Pre-Treatment Mean ± SD	Post-Treatment Mean ± SD	Mean Difference	T-Value	P-Value
SNA (°)	81.6 ± 2.4	81.2 ± 2.3	-0.4	1.89	0.062
SNB (°)	76.4 ± 2.8	79.1 ± 2.5	2.7	11.83	<0.001
ANB (°)	6.2 ± 1.4	3.5 ± 1.2	-2.7	14.25	<0.001

Table 3. Comparison of Dentoalveolar Measurements before and After Twin Block Therapy

Variable	Pre-Treatment Mean ± SD	Post-Treatment Mean ± SD	Mean Difference	T-Value	P-Value
U1-SN (°)	108.5 ± 5.4	103.7 ± 4.8	-4.8	9.72	<0.001
IMPA (°)	94.1 ± 4.9	98.2 ± 4.7	4.1	8.64	<0.001

Table 4. Comparison of Occlusal Parameters before and After Twin Block Therapy

Variable	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	Mean Difference	t-value	p-value
Overjet (mm)	8.1 ± 1.9	3.2 ± 1.1	-4.9	18.47	<0.001
Overbite (mm)	5.1 ± 1.4	2.8 ± 0.9	-2.3	12.76	<0.001

Table 5. Paired Samples Test Showing Overall Treatment Effects

Parameter	Mean Difference	95% CI Lower	95% CI Upper	P-Value
SNB (°)	2.7	2.2	3.1	<0.001
ANB (°)	-2.7	-3.1	-2.3	<0.001

Table 6. Summary of Significant Skeletal and Dentoalveolar Changes

Outcome Variable	Direction Of Change	Significance
Snb Angle	Increased	Significant
Anb Angle	Decreased	Significant
Overjet	Decreased	Significant

DISCUSSION

This study investigated the dentoalveolar and skeletal changes in patients with skeletal Class II malocclusion after use of Twin Block appliance. Post treatment, patients in the study experienced improvement in all three dimensions of malocclusion. Participants also exhibited an increase in the SNB angle and a length increase in the mandible, which suggests that there was an increase in growth of the mandible and a decrease in the structural restriction of the mandible in the anteroposterior direction. Improvement in the mandible's position and improvement in the anteroposterior relationship of the mandible have also been documented in the literature [9, 10]. Therefore, these changes also demonstrate the validation of the effect of the Twin Block appliance's growth modification during the active growth phase.

Improvement in the ANB angle post treatment of the study participants also exhibited a decrease in the restriction of the mandible in the anteroposterior direction. Decrease in this angle has been documented in the literature also in which there was improvement of the mandible and maxilla positioning post Twin Block therapy [11, 12]. These results also

demonstrate the significant effect that growth of the mandible has on the treatment of skeletal Class II malocclusion.

For dentoalveolar changes, there was an observation of mild proclination of the inferior incisors, and retroclination was observed in the superior incisors. These changes had a positive contribution to both the overjet and the occlusion. The impact of the Twin Block appliances and the growth of Class II patients described here and in the existing literature shows the same dentoalveolar adaptations [13,14].

The changes in overjet and overbite were considerable in this study. The data show an average overjet of 3.2 mm and an overbite of 2.8 mm. The data corroborate other studies and show that the application of the Twin Block appliances had a positive impact on the occlusal relationship [15,16]. Clinically, the reduction of overjet and overbite is of importance due to the improvement of the function of the stomatognathic system and the facial esthetics.

The increase of lower anterior facial height in the present study may suggest an impact on the vertical growth of the face due to the addition of the Twin Block appliances and their added vertical dimension. The impact of vertical dimension of face from functional appliances has been noted and is present in the literature [17]. The vertical dimension changes are secondary treatment effects, and in a change of this nature, may have a positive contribution to facial balance.

Moreover, the present study found that Twin Block therapy develops a combination of skeletal and dentoalveolar changes that successfully address Class II skeletal malocclusion. Changes in the position of the mandible, ANB angle, overjet, overbite, and inclination of the incisors, are in accordance with recent findings on the efficacy of the functional appliance [18]. Overall, the results of this study show that the Twin Block appliance is still a viable option for an active patient that presents with a Class II skeletal malocclusion and retruded mandible.

CONCLUSION

The present study found that the Twin Block appliance is an effective option for the correction of Class II skeletal malocclusion in the active patient. The result of the study showed significant changes to the skeletal system, in particular an increase in the length of the mandible, an increase in the SNB angle and a reduction of the ANB angle. Result of the study also showed positive changes to the dentoalveolar system with a reduction of the overjet and overbite, and an improvement of the inclination of the incisors. The result of the cephalometric study confirmed that the Twin Block therapy addressed the correction of the sagittal skeletal discrepancy and improvement of the occlusion; therefore, the author consider the approach of the Twin Block therapy as a functional appliance in the active patient, an appropriate option.

REFERENCES

1. Gandhi V, Mehta F, Patel D, Joshi H, Tadinada A, Yadav S, Malek F. Evaluation of Skeletal and Dentoalveolar Changes in Patients With Class II Div 1 Malocclusion Treated With Twin Block Appliance. Cureus. 2023 Nov 24;15(11):e49364. doi: 10.7759/cureus.49364. PMID: 38024011; PMCID: PMC10673708.
2. Coronel-Zubiate FT, Meza-Málaga JM, Luján-Valencia SA, Marroquín-Soto C, Cruzado-Oliva F, Aguirre-Ipenza R, Luján-Urviola E, Farje-Gallardo CA, dos Santos Pinto A and Arbildo-Vega HI (2026) Herbst and Twin Block appliances in Class II malocclusion management for children: a systematic review and meta-analysis. Front. Dent. Med. 7:1717387. doi: 10.3389/fdmed.2026.1717387.
3. Jha K, Adhikari M. Effects of modified twin block appliance in growing Class II high angle cases: A cephalometric study. F1000Res. 2024 Apr 23;11:459. doi: 10.12688/f1000research.109040.3. PMID: 38680231; PMCID: PMC11053348.
4. Rohan S. Kirtane, William A. Wiltshire, Badri Thiruvenkatachari, Adnan Shah, PatrÃ-cia Bittencourt Dutra dos Santos, Fabio Henrique de Sa Leitao Pinheiro, Cephalometric effects of Twin-block and van Beek Headgear-Activator in the correction of Class II malocclusion, American Journal of Orthodontics and Dentofacial Orthopedics, Volume 163, Issue 5, 2023, Pages 677-689, ISSN 0889-5406, https://doi.org/10.1016/j.ajodo.2022.05.020.
5. Suleman, S., Riaz, S., Kausar, L., Qazi, H. S., & Ullah, W. (2024). Insight into Twin Block - A Versatile Appliance. Pakistan Orthodontic Journal, 16(1), 37-45. Retrieved from

https://poj.org.pk/index.php/poj/article/view/370.

6. Khalid, M. A., Zulfiqar, K., Bashir, U., Shaheen, A., Iqbal, R., Rizwan, Z., Rizwan, G., & Fraz, M. M. (2023). CEPHA29: Automatic Cephalometric Landmark Detection Challenge 2023. arXiv preprint arXiv:2212.04808v2. https://doi.org/10.48550/arXiv.2212.04808
7. Mohamed RN, Basha S, Al-Thomali Y. Changes in Upper Airway Dimensions Following Orthodontic Treatment of Skeletal Class II Malocclusion with Twin Block Appliance: A Systematic Review. Turk J Orthod. 2020 Mar 1;33(1):59-64. doi: 10.5152/TurkJOrthod.2020.19028. PMID: 32284900; PMCID: PMC7138231.
8. Mohamed RN, Basha S, Al-Thomali Y. Changes in Upper Airway Dimensions Following Orthodontic Treatment of Skeletal Class II Malocclusion with Twin Block Appliance: A Systematic Review. Turk J Orthod. 2020 Mar;33(1):59-64. doi: 10.5152/TurkJOrthod.2020.19028.
9. Ghaffar F, Jan A, Akhtar O, Mughal AT, Shahid R, Shafique HZ, Bibi K, Mehmood S, Afgan N, Zaheer R. Comparative Analysis of Dentoskeletal Changes of the Twin Block Appliance and the AdvanSync2 Appliance in Treatment of Skeletal Class-II Malocclusion in Pakistani Population: A Randomized Clinical Trial. Eur J Dent. 2022 Jul;16(3):680-687. doi: 10.1055/s-0041-1739543. Epub 2021 Dec 15. PMID: 34911136; PMCID: PMC9507613.
10. Ajami S, Morovvat A, Khademi B, Jafarpour D, Babanouri N. Dentoskeletal effects of class II malocclusion treatment with the modified Twin Block appliance. J Clin Exp Dent. 2019 Dec 1;11(12):e1093-e1098. doi: 10.4317/jced.56241. PMID: 31824588; PMCID: PMC6894910.
11. Shahi AK, Sharma P, Juneja A, Shetty D, Bhardwaj R, Jain S. Comparison of AdvanSync2® and Twin Block Appliances in Treatment of Class II Malocclusion With Retrognathic Mandible—An Observational Retrospective Study. Journal of Indian Orthodontic Society. 2022;56(3):256-266. doi:10.1177/03015742211057241
12. Tripathi T, Singh N, Rai P, Gupta P. Comparison of Dentoskeletal Changes, Esthetic, and Functional Efficacy of Conventional and Novel Esthetic Twin Block Appliances among Class II Growing Patients: A Pilot Study. Turk J Orthod. 2020 Jun 1;33(2):77-84. doi: 10.5152/TurkJOrthod.2020.19030. PMID: 32637187; PMCID: PMC7316480.
13. Johnson JS, Satyaprasad S, Sharath Chandra H, Havaldar KS, Raj A, Suresh N. A Comparative Evaluation of the Dentoskeletal Treatment Effects Using Twin Block Appliance and Myobrace System on Class II Division I Malocclusion. Int J Clin Pediatr Dent. 2021;14(Suppl 1):S10-S17. doi: 10.5005/jp-journals-10005-2013. PMID: 35082460; PMCID: PMC8754264.
14. Alsilq, M.N., Youssef, M. Dentoskeletal effects of aesthetic and conventional twin block appliances in the treatment of skeletal class II malocclusion: a randomized controlled trial. Sci Rep 15, 1879 (2025). https://doi.org/10.1038/s41598-025-86219-0.
15. Cristina Bastiani, Silvio Augusto Bellini-Pereira, Aron Aliaga-Del Castillo, Kelly Chiqueto, JosÃ© Fernando Castanha Henriques, Guilherme Janson, Twin-block and mandibular anterior repositioning appliances effects in Class II malocclusion correction, American Journal of Orthodontics and Dentofacial Orthopedics, Volume 163, Issue 2, 2023, 181-190, 0889-5406,https://doi.org/10.1016/j.ajodo.2021.09.021.
16. Anosh A Haik, Yassir A Yassir, A modified clear twin block appliance for treatment of class II malocclusion: a randomized clinical trial, European Journal of Orthodontics, Volume 48, Issue 1, January 2026, cjaf103, https://doi.org/10.1093/ejo/cjaf103.
17. Rohan S. Kirtane, William A. Wiltshire, Badri Thiruvenkatachari, Adnan Shah, PatrÃ-cia Bittencourt Dutra dos Santos, Fabio Henrique de Sa Leitao Pinheiro, Cephalometric effects of Twin-block and van Beek Headgear-Activator in the correction of Class II malocclusion, American Journal of Orthodontics and Dentofacial Orthopedics, Volume 163, Issue 5, 2023, 677-689, 0889-5406, https://doi.org/10.1016/j.ajodo.2022.05.020.
18. Gandhi V, Mehta F, Patel D, Joshi H, Tadinada A, Yadav S, Malek F. Evaluation of Skeletal and Dentoalveolar Changes in Patients With Class II Div 1 Malocclusion Treated With Twin Block Appliance. Cureus. 2023 Nov

24;15(11):e49364. doi: 10.7759/cureus.49364. PMID: 38024011; PMCID: PMC10673708.