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Original Article

Skeletal and Dental Effects of Twin-Block Appliances in Patients Treated With or Without Expansion

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Main Points

- Due to the addition of expansion screws to the twin-block appliance, expansion and functional treatment are simultaneous.
- Including expansion in the twin-block treatment allows dental expansion but not transverse skeletal expansion.
- In addition to eliminating the maxillary transverse deficiency, it is possible to gain space due to an increase in the length of the arch and intercanine and intermolar distances using the twin-block appliance with expansion.

ABSTRACT

Objective: To compare the skeletal and dental effects of twin-block appliances with or without expansion.

Methods: From our archives, patients using twin-block appliances were selected. A total of 20 patients with expansion screws were classified as group 1 (10 male, 10 female; mean age 12.48 $\pm$ 1.38 years), and 18 patients without screws as group 2 (8 male, 10 female; mean age 12.81 $\pm$ 1.16 years). Cephalometric radiographs at pre-and post-treatment were used to evaluate skeletal and dentoalveolar parametric changes; study models and posteroanterior radiographs were used for transverse evaluation. The initial measurements and the treatment-related mean changes within the study groups were analyzed using the Student's *t*-test.

Results: Changes in maxillary skeletal measurements were not statistically significantly different between groups except for A-VRL ($P > .05$). Mandibular measurements showed an increase in SNB (°) and Co-Gn distance in both groups. However, these changes were similar for both groups ($P > .05$). The maxillary measurements showed that incisors were proclined in the expansion group and retroclined in the non-expansion group. No significant difference was found between the groups in terms of changes in the skeletal transversal measurements ($P > .05$). On the study models, the changes in maxillary intercanine and intermolar widths, and in arch length differed to a statistically significant degree between groups ($P < .05$).

Conclusion: The skeletal effects of 2 different types of twin-block appliances in the transversal direction were similar; it was determined that dental expansion was obtained in the maxilla by adding screws to the twin-block appliances.

Keywords: Twin-block, expansion, posteroanterior, cephalometrics

INTRODUCTION

The twin-block functional orthodontic appliance was developed by William Clark. It is frequently used for functional correction of the mandible in the treatment of Class II Division 1 malocclusion and initially consisted of interconnected acrylic occlusal bite blocks in the form of a simple removable appliance.[1,2] While this basic principle is still applied, the design of the functional appliance has varied over the years for the treatment of skeletal Class II malocclusion, as greater understanding of the appliance and treatment technique are gained. Appliance design has been made easier and become more acceptable to patients by improving and simplifying the appliance without reducing its effectiveness. One of the most important advantages is that the twin-block appliance can be designed in different ways. Hence, the twin-block appliance largely meets the needs of patients of a wide range of ages, from childhood to adulthood, with various types of malocclusions. This is because the

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upper and lower pieces consist of 2 separate parts, and the parts can be individually designed to address the needs of both arches independently.[2]

The systematic review by Cozza et al.[3] searched for answers to 2 key questions. First, is mandibular growth in individuals with Class II anomalies treated with functional appliances more likely than in untreated Class II anomalies? Second, is the average effect of functional appliances on mandibular length clinically significant? Of the 22 articles that met the author's criteria, 66% found total clinically significant growth (mandibular length) with active treatment with functional appliances. The Herbst appliance (0.28 mm/month) was found to have the highest efficiency coefficient among the functional appliances used, followed by the twin-block (0.23 mm/month).

However, many investigators have reported undesirable effects of functional appliances, such as retraction in maxillary incisors and protrusion in mandibular incisors.[4-6] To reduce the protrusion effect of the activator on the mandibular incisors, the researchers made various modifications to the activator. In the Van Beek activator designed for this purpose, the labial surfaces of the lower incisors were covered with acrylic.[7]

It is also possible to expand the maxillary arch by adding active parts to the appliances, such as screws. The design of these parts is advantageous for patients with mandibular retrognathia with transversal constriction of the maxilla. Conventionally, these patients require maxillary expansion after functional treatment, which can result in prolonged duration of orthodontic treatment, reduction in patient cooperation, and loss of time and cost for the physician. The fact that the 2 parts of the twin-block appliances are independent of one another enables the mandible to be extended while simultaneously expanding the maxilla.[8,9]

In the literature, there are limited studies about the transversal effects of functional appliances. Therefore, the aims of our study were to reveal the transversal effects of the twin-block appliance and to compare the short-term skeletal and dental effects of the twin-block appliance with and without expansion.

METHODS

A parallel-group retrospective clinical study was performed. Ethical approval was obtained from the Clinical Research Ethics Committee, Suleyman Demirel University (28.05.2019/186).

Patients were recruited at the Suleyman Demirel University, Faculty of Dentistry, Department of Orthodontics, from 2018 to 2019. Written informed consent was obtained from all patients who applied to our clinic for treatment, each indicating that their radiographs or materials could be used in scientific articles. The following inclusion criteria were applied: (1) Class II malocclusions characterized by a retrognathic mandible (SNB < 76°, ANB > 4°), (2) overjet of 6 mm or more, (3) Class II molar relationships, (4) CVM between stage 2 and 3 in initial records (Lamparski method), (5) treated with a twin-block appliance with or without screws, (6) posteroanterior and lateral cephalometric radiographs and study models taken before and after functional treatment, and (7) landmarks identifiable on all radiographs. Those with a history of orthodontic treatment or craniofacial syndromes, and patients treated with different functional appliances were excluded (Figure 1).

All twin-block appliances were made by the same orthodontic technician. The features of the appliances were: (1) Adam's clasps on the first molars and premolars or deciduous molars, (2) a 3-sided (Bertoni) screw placed and activated in the upper plate (in the expansion group), (3) acrylic blocks constructed at 70° to the occlusal plane, (4) upper vestibule arch placed

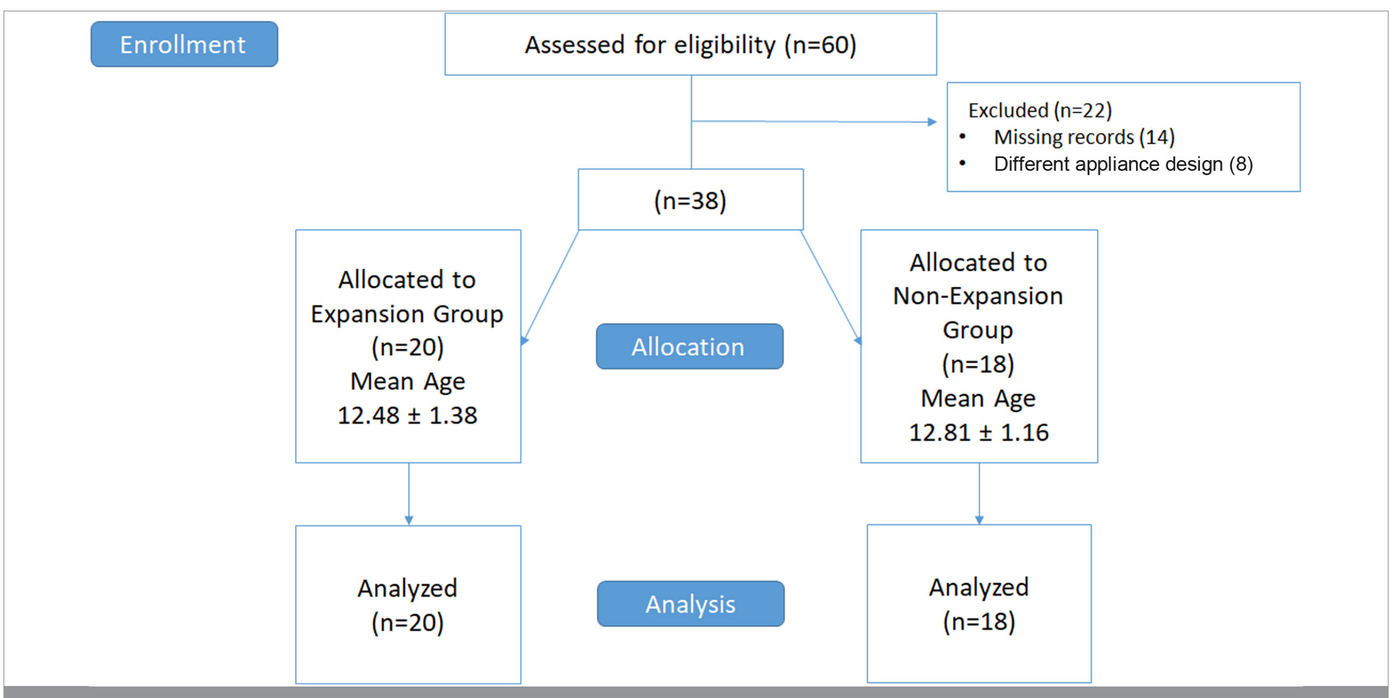

Figure 1. Flow diagram of the groups.

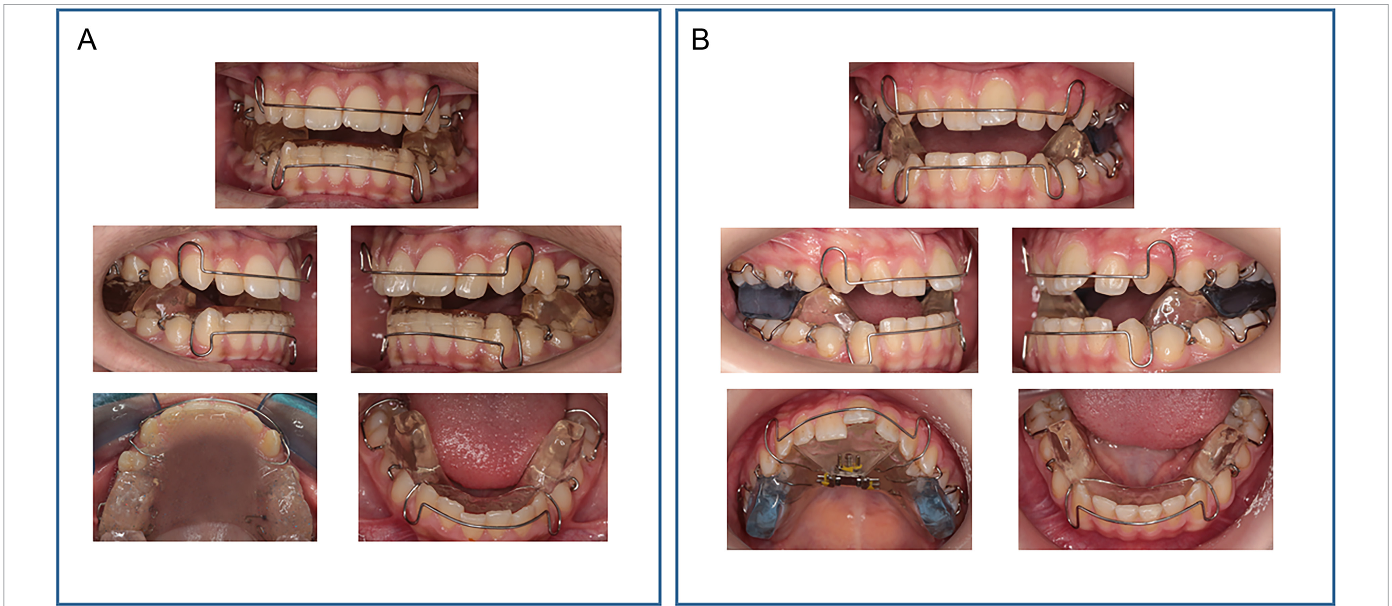

Figure 2. Intraoral view of twin-block appliances without expansion (A) and with expansion (B).

canine-to-canine, and (5) ball-ended clasps on the mandibular incisors. Construction bite registration was obtained in edge-to-edge relation within 2 mm interincisal space (Figure 2).

In patients with transverse deficiency in the maxilla, the mandible was brought forward, while maxillary expansion with screw was performed in the expansion group (Group 1). Patients without transversal deficiency were placed into the non-expansion group (Group 2). In group 1, expansion of the maxilla was performed until posterior crossbite improved.

An appropriate sample size was calculated using the formula recommended by Pandis,[10] for a significance level of 0.05, and a power of 80%, to detect clinically meaningful differences between the groups. A power analysis showed that 31 patients were needed for the study. A total sample of 34 patients (17 per group) was therefore required, although a further 4 patients were recruited to allow for potential attrition. A total of 20 individuals (10 males, 10 females; 12.48 ± 1.38 years) were included in the expansion group, and 18 individuals (8 males, 10 females; 12.81 ± 1.16 years) were included in the non-expansion group, according to the criteria.

All patients were treated by the same clinician during the twin-block treatment (MHB). Since both device types are routinely used in clinical practice, patients were instructed to wear the appliance full-time, except during meals, and for the duration specified on the patient-treatment form. Patient cooperation was evaluated. T0 (pre-treatment) and T1 (post-treatment, i.e., after functional treatment) cephalograms and posteroanterior radiographs were obtained using a standard lateral cephalometric X-ray device (Planmeca ProMax 3D Mid, Planmeca Oy, Helsinki, Finland). Transversal measurements were also performed on the study models pre- and post-treatment.

All lateral cephalometric radiographs were analyzed with Dolphin 3D software (Version 11.8, Dolphin Imaging & Management Solutions, Chatsworth, California, USA) by the single author (BK), who was blinded to the type of appliance. To detect skeletal and dental effects on the radiographs, measurements were also made using reference planes. On each radiograph, a horizontal reference line (HRL) was constructed passing through the tuberculum sella (T) and wing points (W) and a perpendicular line passing through the T as a vertical reference line (VRL) (Figure 3).

Posteroanterior radiographs and study models were used to assess the transversal effects of 2 different twin-block appliances. Dolphin 3D analysis software was used to measure internasal, interfacial (interzygomatic), maxillary (interjugular), and mandibular (intergonial) widths on posteroanterior radiographs. On the study models, intercanine, intermolar, and interpremolar distances and alveolar width were measured with digital calipers, along with maxillary and maxillary arch lengths.

Statistical Analysis

Twenty-five randomly selected lateral cephalometric radiographs were traced 15 days after first measurement by the same clinician. The method error was calculated using the Houston test, which indicated the reliability of the measurements ($r \geq 0.961$). In addition, the results of a paired *t*-test showed that the data were free of systematic error ($P > .05$).

Parametric tests were performed for data analysis because a Shapiro–Wilks test showed normal distribution. The gender distribution in each group was tested using a Pearson chi-square test. Because there was no significant difference between the genders in the chi-square test, the gender factor was ignored in our study ($P > .05$). The changes observed in each group were analyzed using the paired *t*-test, and the initial measurements and the mean changes within the groups were analyzed using a Student's *t*-test. All statistical analyses were performed using the SPSS software package program the Statistical Package for

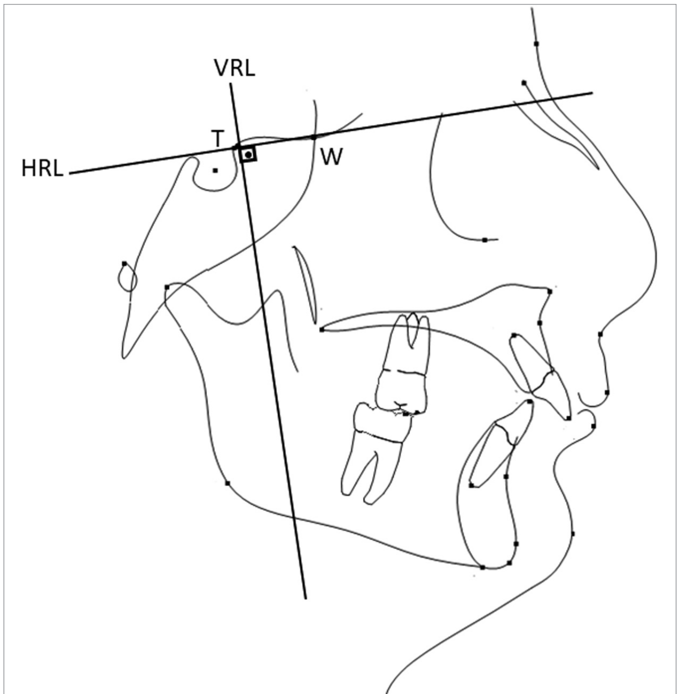

Figure 3. Measurements based on horizontal (HRL) and vertical (VRL) reference lines.

Social Sciences, version 20.0 software (SPSS Inc.; Chicago,IL, USA). at a significance level of $P < .05$.

RESULTS

Table 1 shows the descriptive data of the patients included in the study. No statistically significant differences were found between groups in terms of chronological age, gender distribution and treatment time, as tested by Pearson chi-square and Student's *t*-tests, respectively ($P > .05$). A comparison of the initial values of the groups is shown in Table 2. According to the results of the Student's *t*-test, no significant difference was found between the 2 groups in the initial measurements except for U1-PP (°) and IMPA (°) measurements ($P > .05$). On the other hand, there was a difference in the initial values of both groups in transversal measurements in maxillary interpremolar and intercanine widths and arch length ($P < .05$). The patients in both groups had a skeletal Class II malocclusion due to mandibular retrognathism with normal vertical growth patterns.

Table 3 shows the statistical comparison of the mean changes that occurred in groups using the independent *t*-test. Maxillary measurements showed decreased SNA (°) in both groups, while Co-A distance increased in both groups. A-HRL and A-VRL measurements increased in both groups due to forward and downward movement at point A ($P < .001$). However, there were no statistically significant differences between groups, except A-VRL ($P > .05$). Mandibular measurements showed an increase in SNB (°) and Co-Gn distance in both groups ($P < .001$). At the B and Pg points, B-HRL, B-VRL, Pg-HRL, and Pg-VRL measurements increased in both groups due to forward and downward movement. However, no statistically significant differences were found between groups ($P > .05$). Those changes in the maxilla and the mandible caused an improvement in the maxillo–mandibular relationships.

When the maxillary dentoalveolar measurements were compared, a statistically significant increase in U1-PP (°), U1-VRL, and U1-HRL measurements was found in the expansion group, and a statistically significant decrease was found in the non-expansion group ($P < .001$). the changes in U1-PP and U1-VRL were significantly different between groups ($P < .05$). When mandibular dentoalveolar measurements were compared, the increase in IMPA were similar in both groups ($P > .05$). Both overjet and overbite decreased due to dentoalveolar changes. However, there was no statistically significant difference between groups ($P > .05$).

When the transversal measurements were evaluated, no statistically significant differences were found in the measurements on posteroanterior radiographs, both in non-expansion group and intergroup ($P > .05$). Transverse measurements on the study models showed no statistically significant differences between interdental widths, intragroup and between groups, and in alveolar width measurements in the mandible ($P > .05$). Regarding maxillary measurements, the treatments in the groups resulted in changes that were statistically significant ($P < .05$); intercanine, intermolar widths, and arch length changes between groups were statistically significant ($P < .05$).

DISCUSSION

Class II malocclusions are one of the most common types of malocclusion treated by orthodontists.[11,12] These malocclusions may occur as a result of various skeletal and dental combinations[13]; however, it has been reported that they are mostly caused by mandibular retrognathism.[14] Functional appliances are often used in the treatment of Class II Division 1 malocclusions caused by mandibular retrognathia.[15] The objectives of functional orthopedic treatment for skeletal Class II malocclusions are the formation of an orthognathic profile and the reduction of mandibular retrognathia,

Table 1. Comparison of the chronological age, CVM periods, gender distributions, and treatment time between groups

	Gender Distribution (Male/Female)	Chronological Age Mean±SD (Years)	CVMPeriod Number (%)	Treatment Time Mean±SD (Years)
Group 1 ($N = 20$)	10/10	12.48 ± 1.38	CS 2 (8) 40 CS 3 (12) 60	1.09 ± 0.19
Group 2 ($N = 18$)	8/10	12.81 ± 1.16	CS 2 (8) 45 CS 3 (10) 55	1.07 ± 0.23
P	.852*	.922†	.947*	.716†

Group 1: Twin-Block Group with expansion; Group 2: Twin-Block Group with non-expansion;
*Results of Pearson chi-square test; †Results of Student's *t*-test.
CVM, cervical vertebral maturation period; SD, standard deviation; *N*, number.

Table 2. Comparison of in-group changes with paired t-test and initial values between groups with student's t-test

	Group 1 (Expansion)			Group 2 (Non-expansion)			
	T0	T1		T0	T1		
Cephalometric Measurements	Mean ± SD	Mean ± SD	*P*	Mean ± SD	Mean ± SD	*P*	P'
SNA (°)	80.13 ± 3.83	78.82 ± 3.47	.000	79.31 ± 2.79	78.5 ± 2.54	.000	.428
SNB (°)	74.94 ± 2.18	77.62 ± 2.09	.000	73.69 ± 2.67	76.45 ± 2.39	.000	.524
ANB (°)	5.19 ± 0.97	1.2 ± 0.71	.000	5.62 ± 0.81	2.26 ± 0.73	.000	.328
Co-A (mm)	81.67 ± 2.85	82.59 ± 2.63	.000	82.94 ± 3.53	83.75 ± 3.66	.000	.224
Co-Gn (mm)	105.11 ± 4.54	110.01 ± 4.77	.000	102.69 ± 6.01	107.44 ± 5.97	.000	.137
Wits (mm)	5.39 ± 1.40	1.87 ± 1.03	.000	5.88 ± 1.18	2.28 ± 1.22	.000	.704
A: VRL (mm)	54.83 ± 5.46	54.85 ± 5.29	NS	54.63 ± 5.83	55.1 ± 5.41	.000	.230
B: VRL (mm)	43.28 ± 7.85	46.52 ± 7.42	.000	43.5 ± 8.16	46.6 ± 7.88	.000	.241
Pg: VRL (mm)	45.33 ± 7.44	48.25 ± 7.16	.000	47.02 ± 8.46	49.61 ± 8.03	.000	.285
U1: VRL (mm)	47.88 ± 4.66	50.07 ± 4.93	.000	48.56 ± 2.86	47.85 ± 2.75	.000	.092
L1: VRL (mm)	56.44 ± 4.35	57.77 ± 4.21	.000	54.81 ± 5.44	56.02 ± 4.92	.000	.874
A: HRL (mm)	50.39 ± 5.71	50.98 ± 5.34	.000	51.13 ± 5.27	51.75 ± 6.08	.000	.842
B: HRL (mm)	85.83 ± 5.25	89.58 ± 5.01	.000	83.94 ± 4.22	87.71 ± 3.84	.000	.225
Pg: HRL (mm)	93.22 ± 5.02	97.07 ± 4.87	.000	96.08 ± 6.41	99.99 ± 6.62	.000	.958
U1: HRL (mm)	26.63 ± 2.02	25.96 ± 1.44	.000	26.39 ± 2.28	27.14 ± 3.11	.000	.552
L1: HRL (mm)	34.17 ± 2.08	34.68 ± 1.82	NS	33.81 ± 2.05	34.54 ± 2.6	NS	.167
SN/PP (°)	9.33 ± 1.37	9.45 ± 1.45	.000	9.5 ± 1.51	9.56 ± 1.23	.000	.618
SN/GoGn (°)	29.35 ± 3.69	31.54 ± 3.31	.000	30.78 ± 4.63	32.74 ± 5.07	.000	.416
FMA (°)	24.56 ± 4.1	25.54 ± 3.94	.000	25.67 ± 4.43	26.5 ± 4.38	.000	.772
U1/PP (°)	106.94 ± 7.75	109.31 ± 6.84	.000	110.67 ± 4.32	109.54 ± 4.97	.000	.019
IMPA (°)	95.19 ± 9.92	98.67 ± 10.03	.000	96.28 ± 5.83	99.99 ± 6.09	.000	.0.11
Overjet (mm)	6.71 ± 0.53	2.44 ± 0.47	.000	7.94 ± 1.54	2.91 ± 1.33	.000	.141
Overbite (mm)	5.01 ± 1.85	1.59 ± 1.06	.000	5.19 ± 1.97	2.13 ± 1.05	.000	.487
Posteroanterior measurements							
Internasal width	27.63 ± 2.41	27.68 ± 2.19	NS	26.85 ± 2.35	26.88 ± 2.21	NS	.514
Interfacial width	96.65 ± 9.01	97.61 ± 8.74	.000	94.35 ± 10.71	94.9 ± 11.27	NS	.348
Maxillary width	56.95 ± 3.93	57.37 ± 4.06	.000	58.18 ± 3.12	58.26 ± 2.89	NS	.068
Mandibular width	80.06 ± 6.43	80.42 ± 6.69	NS	78.91 ± 3.52	79.15 ± 3.14	NS	.209
Dentoalveolar measurements							
Max. intercanine width	32.13 ± 3.08	33.82 ± 3.14	.000	33.07 ± 1.81	32.81 ± 1.92	.000	.496
Max. interpremolar width	34.73 ± 1.61	36.39 ± 2.05	.000	36.86 ± 2.76	36.92 ± 3.81	NS	.041
Max. intermolar width	44.97 ± 3.22	47.23 ± 3.18	.000	48.89 ± 2.83	48.83 ± 3.01	NS	.033
Max. alveolar width	55.79 ± 3.27	57.01 ± 4.11	.000	59.45 ± 3.02	60.13 ± 4.28	.000	.067
Max. arc length	38.21 ± 2.03	38.72 ± 2.74	NS	39.83 ± 2.27	39.75 ± 2.84	NS	.044
Mand. intercanine width	27.06 ± 1.37	27.64 ± 1.16	NS	24.83 ± 1.90	25.39 ± 1.76	.000	.902
Mand. interpremolar width	33.61 ± 2.26	34.2 ± 2.35	.000	29.77 ± 1.44	30.28 ± 1.87	.000	.247
Mand. intermolar width	41.62 ± 2.57	41.76 ± 2.99	NS	41.24 ± 2.22	41.32 ± 2.83	NS	.465
Mand. alveolar width	56.12 ± 1.98	56.24 ± 2.13	NS	55.94 ± 2.83	56.03 ± 2.96	.000	.819

P, results of paired t-test comparing the in-group changes; P', results of Student's t-test comparing the initial values of the groups; SD, standard deviation; NS, non-significant.

to achieve normal occlusion and facial profile improvement.[16] With the use of the twin-block appliance, developed by Clark and applied separately to the maxilla and mandible, it was observed that patients were able to perform functions such as eating and speaking more easily.[17] The most important advantages of this appliance are that the patient can wear the appliance even while eating, and in patients with transversal problems, it can bring the mandible forward at the same time.

Table 3. Statistical comparison of the mean changes between the groups with independent t-test

	Group 1 (Expansion)	Group 2 (Non-Expansion)	
	Mean ± SD	Mean ± SD	P
Cephalometric measurements			
SNA (°)	−1.31 ± 1.40	−0.81 ± 1.24	.072
SNB (°)	2.68 ± 0.78	2.55 ± 0.72	.828
ANB (°)	−3.99 ± 1.75	−3.36 ± 1.37	.622
Co-A (mm)	0.92 ± 2.16	0.81 ± 2.71	.064
Co-Gn (mm)	4.89 ± 1.81	4.75 ± 2.67	.169
Wits (mm)	−3.52 ± 1.02	−3.6 ± 1.92	.704
A –VRL (mm)	0.02 ± 2.77	0.47 ± 1.51	.016
B –VRL (mm)	3.24 ± 1.76	3.10 ± 1.93	.590
Pg –VRL (mm)	2.92 ± 1.83	2.59 ± 1.78	.433
U1 –VRL (mm)	2.19 ± 1.87	−0.71 ± 1.63	.029
L1 –VRL (mm)	1.33 ± 0.79	1.21 ± 1.03	.070
A – HRL (mm)	0.59 ± 1.18	0.62 ± 1.26	.682
B – HRL (mm)	3.75 ± 2.35	3.77 ± 2.19	.142
Pg – HRL (mm)	3.85 ± 1.23	3.91 ± 1.89	.094
U1 – HRL (mm)	−0.67 ± 1.13	0.75 ± 0.84	.025
L1 – HRL (mm)	0.51 ± 0.49	0.73 ± 0.54	.086
SN/PP (°)	0.12 ± 0.87	0.06 ± 1.16	.637
SN/GoGn (°)	2.19 ± 0.97	1.96 ± 1.27	.560
FMA (°)	0.98 ± 0.52	0.83 ± 0.48	.326
U1/PP (°)	2.37 ± 1.81	−1.13 ± 2.34	.019
IMPA (°)	3.48 ± 0.59	3.71 ± 0.63	.738
Overjet (mm)	−4.27 ± 0.53	−5.03 ± 1.01	.118
Overbite (mm)	−3.42 ± 1.54	−3.06 ± 1.61	.059
Posteroanterior measurements			
Internasal width	0.05 ± 0.41	0.03 ± 0.35	.707
Interfacial width	0.66 ± 0.32	0.55 ± 0.11	.498
Maxillary width	0.42 ± 1.12	0.08 ± 0.15	.070
Mandibular width	0.36 ± 0.31	0.24 ± 0.21	.543
Dentoalveoler measurements			
Max. intercanine width	1.69 ± 0.76	−0.26 ± 0.83	.036
Max. interpremolar width	1.66 ± 1.05	0.06 ± 0.82	.054
Max. intermolar width	2.26 ± 1.43	-0.06 ± 0.39	.018
Max. alveolar width	1.22 ± 1.30	0.68 ± 1.17	.136
Max. arc length	0.51 ± 0.37	−0.08 ± 0.43	.042
Mand. intercanine width	0.58 ± 0.95	0.56 ± 0.35	.871
Mand. interpremolar width	0.59 ± 0.74	0.51 ± 0.39	.876
Mand. intermolar width	0.14 ± 0.28	0.08 ± 0.40	.606
Mand. alveolar width	0.12 ± 0.41	0.09 ± 0.23	.754

Group 1, Twin-Block Group with expansion; Group 2, Twin-Block Group with non-expansion.
SD, standard deviation; P, results of independent *t*-test.

The T point, where the sella tursica intersects with the total anterior clinoid process, and the midpoint of the intersection of the anterior skull base of the large wings of the sphenoid bone (Wing point -W)were reported to be the most stable points that are not affected by growth and development.[18] In this study, HRL and VRL planes were used to differentiate the effects of orthodontic treatment from growth and development.

The effects of 2 types of twin-block appliances on maxilla were evaluated by analyzing SNA angle and Co-A, A-VRL, and A-HRL distance. In both groups, the SNA angle decreased; Co-A, A-VRL, and A-HRL increased with treatment. The decrease in SNA angle agrees with other studies.[19] The majority of researchers argue that twin-block appliances limit the sagittal development of the maxilla.[20] It is stated that the mandible is brought forward with functional appliances and forces are applied in the opposite direction to the maxilla, and the growth of the maxilla in the sagittal direction is limited. This effect on the maxilla was called the "headgear effect" by some researchers.[20] There are also studies that report that twin-block appliances have little or no effect on sagittal development of the maxilla.[5,21]

The position of the maxilla was evaluated with the A-VRL distance in the horizontal direction and the A-HRL distance in the vertical direction. In our study, the A-VRL distance was significantly increased in both groups. Cozza et al.[22] reported that the A-point moved forward by 0.97 mm in the group treated with the activator appliances, but that the development of the maxilla was inhibited because it was significantly lower than the 2.23 mm increase in the control group.[22] Our findings are consistent with those of Cozza et al.

In our study, similar increases were observed in mandibular effective length (Co-Gn) in both treatment groups. Mandibular effective length increased by 4.89 mm in the expansion group and by 4.75 mm in the non-expansion group. The increase observed in all mandibular skeletal measurements in both groups showed that both types of appliances increased mandibular development. Although an increase in the SNB angle was seen in both groups, it was not statistically significant. In studies conducted with twin-block appliances, it has been reported that the mandibular effective length increases by between 4.1 and 6.5 mm.[23] They reported that statistically significant increases in the SNB angle with functional treatment are evidence of stimulation of mandibular growth.[21] However, Cozza et al.[22] reported that the SNB angle is a weak determinant of the effects of functional orthopedic treatment in their systematic review that aimed to determine the changes caused by functional appliances on the mandible.[22]

Maxillo–mandibular relationships were evaluated by analyzing the ANB angle and Witts measurement. The decrease in the ANB angle is due to the combination of a decrease in SNA angle and an increase in SNB angle, in accordance with previous studies.[21,24] Wits measurements showed a statistically significant decrease in both groups. In our study, the rotational change of the maxilla relative to the cranial base was evaluated by SN/PP measurements. Although there was a slight increase in SN/PP measurements in both groups, there was no statistically significant difference between the groups. In both groups, the maxilla was slightly rotated clockwise. The rotational changes of the mandible relative to the cranial base were evaluated using the SN/GoGn and FMA angles. There was no statistically significant increase in the SN/GoGn and FMA angles in either group. In clinical studies with functional appliances, some investigators reported an increase of 0.30-1.80 in the mandibular plane angle (SN/GoGn),[17,20] while others did not find a change.[25,26]

In dentoalveolar measurements, it was found that the maxillary incisors were significantly retroclined in the non-expansion group; this effect has been reported in many studies with functional appliances.[15,23] Others reported that the labial arch in the twin-block appliances caused a headgear effect on the maxillary incisors and led to lingual inclination. Toth and McNamara[5] reported that this retusion and lingual bending seen in the maxillary incisors in the twin-block appliances was caused by the effect of lip muscles in contact with the maxillary teeth.[5] In the expansion group, the maxillary incisors were proclined due to the anterior part of the screw. When the effect of the appliances in both groups on the mandibular incisors was examined, it was found that there was statistically significant protrusion of mandibular incisors in both groups. When the groups were compared, it was found that the appliances caused a similar amount of protrusion of mandibular incisors. The amount of overjet in both groups decreased. In the expansion group, the overjet decreased by 4.27 mm and in the non-expansion group by 5.03 mm.

To our knowledge, the current study is the first to compare the transversal effects of twin-block appliances. Transversal measurements on posteroanterior radiographs did not reveal any significant difference in either appliance type. Therefore, it may be concluded that expansion with twin-block appliances has minimal skeletal effects and more dental effects. Measurements showed a clinically insignificant increase only between molar distances in the maxilla, but this increase was not significant when the groups were compared.

When the measurements taken from the study models were examined, increased intermolar and interpremolar distances and maxillary arch lengths were detected. Although the expansion screw of the twin-block appliance is in the upper part, an increase in the distance between the mandibular posterior teeth was observed (but remained minimal) due to the contacts in the mandible. Even though maxillary expansion increases the distance between the premolar and molar, the increase in the alveolar base may be meaningless, and the expansion may only be dental. In addition, the distance between the canines increased, but was found to be statistically insignificant. This may be due to the part of the labial arch in the canine region. The increase in arch length may be related to the protrusion of incisors in the mandible and the opening of the anterior part of the screw in the maxilla.

Cone-beam computed tomography (CBCT) has been developed for maxillofacial imaging and can provide accurate and reliable measurements in orthodontics. CBCT images have several advantages over conventional lateral cephalometric films that have been reported in previous studies. Our study provides an opportunity for clinicians to compare the findings obtained in CBCT studies. Therefore, the findings of this retrospective clinical study should be considered within the limits of the 2-dimensional radiographic design used for evaluation.

Another limitation of our study was the absence of a control group, which would have allowed us to differentiate between outcomes of clinical treatment and changes due to growth and development. However, since skeletal Class II malocclusions are often severe malocclusions in orthodontics that require early treatment, it is unethical to assign these patients to a control group and not provide them treatment.[26,27] Therefore, our study did not include a control group.

CONCLUSION

- Both types of twin-block appliances were effective treatments for skeletal Class II malocclusion. Overjet and overbite decreased significantly.
- There was no significant difference in terms of protrusion of lower incisors between the 2 types of twin-block appliances. In the expansion group, the maxillary incisors protruded significantly; in the non-expansion group, they were retruded.
- The skeletal effects of both twin-block appliances in the transverse direction were similar; dental expansion was achieved in the maxilla by adding screws to the twin-block appliances.

Ethics Committee Approval: The study was approved by the Clinical Research Ethics Committee, Suleyman Demirel University (Approval No: May 28, 2019/187).

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

Peer Review: Externally peer-reviewed.

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