Review Article

Clinical Success, Patients' Satisfaction and Dentoalveolar Changes After Using Twin Block and Bionator Appliances: Systematic Review

Ahmed Abdullah Bahamid[1*], Felwa Sulaiman AlHudaithi[1]

[1]Department of Orthodontics, College of Dentistry, Riyadh Elm University, Riyadh, Saudi Arabia.

Abstract

The twin block and the bionator from Balters are two of the most widely utilized functional appliances available today. While they are both tooth-borne, the twin block is designed to be worn full-time and operates all functional forces, including mastication forces, used to the dentition. The impacts of these appliances have yet to be compared in many researches.

In summary, the studies presented various findings related to the effectiveness of Bionator and Twin Block appliances in treating Class II malocclusions. Twin Block was observed to have positive effects on mandibular growth, overjet reduction, molar correction, and incisor proclination, while both appliances were found to induce changes in temporomandibular joint position. However, there were no significant differences in skeletal and dental effects between Bionator and Twin Block, and both caused significant soft tissue changes. A literature review suggested that Twin Block appliances enhance mandibular development, but there is ongoing debate about the causes of mandibular growth and the role of patient compliance in device effectiveness. Additionally, a cephalometric analysis revealed no significant differences between Twin Block and Bionator in specific angles.

Keywords: Twin block, Bionator, Orthodontics, Patients' satisfaction

Introduction

The most prevalent skeletal discrepancy that is clinically observed is definitely Class II Division 1 malocclusion, with mandibular skeletal deficit being the most common distinctive feature. Over the last three decades, functional appliance treatment has been more popular and has caused heated disagreements when it comes to treating skeletal class II deficient mandibles in growing children. These appliances enhance the interaction between the teeth and muscles, modify maxillary development, and affect mandibular growth and position. Maxilla's forward development may be slowed, diverted downward, or left unaltered, according to some claims. Numerous investigations concur that dentoalveolar, as opposed to skeletal, effects are the most important outcomes of therapy [1, 2].

The constraint that all functional appliances descended from the Monobloc share is the joining of the top and bottom components. With the device in place, the patient is unable to talk, eat, or otherwise use their mouth properly. Sagittal disparity, narrow maxilla, and high palate are three examples of the three dimensions in which class II division 1 malocclusion might differ. However, mandibular skeletal retrusion is the most often seen diagnostic feature in class II malocclusion [3]. Therefore, a therapeutic intervention using functional equipment to augment mandibular development has been recommended for these individuals [1, 3]. Changing the dentition's operational environment to support normal function is the aim of functional treatment [1]. By promoting the active movement of the mandibular condyles downward and forward in the glenoid cavity, most appliances are designed to improve mandibular growth [1, 4].

From the monobloc, all of the first working appliances developed and underwent several changes. One such modification was the Balters Bionator [3, 4]. In recent years, a great deal of study has been done to determine the potential for growth changes using functional appliances; nevertheless, the findings have been unambiguous.

Address for correspondence: Ahmed Abdullah Bahamid, Department of Orthodontics, College of Dentistry, Riyadh Elm University, Riyadh, Saudi Arabia.
ahmed.bahamid@riyadh.edu.sa

How to cite this article: Bahamid AA, AlHudaithi FS. Clinical Success, Patients' Satisfaction and Dentoalveolar Changes After Using Twin Block and Bionator Appliances: Systematic Review. Arch Pharm Pract. 2023;14(2):147-52. https://doi.org/10.51847/IMBf1mq1eu

While some studies have shown notable results, others have yet to offer any improvements consistently [5, 6].

Studies using cephalometrics have adequately shown how functional appliances affect dentofacial anatomy [5-7]. On the other hand, our understanding of the temporomandibular joint's alterations is restricted. The objective of creating more recent functional appliances, such as the Bionator from Balter and the Twin Block from Clark, was to create a system that the patient would find easy to use, pleasant, and aesthetically pleasing [3, 4]. Numerous research works have examined how the Bionator and Twin block appliance affect dental and skeletal characteristics. Nonetheless, an absence of research has directly juxtaposed the treatment modifications of this equipment with typical growth fluctuations in an untreated Class II population. The bionator and the twin block from Balters are two of the most widely utilized functional appliances available today. While they are both tooth-borne, the twin block is designed to be worn full-time and operates all functional forces, including mastication forces, used to the dentition [4, 6]. The impacts of these appliances have yet to be compared in many research.

Materials and Methods

A systematic literature review was conducted from 2000 to 2023 using Science Direct, Medline, and PubMed databases. The keywords patients' satisfaction, Orthodontics, Bionator, and Twin block were used to search. PRISMA flowchart was applied to describe the article selection process **(Figure 1)**.

Inclusion Criteria

- Randomized control and case-control studies
- Articles published from 2000-2003
- The article that the language is English
- Human studies (In vivo)

Exclusion Criteria

- Narrative reviews, expert opinions, meta-analyses, or systematic reviews
- Studies that were based on surveys
- Out of the time frame considered
- The language of the articles is not English
- In vitro studies

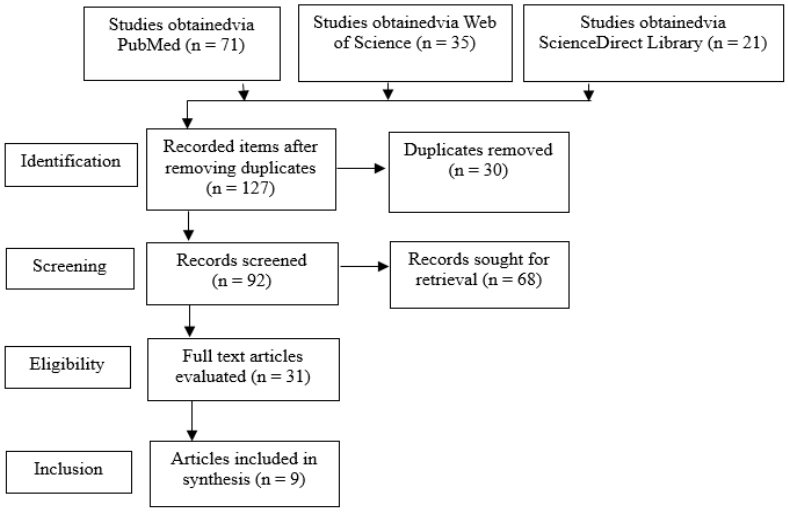

Figure 1. PRISMA Flow Diagram

Bias Assessment Risk

Cochrane risk of bias assessment method was applied to evaluate the quality of the available studies **(Table 1)**.

Table 1. Cochrane Risk Summary of Bias Assessment

Study	Selection Bias/Appropriate control selection/baseline characteristics similarity	Selection bias in randomization	Selection bias in allocation concealment	Performance-related bias in blinding	Reporting bias/Selective reporting of outcomes	Detection bias Blinding outcome assessors	Accounting for confounding bias
Siara-Olds *et al*. (2010)	+	+	+	-	+	+	+
Jena AK *et al*. (2006)	-	+	+	+	-	+	+

Chavan *et al*. (2014)	+	+	+	+	+	+	+
Chavan *et al*. (2014)	+	+	+	+	+	+	-
Alsheikho *et al*. (2021)	+	+	+	+	+	+	-
Gupta *et al*. (2012)	+	+	+	-	+	+	+
Miresmaeili *et al*. (2014)	+	+	+	-	+	+	+
Rodi *et al*. (2016)	+	+	+	+	+	-	+
Ahmadian-Babaki *et al*. (2017)	+	-	+	+	+	+	+

Results and Discussion

Siara-Olds *et al*. (2010) [8] researched to ascertain if the long-term dento-skeletal alterations in patients receiving tooth-borne functional equipment could be compared to matched controls and each other. Children with untreated class II skeletal malocclusion (twenty-one children) constituted the control group. The treated group had lateral cephalograms at T1 (first recordings), T2 (functional treatment completion), and T3 (fixed appliance therapy completion). After therapy, there was a significant flare-up in the lower incisors in the Twin Block group (7). Neither treated nor untreated patients saw any appreciable changes in soft tissue over time. Among the different treatment groups and matched controls, no long-term significantly remarkable changes in dento-skeletal characteristics were found **(Table 2)**.

This experiment performed by Jena *et al*. (2006) [9] aimed to assess the effects of Bionator and Twin-block appliances on the skeleton and dentoalveolar tissue. For the study, fifty-five girls from North India who had the same physical development maturation status and Class II Division 1 malocclusion were selected. The treated participants exhibited considerably larger (P =.000) mandibular incisor proclination, overjet reduction, and x-molar correction as compared to the controls.

The analysis assessed by Chavan *et al*. (2014) [10] aimed to assess and compare the impact of Bionator and Twin Block appliances on the temporomandibular joint, specifically focusing on the disk-condyle-fossa connection after functional therapy. Thirteen men and seventeen girls, aged between nine and fourteen, who had class II division 1 malocclusion with mandibular retrognathism made up the sample as a whole. Ten participants each made up the Twin Block and Bionator treatment groups, while another ten participants made up the control group. Over six months, there were no changes in the disk and condyle position in the control group.

Chavan *et al*. (2014) [11] created a prospective clinical trial to investigate the impact of these appliances on the skeleton and teeth, as well as any alterations that take place in the control group.30 growing subjects with class II division 1 malocclusion, aged 9 to 14 years, were included in this study. Ten patients from each of the three groups—ten for the twin block and ten for the bionator—were assigned as controls. The course of therapy lasted six months on average. When comparing the modifications caused by the two appliances, there were no appreciable differences. In conclusion, developing people with skeletal class II malocclusion may benefit from the efficient use of both Twin block and Bionator appliances for correction.

Assessment evaluated by Alsheikho *et al*. (2021) [12] in which cervical spine and head position, as well as sample size estimated. A total of thirty suitably qualified individuals in need of functional treatment were randomized into three groups: Bionator (B), Twin Block (TB), and Control (C). In any of the three groups, there were no significantly remarkable changes seen in the head or cervical characteristics.

The aim of the study practiced by Gupta (2012) [13] was to examine how a detachable functional device affected the soft tissue alterations in the face profile. The Twin Block and Bionator appliances were selected as the study's removable functional appliances. Analysis was done on lateral cephalometric radiographs before and after treatment. The soft tissue alterations in the twin block group and the bionator group were compared. When compared to the untreated group, the twin block and bionator groups had significant alterations in the soft tissue face complex. Of these, ten were successfully treated with Bionator, ten with Twin Block, and the remaining ten were part of the untreated group.

This research attempted by Miresmaeili, *et al*. (2014) [14] to assess the dento-skeletal effects of a functional appliance called the Twin Block (TB) and a modified bionator (FA) in the treatment of skeletal Class II malocclusion. From each of the two private clinics, 30 treated CL II patients with an overjet larger than 4 mm were chosen for this retrospective analysis. Either FA or TB were utilized in each office. Significant retrusion of the upper lip occurred in both appliances due to a reduction in overjet (TB=002, FA=.000). There was no discernible statistical difference between the two appliances.

The aim of the study finished by Rodi *et al*., [15] is to examine the skeletal and dental effects of Bionator, Twin Block, and Frankel II utilizing a review of the literature

conducted using PubMed from 1998 to 2016. Our research's conclusive findings show that the Twin Block appliances significantly improve mandibular development while also determining a higher positive torque of the lower incisors together. Even now, there are still differing views about the causes of mandibular growth. While some literary works attribute it to advancements made possible by functional devices, others relate it to the two jaws' differing rates of development. It's important to keep in mind, however, that these devices rely on patient compliance, and it may be difficult to compare the benefits that skeletal and dental health have on different people.

The aim of the study analyzed by Ahmadian-Babaki *et al*. (2017) [16] was to use cephalometric radiographs to compare the treatment results of these two appliances. 33 patients with class II division I malocclusion had their before and after treatment cephalometric radiographs digitalized. The ANB, NA-Pog, Ar-Go-Me, and Basal angles were the only cephalometric metrics in which twin block and bionator did not exhibit statistically significant differences.

Table 2. Summary of the included studies in this systematic review

Study	Objective	Materials	Results
Siara-Olds *et al*. (2010) [8]	Compare long-term dento-skeletal changes in tooth-borne functional appliances	80 consecutively treated patients and 21 untreated controls	No significant dento-skeletal differences among treatment groups and controls; the Twin Block group had lower incisor flaring.
Jena *et al*. (2006) [9]	Evaluate dentoalveolar and skeletal effects of Bionatorand Twin Block in Class II Division 1 malocclusions	55 girls	Twin Block showed greater mandibular growth, overjet reduction, molar correction, and incisor proclination compared to Bionator.
Chavan *et al*. (2014) [10]	Examine the changes of temporomandibular joint using Bionator and Twin Block appliances	30 subjects	Both appliances led to the anterior condyle and posterior disk movement; the control group showed no changes.
Chavan, *et al*. (2014) [11]	Investigate dental and skeletal effects of Bionator and Twin Block appliances	30 individuals	No significant differences between the appliances in terms of changes.
Alsheikho *et al*. (2021) [12]	Analyze head and cervical spine posture changes	30 participants	Significant changes in SNB and ANB angles for Twin Block, and SNA and ANB angles for Bionator; no cervical variable changes.
Gupta (2012) [13]	Compare soft tissue changes using Bionator and Twin Block		Both appliances showed significant soft tissue changes compared to the untreated group.
Miresmaeili, *et al*. (2014) [14]	Evaluate dento-skeletal effects of modified Bionator and Twin Block	30 patients	Both appliances led to upper lip retrusion; no significant difference between the two.
Rodi *et al*. (2016) [15]	Examine skeletal and dental effects of Frankel II, Bionator, and Twin Block	Literature review from 1998 to 2016	Literature-based findings: Twin Block appliances significantly enhance mandibular development and positive torque of lower incisors. Debate on mandibular growth causes functional devices vs. differing jaw development rates. Patient compliance affects the devices' effectiveness.
Ahmadian-Babaki *et al*. (2017) [16]	Compare treatment results of Twin Block and Bionator using cephalometric radiographs	33 patients	Cephalometric analysis showed no statistically significant differences.

Of all malocclusions, class II malocclusion is the most prevalent and may be caused by a variety of skeletal and dental factors. According to Jungbauer [1], mandibular retrusion is the most pervasive feature in a Class II sample group, even though mandibular retrusion and maxillary protrusion are both discovered to be potential causal causes. Functional appliance treatment is the most effective way to address the cause of the mandible's retrognathic development in Class II patients. This involves attempting to change the direction or quantity of growth in the jaw.

This study aimed to compare the effects of two full-time wear functional appliances—the Bionator and the Twin block appliance.

Effects of Dentoalveolar

In the control group comparison, lingual tilting of the upper incisors was seen in both groups in this research. Comparing the Twin block (2.4°) to the Bionator (2.0°) group, there was greater lingual tilting than in the Control group. The Twin block group revealed the most decrease in upper incisor proclamation, followed by the Bionator group, while the Bass appliance group showed the least. Other Twin block investigations obtained similar results [5, 8, 17].

Compared to the control group, the lower incisor proclination in both treatment groups was statistically significant. Although it was not statistically significant between the Twin block group (2.5°) and the Bionator group

(1.4°), it was higher in the former. In the comparable Twin block research, the lower incisors proclination increased by 3.8° according to Balakrishnan [5]. Lower incisor proclination increased more in the Bionator group than in the Twin block group [13]. Additional investigations on functional appliances supported these findings [14].

The findings go counter to [15], which reported no discernible lower incisor proclination after using a modified Twin block appliance with a South end clasp in the lower incisor. In the same way, Varghese [16] discovered that using Bionator appliance incisor capping did not significantly cause a lower incisor proclination.

When compared to the Controls in the current research, overjet was much lower in both treatment groups. With the Twin block group, the overjet decrease was 3.3 mm, whereas with the Bionator group, it was 3.1 mm. Proclination of the lower incisors, lingual tipping of the upper incisors, and adjustment of the dental base relationship all contributed to this decrease in overjet. These results are consistent with the Illing *et al*. research. In [12] In a similar Higgins [18] discovered that the Twin block reduced overjet because of dentoalveolar and skeletal correction.

In comparison to the control group, there was no discernible difference in the upper first molars between the treatment groups. Twin block and bionator treatment had no discernible effect on the top molar's vertical eruption. Elabbassy [14, 19] with Twin block obtained similar results. In the Twin block group, the lower molar displacement was 3.4 mm, whereas in the Bionator group, it was 2.7 mm. Other research revealed similar results [5, 9, 10, 15]. A significant molar overjet correction was seen in both groups. In the Twin block, it was adjusted by 2.6 mm, and in the Bionator group, by 2.58 mm. Magnificent rectification in molar connection using a Twin block was reported by Mehyar [20].

In the Twin block, lower molar eruption was 1.8 mm, whereas in the Bionator group, it was 1.6 mm. Compared to the control group, it was statistically significant. The lower molar's eruption resulted from the appliances being trimmed during treatment. The lower molar eruption of the twin group was on average four times higher than the control group. In comparison to the control group, Lund and Sandler's research [9] revealed mean variations in lower molar eruptions of 0.9 mm in the Twin block group. The lower molar vertical eruption was larger in the Twin block than in the Frankel groups. For molar relationship correction and overjet reduction, the Twin block and Bionator performed comparably. The dentoalveolar effects did not substantially vary between them. Nonetheless, the Twin block appliance mostly showed dentoalveolar alterations. In contrast, it was discovered that during normal growth, the jaw rotates upward and forward as a result of posterior vertical growth outstripping anterior vertical growth. Between the ages of 14 and 20, the mandibular plane angle dropped by 1.1°, indicating a propensity for the jaw to close. It was found that the growth rate of the mandibular at the age of 14-16 years is twice more than that of 16-20 years. As people age, it has been seen that lower incisors tip lingually, which may be a contributing reason to late incisor mandibular crowding [21-23].

Given that all of the patients were matched based on their growth maturation state, the greater growth increments seen with the MARA, Herbst, and Twin Block could not be explained by differences in chronologic age. In comparison to the controls, functional appliance therapy resulted in the largest change in mandibular length. Comparing the MARA patients to the possession, only the former saw a longer mandibular growth length of 1.0 mm each year after this initial growth spurt. This result is consistent with that published by Livieratos and Johnston, who proposed that mandibular development is mortgaged to the extent that functional appliances are present. The use of active devices did not significantly modify mandibular length over the long term, according to control clinical studies.

Following Twin Block appliance therapy, it was noteworthy to note that the treated children's occlusion improved from class II to class I. The condyles are retracted and inserted into their glenoid fossa. The position of the condyle about the cavity remains anterior to the pre-treatment position, even though it seemed as if it was seated in its fossa. Similar results were seen in the group of Clark Twin Block patients whom Bajjad *et al*. [24] effectively treated. Similar findings in individuals receiving activator treatment were also visited by Pacha [25]. Additionally, the anterior condylar position during Herbst therapy was observed [12]. They did, however, add that one year after the treatment time, the occlusion settled, and the condyle position returned [26].

After six months, there was no discernible difference between the Bionator and Twin Block groups, even though both appliances had positioned the condyles anteriorly. More anterior condyle location was seen with the Twin Block appliance. However, the difference is not statistically significant [24].

Conclusion

In summary, the studies presented various findings related to the effectiveness of Bionator and Twin Block appliances in treating Class II malocclusions. Twin Block was observed to have positive effects on mandibular growth, overjet reduction, molar correction, and incisor proclination, while both appliances were found to induce changes in temporomandibular joint position. However, there were no significant differences in skeletal and dental effects between Bionator and Twin Block, and both caused significant soft tissue changes. A literature review suggested that Twin Block appliances enhance mandibular development, but there is ongoing debate about the causes of mandibular

growth and the role of patient compliance in device effectiveness. Additionally, a cephalometric analysis revealed no significant differences between Twin Block and Bionator in specific angles.

ACKNOWLEDGMENTS: None
CONFLICT OF INTEREST: None
FINANCIAL SUPPORT: None
ETHICS STATEMENT: None

REFERENCES

1. Jungbauer R, Koretsi V, Proff P, Rudzki I, Kirschneck C. Twenty-year follow-up of functional treatment with a bionator appliance: A retrospective dental cast analysis. Angle Orthod. 2020;90(2):209-15.
2. Pintucci F, Maspero C, De Grazia MT, Angelino E, Vincenzo M, Farronato M, et al. Use of Clark's twin block for the treatment of angle class ii malocclusion during development: Retrospective study based on literature data. Int J Clin Dent. 2022;15(2).
3. Bahar AD, Kamarudin Y, Chadwick S. A national survey of orthodontists in Malaysia and their use of functional appliances for Class II malocclusions. Aust Orthod J. 2021;37(2):217-26.
4. Hanoun AA, Rao GK, Khamis MF, Mokhtar N. Efficacy of the prefabricated myofunctional appliance T4FTM in comparison to twin block appliance for class II division 1 malocclusion treatment: A randomized clinical trial. Malays J Med Health Sci. 2020;16(4).
5. Balakrishnan A, Antony V, Parayarthottam P, Ali J. One-phase management with a standard twin-block appliance followed by fixed orthodontic treatment–A case report. J Res Adv Dent. 2022;13(2):1-5.
6. Akan B, Erhamza TS. Does appliance design affect treatment outcomes of class II division 1 malocclusion? A two-center retrospective study. J Oral Maxillofac Res. 2021;12(2).
7. Oliver GR, Pandis N, Fleming PS. A prospective evaluation of factors affecting occlusal stability of Class II correction with Twin-block followed by fixed appliances. Am J Orthod Dentofacial Orthop. 2020;157(1):35-41.
8. Siara-Olds NJ, Pangrazio-Kulbersh V, Berger J, Bayirli B. Long-term dentoskeletal changes with the Bionator, Herbst, Twin Block, and MARA functional appliances. Angle Orthod. 2010;80(1):18-29.
9. Jena AK, Duggal R, Parkash H. Skeletal and dentoalveolar effects of Twin-block and bionator appliances in the treatment of Class II malocclusion: a comparative study. Am J Orthod Dentofacial Orthop. 2006;130(5):594-602.
10. Chavan SJ, Bhad WA, Doshi UH. Comparison of temporomandibular joint changes in Twin Block and Bionator appliance therapy: a magnetic resonance imaging study. Prog Orthod. 2014;15:1-7.
11. Chavan SJ, Bhad WA, Doshi UH. Comparison of temporomandibular joint changes in Twin Block and Bionator appliance therapy: A magnetic resonance imaging study. Prog Orthod. 2014,11(1):221-8.
12. Alsheikho HO, Jomah DH, Younes M, Tizini M, Hassan H, Khalil F. Evaluation of head and cervical spine posture after functional therapy with Twin Block and Bionator appliances: A pilot randomized controlled trial. CRANIO®. 2021:1-0.
13. Gupta C. A cone beam computed tomography study to correlate the oropharyngeal airway dimensions in angle's class II Division I Patients Treated with Functional Appliance-an Invitro Study. Iran J Orthod. 2012:7(2):12-9.
14. Miresmaeili A, Javanshir B, AkbarZadeh M. Cephalometric comparison of a modified bionator (Farmand Appliance) and twin-block appliance in treatment of skeletal Cl II malocclusion. Iran J Orthod. 2014;9(1):13-20.
15. Rodi G, Emanuele F, Elisa L, Martina Maria D, Gabriella P. Twin block, Bionator and Frankel II: comparative study. WebmedCentral Orthodontics. 2016;7(11):WMC005214.
16. Ahmadian-Babaki F, Araghbidi-Kashani SM, Mokhtari S. A cephalometric comparison of twin block and bionator appliances in treatment of class II malocclusion. J Clin Exp Dent. 2017;9(1):e107.
17. Bondemark L, Kallunki J, Paulsson L. An updated systematic review regarding early Class II malocclusion correction. J World Fed Orthod. 2019;8(3):89-94.
18. Frilund E, Sonesson M, Magnusson A. Patient compliance with Twin Block appliance during treatment of Class II malocclusion: a randomized controlled trial on two check-up prescriptions. Eur J Orthod. 2023;45(2):142-9.
19. Elabbassy EH, Abdeldayem RF. One Phase versus two phase treatment in management of growing class II patients: A retrospective study. Egypt Dent J. 2023;69(3):1721-30.
20. Mehyar L, Sandler J, Thiruvenkatachari B. Does observational study on the effectiveness of the Twin Blocks overestimate or underestimate the results? A comparative analysis of retrospective samples versus randomized controlled trial. J World Fed Orthod. 2021;10(2):43-8.
21. Sabouni W, Mansour M, Gandedkar NH. Scope of clear aligner therapy (CAT) in Phase I (early) orthodontic treatment. InSeminars in Orthodontics 2023 May 21. WB Saunders.
22. Inchingolo AD, Patano A, Coloccia G, Ceci S, Inchingolo AM, Marinelli G, et al. The efficacy of a new AMCOP® elastodontic protocol for orthodontic interceptive treatment: A case series and literature overview. Int J Environ Res Public Health. 2022;19(2):988.
23. Sun R, Liu P. A growing adolescent with Class II Division 1 malocclusion featuring a retruded mandible and proclined mandibular incisors treated with clear aligners in a combined orthopedic and orthodontic approach. AJO-DO Clin Companion. 2023.
24. Bajjad AA, Chauhan AK, Singh G, Hani SU. Assessment and implication of growth in the management of sagittal dysplasia. Orange Books Publication; 2023.
25. Pacha MM, Fleming PS, Johal A. A comparison of the efficacy of fixed versus removable functional appliances in children with Class II malocclusion: a systematic review. Eur J Orthod. 2016;38(6):621-30.
26. Xie J, Zheng Y, Wu J. Three-dimensional dentoskeletal effects of the Angelalign A6 clear aligners in a skeletal Class II growing patient: A case report. Int Orthod. 2023;21(2):100756.