Research Paper: Lateral cephalometric comparison of dental, skeletal, and soft tissue effects of Twin Block and Guilan Functional Appliance on Class II patients with mandibular deficiency

Davood Atrkar rowshan[1], Fatemeh Masoomi[1], Amirhossein Toghrolian[2], Forough Moghassem hamidi[3],

[1]Assisant professor, Department of orthodontics, School of dentistry, Guilan university of medical sciences, Rasht,Iran
[2]Postgraduate Student of Orthodontics, Student Research Committee, Guilan University of Medical Sciences, Guilan, Iran.
[3]Assistant professor, Department of Orthodontics, Qazvin University of Medical Sciences, Qazvin, Iran.

Use your device to scan and read the article online

Citation: Atrkar rowshan D, Masoomi F, Toghrolian A, Moghassem hamidi F. Lateral cephalometric comparison of dental, skeletal, and soft tissue effects of Twin Block and Guilan Functional Appliance on Class II patients with mandibular deficiency. Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2024; 13(1):7-20. http://dx.doi.org/10.32598/3dj.7.4.145

http://3dj.gums.ac.ir

Article info:
Received: 2024/01/13
Accepted: 2024/04/23

Keywords:
Malocclusion,
Angle Class II
Cephalometry
Micrognathism
Orthodontic Appliances

ABSTRACT

Introduction: Class II malocclusion is a common orthodontic discrepancy affecting one-third of the world's population. Thus, functional appliances that cause forward posturing of the mandible can induce mandibular growth, and are therefore a popular approach for treatment of Class II malocclusion during the growth spurt period.

This study aimed to compare the dental, skeletal, and soft tissue effects of the Twin Block (TB) and Guilan Functional Appliance (GFA) on Class II patients with mandibular deficiency.

Materials and Methods: This retrospective study compared 30 patients treated with TB and 30 patients treated with GFA. All patients had ANB > 5 degrees, SNB < 77 degrees, and overjet > 5 mm. Preoperative lateral cephalograms of patients were compared with their lateral cephalograms obtained after completion of phase II of treatment. Comparisons were made by paired t-test (alpha=0.05).

Results: In the GFA group, SNA significantly decreased from 84.66 to 82.16 degrees ($P<0.05$) while SNB experienced an insignificant reduction from 75.83 to 74.63 degrees, and ANB experienced a significant reduction from 6.26 to 4.86 degrees ($P=0.005$). In the TB group, SNA significantly decreased from 82.26 to 81.96 ($P<0.05$) while SNB increased from 75.43 to 76.69 degrees ($P=0.599$), and ANB decreased from 6.3 to 5.67 degrees ($P=0.049$). both the TB and GFA decreased the Wits. This reduction was greater in the GFA group; however, the difference between the two groups did not reach statistical significance($P=0.931$).

Conclusion: Despite different designs, both functional appliances were successful in treatment of patients with mandibular deficiency.

*** Corresponding Author:**
Forough moghassem hamidi
Address: Assistant professor, Department of Orthodontics, Qazvin University of Medical Sciences, Qazvin, Iran.
Tel: +98 - 9112440180
E-mail: foroughhamidi17@gmail.com

Journal of Dentomaxillofacial Radiology, Pathology and Surgery

Introduction

Class II malocclusion is a common orthodontic discrepancy affecting one-third of the world's population.(1,2) Considering the dental and skeletal characteristics of Class II malocclusion, skeletal mandibular retrusion is a common finding.(3) Thus, functional appliances that cause forward posturing of the mandible can induce mandibular growth, and are therefore a popular approach for treatment of Class II malocclusion during the growth spurt period.(4)

Several functional appliances have been proposed for treatment of Class II malocclusion. A recent systematic review reported that the Herbst appliance followed by the Twin Block (TB) had the highest efficacy for acceleration of mandibular growth.(5) The TB appliance developed by Clark (6) has almost similar design in all patients. Its maxillary acrylic appliance includes the Adams clasps on first molars and a labial bow, as well as an expansion screw at the midline, if required. The acrylic appliance of the mandible includes the Adams clasps on first premolars and an anterior ball clasp.

The positive skeletal effects of the TB appliance on Class II patients have been well documented. However, proclination of mandibular incisors that occurs during treatment with the TB functional appliance decreases the potential to benefit from the maximum skeletal effects of this appliance. Also, wire clasps may cause tissue injury and require repeated adjustments. Moreover, the wire elements on the labial surface of the teeth compromise esthetics.(7) Thus, attempts have been made to design a functional appliance without such shortcomings.

A new functional appliance was recently introduced by Dr. Davood Atrkar Roshan, known as the Guilan Functional Appliance (GFA).(8) It is a mono-block functional appliance fabricated with no wire or clasp. The maxillary and mandibular components of the appliance are connected with acrylic resin, using occlusal wax in an articulator (Figure 1).

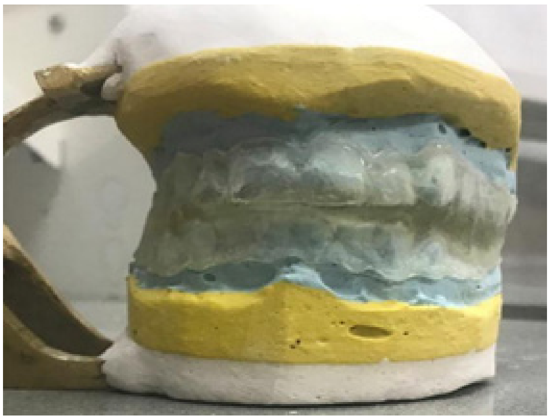

Figure 1. (Left) Frontal view of GFA; (Right) Lateral view of GFA showing Class I canine relationship after mandibular advancement

The GFA may be used to fix Class II malocclusion with or without asymmetry. The main advantages of the GFA include its simple design and the fact that it can also be used in the second phase of treatment along with the fixed appliance, to further stabilize the position of the mandible in the second phase of treatment, which cannot be performed with other functional appliances. Considering all the above, this study aimed to compare the dental, skeletal and soft tissue effects of the GFA with those of the TB on Class II patients with mandibular deficiency.

Atrkar rowshan D, Masoomi F, Toghrolian A, Moghassem hamidi F. Lateral cephalometric comparison of dental, skeletal, and soft tissue effects of Twin Block and Guilan Functional Appliance on Class II patients with mandibular deficiency. Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2024; 13(1):7-20. http://dx.doi.org/10.32598/3dj.

Materials and Method

This retrospective study was conducted on lateral cephalograms of patients treated in two orthodontic offices.

Sample size

The minimum sample size was calculated to be 30 patients in each group according to a study by Jena et al,(9) assuming alpha=0.05, study power of 80%, standard deviation of overjet to be 1.71 mm in the TB, and 2 mm in the Bionator group, and effect size (d) of 1.36.

Eligibility criteria

The inclusion criteria were (I) CS3-CS5 skeletal maturation stage, (II) a minimum of 5 mm of overjet, (III) ANB > 5 degrees, SNB < 77 degrees, (IV) end-to-end molar relationship, (V) minimal crowding (< 4 mm), (VI) normal vertical growth pattern, and (VII) no simultaneous use of any other appliance or adjunct treatment.

The exclusion criteria were (I) syndromic patients or those with cleft lip and/or palate, (II) history of orthodontic treatment, (III) asymmetry, (IV) severe crowding or severe proclination of anterior teeth, and (V) Class II malocclusion due to maxillary prognathism.

Intraoral photographs and lateral cephalograms of patients available in their dental records were used to ensure the eligibility criteria. accordingly, the sample consisted of 30 patients treated with TB that were selected from an orthodontic office, and 30 patients treated with GFA selected from another orthodontic office.

Data collection

Written informed consent was obtained from all patients to use their preoperative and postoperative dental records for research purposes.

For both groups, the construction bite was recorded with a maximum of 5 to 7 mm of forward posturing of the mandible until achieving edge-to-edge incisor relationship.

The patients in the TB group received a mono-block appliance after completion of treatment with the TB until termination of their growth spurt period.

Treatment of patients in both groups continued in the first treatment phase until correction of the sagittal relationship of the jaws and achieving superclass I canine relationship.

Both groups of patients were instructed to use the appliance full-time except when eating, and tooth brushing, and during contact sports. In both groups of patients, the second phase of treatment was continued for a minimum of one year with fixed orthodontic system (0.028 x 0.022-inch slot MBT brackets) as non-extraction orthodontic treatment after complete correction of the sagittal relationship of the jaws.

Lateral cephalograms of patients taken upon termination of functional treatment were not available. Thus, the preoperative lateral cephalograms of patients were compared with lateral cephalograms taken after completion of the second phase of treatment with the fixed appliance. All cephalograms had been taken in natural head position. Also, all cephalograms were standardized in terms of magnification for accurate comparison of linear measurements.

Measurements

Skeletal parameters

Linear and angular measurements were used to compare the effects of the two appliances (Figures 2 and 3). The lateral cephalograms were manually traced and analyzed using Ricketts (10), Steiner (11), and Downs (12) analyses.

The following angular measurements were made in the sagittal plane:

SNA (S point, Nasion, A point)

SNB (S point, Nasion, B point)

Wits

The following angular and linear measurements were made in the vertical plane:

SN to Go-Mn (Gonion to mandibular plane)

Y-axis (S point-Gnathion to SN)

Lower anterior facial height (LAFH)

Total anterior facial height (TAFH)

The Condylion to Gnathion (CO-GN) distance was measured for mandibular length.

Dental parameters:

The following dental parameters were also measured:

Upper 1 to SN (U1-SN)

Lower 1 to Go-Mn (IMPA)

Interincisal angle

Overjet

Moreover, the Pancherz method (13) was used for linear measurements, such that occlusal line (OL) and occlusal line perpendicular (OLP) drawn perpendicular to the occlusal line from sella (S) point were used for the measurements (Figure 4).

The distances between the following points were measured:

ANS-OLP, Pogonion (PG)-OLP, upper incisor (UI)-OLP, upper molar (UM)-OLP, lower incisor (LI)-OLP, and lower molar (LM)-OLP.

The distance (in millimeters) between the LI-OLP and UI-OLP was measured to assess the overjet, while the distance between the UM-OLP and LM-OLP was measured to analyze the molar relationship.

The PG-OLP was used to assess the position of the base of mandible; while ANS-OLP was used to assess the position of the base of maxilla.

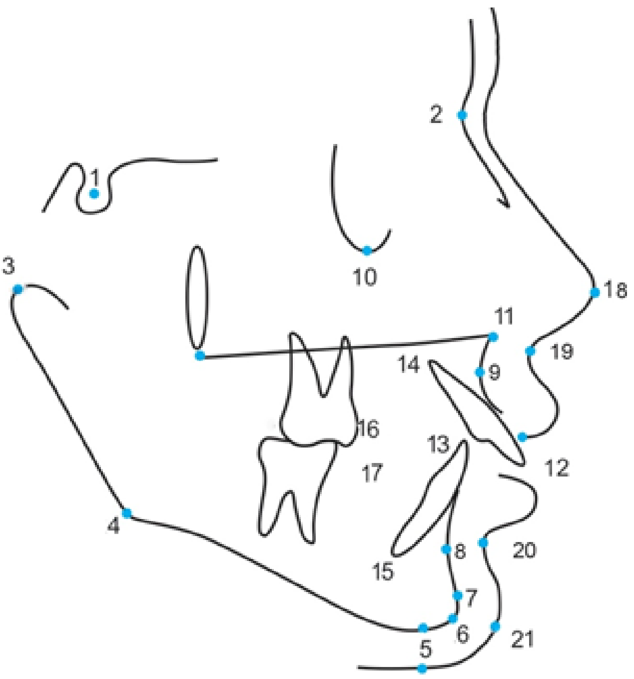

Figure 2: Landmarks used in cephalometric analysis; (1) sella turcica (S), (2) Nasion (N), (3) Condylion (COND), (4) Gonion (Go), (5) Menton (Mn), (6) Gnathion (Gn), (7) Pogonion (Pog), (8) Point B, (9) Point A, (10) Orbitale (Or), (11) Anterior nasal spine (ANS), (12) Upper incisal edge (UIE), (13) Lower incisal edge (LIE), (14) Upper incisal apex (UIA), (15) Lower incisal apex (LIA), (16) Upper molar mesial contact (UMC), (17) Lower molar mesial contact (LMC), (18) Nose tip (P), (19) Subnasale (Sn), (20) Labiomental (SI), (21) soft tissue pogonion (pog')

Atrkar rowshan D, Masoomi F, Toghrolian A, Moghassem hamidi F. Lateral cephalometric comparison of dental, skeletal, and soft tissue effects of Twin Block and Guilan Functional Appliance on Class II patients with mandibular deficiency. Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2024; 13(1):7-20. http://dx.doi.org/10.32598/3dj.

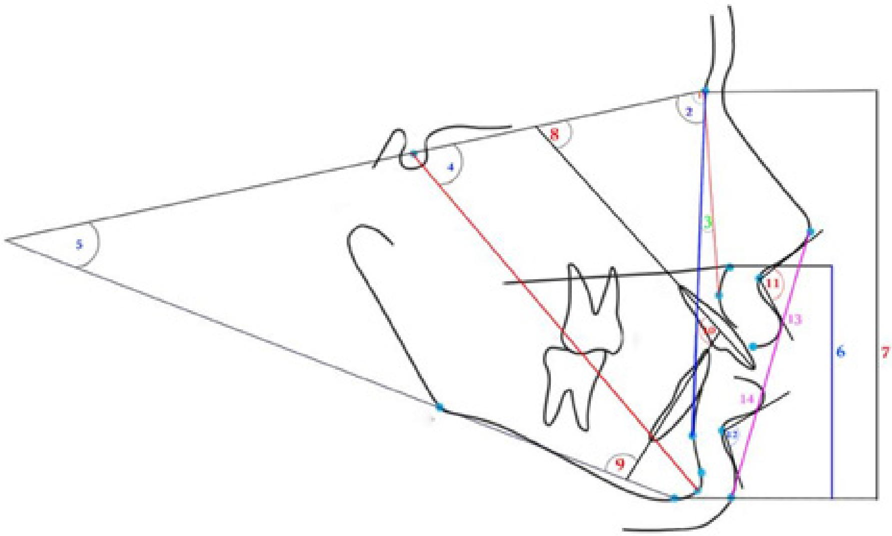

Figure 3: Linear and angular measurements; (1) SNA, (2) SNB, (3) ANB, (4) Y-axis, (5) SN to Go-Mn, (6) AFH, (7) TAFH, (8) U1-SN, (9) L1-SN, (10) interincisal angle, (11) nasolabial angle, (12) mentolabial angle, (13) U1-E line, (14) L1 to E line

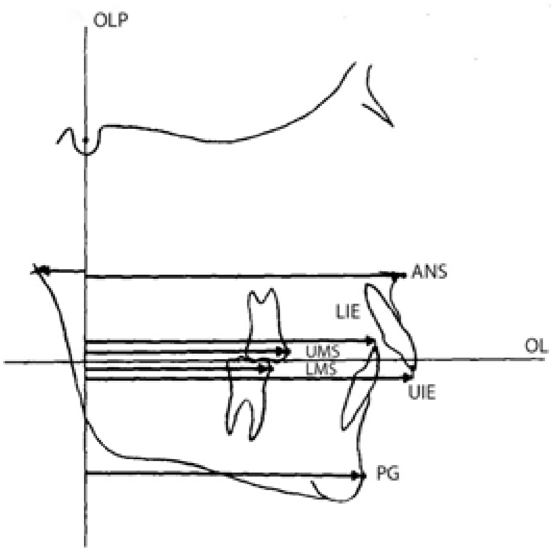

Figure 4: Measurements according to the Panchez method; OL is the line tangent to the distobuccal cusp of permanent maxillary first molar that passes through the midline of incisal overbite. OLP is the line perpendicular to OL that passes from the S point. Lower incisor (LI) is the incisal tip of the most prominent lower incisor. Upper incisor (UI) is the incisal tip of the most prominent upper incisor. Lower molar is the mesial contact point of permanent mandibular first molar determined by a line tangent and perpendicular to OL. Upper molar (UM) is the mesial contact point of mandibular permanent first molar tangent and perpendicular to the OL. Anterior nasal spine (ANS) is the most prominent point on the chin determined by a line tangent and perpendicular to OL. PG: Pogonion.

Soft tissue parameters

The following variables were measured for soft tissue analysis: Nasolabial angle, mentolabial angle, U1 to E-line, and L1 to E-line.

To minimize errors, both preoperative and postoperative lateral cephalograms were traced twice by the same examiner after a one-week interval to assess the intra-examiner agreement.

Statistical analysis

The intraclass correlation coefficient was calculated to assess the intra-examiner agreement in measurements. Normal distribution of data was analyzed by the Shapiro-Wilk test. The Levene's test was applied to analyze the homogeneity of variances. Independent t-test and paired t-test were applied for the comparison of quantitative variables since the assumptions were met. All statistical analyses were carried out using SPSS version 26 (SPSS Inc., IL, USA) at 0.05 level of significance.

Results

Thirty patients treated with the TB appliance including 13 boys and 17 girls with a mean age of 12 ± 0.6 years, and 30 patients treated with the GFA including 7 boys and 23 girls with a mean age of 13 ± 0.4 years were compared.

With respect to skeletal, dental and soft tissue parameters, t-test showed no significant difference between the GFA and TB groups at baseline (preoperatively); the difference in ANB (P=0.945), Wits (P=0.828), U1-SN (P=0.828), IMPA (P=0.198), overjet (P=0.340), and nasolabial angle (P=0.377) was not significant between the two groups.

Skeletal linear measurements

Table 1 compares the skeletal linear measurements between the two groups of TB and GFA.

ANS-OLP: Paired t-test showed a significant change in ANS-OLP in both the GFA (P=0.044) and TB (P=0.001) groups after the treatment compared with baseline. According to t-test, the difference between the two groups was not significant regarding the change in ANS-OLP (P=0.623).

A-OLP: Paired t-test showed no significant change in A-OLP in the FGA group after the treatment compared with baseline (P=0.05). However, the change in this parameter was significant in the TB group (P=0.001). According to t-test, the difference between the two groups was not significant regarding the change in A-OLP (P=0.298).

B-OLP: Paired t-test showed no significant change in B-OLP in the FGA group after the treatment compared with baseline (P=0.129). However, the change in this parameter was significant in the TB group (P=0.0001). According to t-test, the difference between the two groups was not significant regarding the change in B-OLP (P=0.122).

PG-OLP: Paired t-test showed a significant change in PG-OLP in both the GFA (P=0.007) and TB (P=0.0001) groups after the treatment compared with baseline. According to t-test, the difference between the two groups was not significant regarding the change in PG-OLP (P=0.610).

Wits: Paired t-test showed no significant change in the Wits appraisal neither in the GFA (P=0.252) nor in the TB (P=0.344) group after the treatment compared with baseline. According to t-test, the difference between the two groups was not significant regarding the change in the Wits appraisal (P=0.931).

Atrkar rowshan D, Masoomi F, Toghrolian A, Moghassem hamidi F. Lateral cephalometric comparison of dental, skeletal, and soft tissue effects of Twin Block and Guilan Functional Appliance on Class II patients with mandibular deficiency. Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2024; 13(1):7-20. http://dx.doi.org/10.32598/3dj.

Table 1: Comparison of skeletal linear measurements between the two groups of TB and GFA (n=30)

Variable	Group	Before treatment Mean± SD	After treatment Mean± SD	Within-group comparison	Btween-group comparison
ANS-OLP	GFA	69.56 ±10.69	73.53 ± 7.86	P=0.044	P=0.623
	TB	62.16 ± 11.46	66.56 ± 12.72	P=0.001	
A-OLP	GFA	65.60 ± 9.96	69.33 ± 7.95	P=0.05	P=0.298
	TB	60.10 ± 8.28	65.80 ± 8.74	P=0.001	
B-OLP	GFA	52.63 ± 8.29	56.73 ± 9.33	P=0.129	P=0.122
	TB	59.33 ± 8.29	66.60 ± 7.67	P=0.0001	
PG-OLP	GFA	65.56 ± 9.35	69.40 ± 9.14	P=0.007	P=0.610
	TB	60.40 ± 8.40	66.73 ± 9.18	P=0.0001	
Wits	GFA	3.03 ± 2.63	2.17 ± 1.87	P=0.252	P=0.931
	TB	2.91 ± 1.48	2.24 ± 0.78	P=0.344	

Skeletal angular measurements

Table 2 compares the skeletal angular measurements between the two groups of TB and GFA.

SNA: Paired t-test showed a significant change in SNA in the GFA group (P=0.02) but not in the TB group (P=0.599) after the treatment compared with baseline. According to t-test, the difference between the two groups was not significant regarding the change in SNA (P=0.063).

SNB: Paired t-test showed a significant change in SNB in the GFA group (P=0.02) but not in the TB group (P=0.599) after the treatment compared with baseline. According to t-test, a significant difference existed between the two groups regarding the change in SNB (P=0.014).

ANB: Paired t-test showed a significant change in the ANB in both the GFA (P=0.005) and TB (P=0.049) groups after the treatment compared with baseline. According to t-test, no significant difference existed between the two groups regarding the change in ANB (P=0.173).

Table 2: Comparison of skeletal angular measurements between the two groups of TB and GFA (n=30)

Variable	Group	Before treatment Mean± SD	After treatment Mean± SD	Within-group comparison	Btween-group comparison
SNA	GFA	84.66 ± 5.75	82.16 ± 3.79	P=0.02	P=0.063
	TB	82.26 ± 4.80	81.96 ± 4.88	P=0.599	
SNB	GFA	75.83 ± 4.69	74.63 ± 3.85	P=0.02	P=0.014
	TB	75.43 ± 3.6	76.69 ± 3.88	P=0.599	
ANB	GFA	6.26 ± 2.44	4.86 ± 1.87	P=0.005	P=0.173
	TB	6.30 ± 2.34	5.67 ± 1.77	P=0.049	

Skeletal horizontal measurements

Table 3 compares the skeletal vertical easurements between the two groups of TB and GFA.

TAFH: Paired t-test showed a significant change in the TAFH in both the GFA (P=0.0001) and TB (P=0.0001) groups after the treatment compared with baseline. According to t-test, no significant difference existed between the two groups regarding the change in TAFH (P=0.600).

LAFH: Paired t-test showed a significant change in the LAFH in both the GFA (P=0.042) and TB (P=0.036) groups after the treatment compared with baseline. According to t-test, no significant difference existed between the two groups regarding the change in the LAFH (P=0.309).

Co-GN: Paired t-test showed a significant change in the Co-GN in both the GFA (P=0.003) and TB (P=0.001) groups after the treatment compared with baseline.

According to t-test, no significant difference existed between the two groups regarding the change in the Co-GN (P=0.515).

Y-axis: Paired t-test showed no significant change in the Y-axis in either the GFA (P=0.054) or the TB (P=0.458) group after the treatment compared with baseline. According to t-test, a significant difference existed between the two groups regarding the change in the Y-axis (P=0.037).

SN-MNP: Paired t-test showed no significant change in the SN-MNP in either the GFA (P=0.636) or the TB (P=0.212) group after the treatment compared with baseline. According to t-test, no significant difference existed between the two groups regarding the change in the SN-MNP (P=0.633).

Table 3: Comparison of skeletal vertical measurements between the two groups of TB and GFA (n=30)

Variable	Group	Before treatment Mean± SD	After treatment Mean± SD	Within-group comparison	Btween-group comparison
HFAT(mm)	AFG	90.46 ± 5.50	95.03 ± 6.87	P=0.0001	P=0.601
	BT	85.06 ± 4.36	90.66 ± 4.94	P=0.0001	
mm(HFAL)	AFG	50.9 ± 4.82	55.30 ± 9.45	P=0.042	P=0.309
	BT	52.13 ± 6.55	56.0 ± 7.55	P=0.036	
nG-oC (mm)	AFG	95.16 ± 15.54	98.63 ±10.29	P=0.003	P=0.515
	BT	89.2 ± 8.61	92.43 ± 10.39	P=0.001	
sixa-Y (seerged)	AFG	64.0 ± 4.70	65.76 ± 4.81	P=0.054	P=0.037
	BT	66.76 ± 4.30	66.46 ± 4.91	P=0.458	
PNM-nS (seerged)	AFG	27.8 ± 6.74	28.20 ± 6.08	P=0.636	P=0.633
	BT	30.33 ± 5.34	31.26 ± 5.41	P=0.212	

Dental measurements

Table 4 compares the dental measurements between the two groups of TB and GFA.

U1-SN: Paired t-test showed no significant change in the U1-SN in either the GFA (P=0.321) or the TB (P=0.139) group after thetreatment compared with baseline. According to t-test, no significant difference existed between the two groups regarding the change in the U1-SN (P=0.088). IMPA: Paired t-test showed a significant change in the IMPA in the GFA group (P=0.002) but not in the TB group (P=0.978). According to t-test, a significant difference existed between the two groups regarding the change in the IMPA (P=0.007).

Interincisal angle: Paired t-test showed a significant change in the interincisal angle in

Atrkar rowshan D, Masoomi F, Toghrolian A, Moghassem hamidi F. Lateral cephalometric comparison of dental, skeletal, and soft tissue effects of Twin Block and Guilan Functional Appliance on Class II patients with mandibular deficiency. Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2024; 13(1):7-20. http://dx.doi.org/10.32598/3dj.

the GFA group (P=0.002) but not in the TB group (P=0.216). According to t-test, a significant difference existed between the two groups regarding the change in the interincisal angle (P=0.001).

U1-OLP: Paired t-test showed no significant change in the U1-OLP in either the GFA (P=0.071) or the TB (P=0.06) group after the treatment compared with baseline. According to t-test, no significant difference existed between the two groups regarding the change in the U1-OLP (P=0.838).

UM-OLP: Paired t-test showed a significant change in the UM-OLP in both the GFA (P=0.015) and the TB (P=0.017) groups after the treatment compared with baseline. According to t-test, no significant difference existed between the two groups regarding the change in the UM-OLP (P=0.953).

L1-OLp: Paired t-test showed a significant change in the L1-OLP in both the GFA (P=0.042) and the TB (P=0.0001) groups after the treatment compared with baseline. According to t-test, no significant difference existed between the two groups regarding the change in the L1-OLP (P=0.368).

LM-OLp: Paired t-test showed a significant change in the LM-OLp in both the GFA (P=0.0001) and the TB (P=0.0001) groups after the treatment compared with baseline. According to t-test, no significant difference existed between the two groups regarding the change in the L1-OLP (P=0.228).

Overjet: Paired t-test showed a significant change in the overjet in both the GFA (P=0.0001) and TB (P=0.0001) groups after the treatment compared with baseline. According to t-test, no significant difference existed between the two groups regarding the change in the overjet (P=0.251).

Table 4: Comparison of dental measurements between the two groups of TB and GFA (n=30)

Variable	Group	Before treatment Mean± SD	After treatment Mean± SD	Within-group comparison	Btween-group comparison
U1-SN (degrees)	GFA	107.66 ± 11.86	110.1 ± 7.07	P=0.321	P=0.088
	TB	108.26 ± 9.40	105.36 ± 7.11	P=0.139	
IMPA (degrees)	GFA	102.50 ± 11.30	108.43 ± 7.88	P=0.002	P=0.007
	TB	99.23 ± 7.84	99.26 ± 6.37	P=0.978	
Interincisal angle (degrees)	GFA	125.2 ± 14.14	115.2 ± 11.83	P=0.002	P=0.001
	TB	123.0 ± 12.29	125.76 ± 9.06	P=0.216	
U1-OLP (mm)	GFA	74.03 ± 15.49	79.93 ± 8.54	P=0.071	P=0.838
	TB	62.03 ± 7.93	67.2 ± 9.0	P=0.06	
UM-OLP (mm)	GFA	35.23 ± 7.20	39.2 ± 9.08	P=0.015	P=0.953
	TB	30.6 ± 8.59	34.7 ± 6.72	P=0.017	
L1-OLP (mm)	GFA	66.50 ± 11.83	70.03 ± 8.14	P=0.042	P=0.368
	TB	62.03 ± 8.03	68.33 ± 8.52	P=0.0001	
LM-OLP (mm)	GFA	35.70 ± 7.50	40.4 ± 6.16	P=0.0001	P=0.228
	TB	30.56 ± 5.55	35.56 ± 6.10	P=0.001	
Overjet (mm)	GFA	6.17 ± 2.51	2.91 ± 1.35	P=0.001	P=0.251
	TB	5.6±2.06	3.14± 0.72	P=0.001	

Soft tissue measurements

Table 5 compares the soft tissue measurements between the two groups of TB and GFA.

U1-E line: Paired t-test showed no significant change in the U1-E line in either the GFA (P=0.077) or the TB (P=0.058) group after the treatment compared with baseline. According to t-test, no significant difference existed between the two groups regarding the change in the U1-E line (P=0.344).

L1-E line: Paired t-test showed no significant change in the L1-E line in the GFA group (P=0.445). However, the change was significant in the TB group (P=0.034). According to t-test, a significant difference existed between the two groups regarding the change in the L1-E line (P=0.037).

Nasolabial angle: Paired t-test showed no significant change in the nasolabial angle in either the GFA (P=0.987) or the TB (P=0.467) group after the treatment compared with baseline. According to t-test, no significant difference existed between the two groups regarding the change in the nasolabial angle (P=0.607).

Mentolabial angle: Paired t-test showed no significant change in the mentolabial angle in the GFA group (P=0.149). However, the change was significant in the TB group (P=0.0001). According to t-test, no significant difference existed between the two groups regarding the change in the nasolabial angle (P=0.063).

Table 5: Comparison of soft tissue measurements between the two groups of TB and GFA (n=30)

Variable	Group	Before treatment Mean± SD	After treatment Mean± SD	Within-group comparison	Btween-group comparison
U1-E line (mm)	GFA	-3.05 ± 3.76	-4.50 ± 3.13	P=0.077	P=0.344
	TB	0.41 ± 2.51	-0.22 ± 3.07	P=0.058	
L1-E line (mm)	GFA	-3.09 ± 2.57	-2.73 ± 3.24	P=0.445	P=0.037
	TB	-0.22 ± 2.42	-1.25 ± 3.98	P=0.034	
Nasolabial angle (degrees)	GFA	108.0 ± 7.48	108.03 ± 12.93	P=0.987	P=0.607
	TB	106.9 ± 9.08	108.43 ± 10.44	P=0.467	
Mentolabial angle (degrees)	GFA	107.63 ± 20.39	111.80 ± 17.23	P=0.149	P=0.063
	TB	101.81 ± 7.42	110.1 ±13.57	P=0.0001	

Discussion

Class II malocclusion is characterized by a combination of dental, skeletal, and soft tissue changes (14). However, as reported by Franchi et al, (15) the majority of Class II patients have mandibular deficiency. Thus, functional appliances are an ideal treatment approach for growing patients. To achieve maximum efficacy, functional appliance therapy should be started at the time of growth spurt period (16). This study aimed to compare the dental, skeletal and soft tissue effects of the GFA with those of the TB on Class II patients with mandibular deficiency. Skeletal age of patients was determined according to the cervical vertebral maturation stage based on their preoperative lateral cephalogram. Also, the OL/OLP reference system (13) was used for skeletal analyses due to proximity to the mandible, and stability of this system and S point, which is the main reference point in this system, and is used for correct transfer of the OLP reference line from the preoperative to postoperative tracing. Also, by using the OL and OLP reference lines, the change in the occlusal plane steepness that occurs during the treatment

Atrkar rowshan D, Masoomi F, Toghrolian A, Moghassem hamidi F. Lateral cephalometric comparison of dental, skeletal, and soft tissue effects of Twin Block and Guilan Functional Appliance on Class II patients with mandibular deficiency. Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2024; 13(1):7-20. http://dx.doi.org/10.32598/3dj.

does not affect the reference system, and no bias would occur in the measurements. Moreover, in this system, all measurements are made relative to the OLP reference line. Thus, all changes in the sagittal occlusion can be related to skeletal/dental changes of the maxilla and mandible, and the correlation of these changes with the maxilla or mandible can be precisely analyzed. This analysis is only limited to the horizontal changes.

The skeletal effects of functional appliances on the maxilla have been variable in the literature. It has been reported that tension of the muscles and adjacent soft tissue of the face would lead to forward movement of the mandible, and exert a restricting effect on the maxilla, known as the head gear effect (15,17). Illing et al. (18) reported a slight reduction in the SNA angle following functional appliance therapy. Similarly, the SNA slightly decreased in both groups in the present study; this reduction was not statistically significant (compared with baseline) in the TB group while it was significant in the GFA group. The two groups had no significant difference in this regard. Some previous studies showed this inhibitory effect on the maxilla (19,20); however, some others reported no significant orthopedic effect on the maxilla by the TB appliance (9,21). In line with the present results, Khoja et al. (22) reported no significant change in the SNA (22). Also, A-OPL increased by 5.7 mm in the TB and by 4.73 mm in the GFA group, in the present study; this change was significant in the TB and insignificant in the GFA group, compared with baseline. This increase can be due to growth and development of patients during treatment, and the difference between the two groups was not significant in this regard.

In the present study, the mandibular length (Co-GN) significantly increased by 3.23 mm in the TB and by 3.47 mm in the GFA group. Consistent with the present results, Illing et al, (18) and Toth and McNamara (23) reported an increase in the mandibular length (Co-Gn), compared with the control group. Also, the present results were in agreement with those of Lund and Sandler (24) who reported 5.1 mm increase, and the findings of DeVincenzo (25) who reported 6 mm increase in the mandibular length. On the other hand, increased mandibular length manifests as an increase in the LAFH. In the present study, the TB group showed 3.87 mm, and the GFA group showed 4.4 mm increase in vertical height.

In the current study, a slight increase (1.26 degrees) in the SNB was noted in TB group; however, the GFA group showed a slight reduction in the SNB, which was significant. A previous study claimed that functional appliances cause forward movement of the point B and pogonion, and resultantly increase the SNB angle (25). Similarly, Baysal and Uysal (26) reported a significant increase in the SNB angle following treatment with the TB. Moreover, Khoja et al. (22) reported a significant increase in the SNB by 1.56 degrees and mandibular length by 3.27 mm over a 12-month treatment course. Cozza et al, (5) in their systematic review evaluated the effects of functional appliances on the mandibular length in Class II patients, and showed that the results related to changes in mandibular position relative to the cranial base (SNB) were not clinically significant in any study. since we did not have access to the cephalograms of patients taken at the end of the first phase of treatment, the exact effect of the GFA on the SNB remains a matter of question.

Previous studies reported a reduction in the SNA and an increase in the SNB or a combination of both following treatment with the TB, which resulted in a reduction in the ANB. Toth and McNamara (23) reported 1.8 degrees reduction in the ANB in patients treated with the TB. Also, Illing et al. (18) reported a significant reduction in the ANB. In line with the aforementioned studies, the present results showed a reduction in the ANB by 1.4 and 0.63 degrees in the GFA and TB groups, respectively; this reduction was mainly due to the increase in the SNB in the TB group, and reduction of the SNA in the GFA group.

In the present study, both the TB and GFA improved Class II division 1 malocclusion such that both appliances decreased the ANB and Wits. This reduction was greater in the GFA group; however, the difference between the two groups did not reach statistical significance. Optimal forward growth of the mandible was seen in both groups. The overall mandibular length according to Co-Gn increased in both groups; this increase was greater in the TB group; however, the difference did not reach statistical significance.

With respect to dental effects, the GFA increased both the U1-SN and IMPA; however, the TB decreased the U1-SN and did not change the IMPA. In the TB group, the U1-SN decreased by approximately 3 degrees, which was in line with previous studies; however, this angle slightly (approximately 3 degrees) increased, which was not statistically significant. The two groups had no significant difference in this respect. Illing et al.(18) reported a significant reduction in the U1-SN in the TB group, compared with Bass and Bionator groups. This effect was increased in use of labial bow. Moreover, O'Brien et al. (27) observed retraction of upper incisors, which significantly decreased the overjet. Khoja et al, (22) observed retroclination of maxillary incisors following treatment with the TB, which was in contrast to the findings of de Araújo Brito et al (13). De Araújo Brito et al. (13) showed that the Herbst appliance caused greater protrusion of maxillary incisors compared with the control group, which was similar to the results in the GFA group in the present study. Different effects on upper incisors in the two groups in the present study can also be due to different designs of the two appliances, and presence of a labial bow in the TB appliance, as well as the effects of the fixed treatment phase. Moreover, the techniques used in the second phase might have affected the results of functional therapy. Since two different orthodontists performed the treatments in the two groups, and the results of phase I therapy were not available, the effects of the two functional appliances on dental parameters could not be precisely compared.

Literature is controversial regarding the effects of the TB appliance on mandibular incisors. Lund and Sandler (24) and Khoja et al. (22) reported a significant increase in lower incisor angle, which was in agreement with the present results in the GFA group (which was significant). On the other hand, the present results showed no significant change in the IMPA in the TB group, which was in line with the results of Illing et al (18). This difference may be related to the effect of second phase of treatment, and the treatment techniques adopted by the two orthodontists.

Both appliances decreased the overjet in the present study; this reduction was insignificantly greater in the GFA group. It appears that retrusion of upper incisors in the TB group and proclination of lower incisors in the GFA group partly played a role in correction of overjet.

With respect to soft tissue changes, the effects of TB appliance on the soft tissue are conflicting in the literature. In the present study, the UL-E line slightly decreased in both groups, which was not significant. This finding was in line with the results of Morris et al, (28) who reported no significant change in sagittal position of the upper lip despite severe reduction in overjet. However, Quintão et al, (29) and Khoja et al. (22) witnessed no significant change in position of the upper lip due to maxillary incisor retrusion during treatment with the TB appliance.

In the present study, the lower lip position (LL-E line) in the TB group was approximately 1 degree posterior to that at baseline, which was significant. However, it had a more forward position compared with baseline in the GFA group, which was in accordance with the change in the IMPA, and this change was not significant. This finding was in agreement with the results of Baysal and Uysal (26) and Khoja et al, (22) who showed more forward position of the lower lip, lower lip sulcus, and soft tissue pogonion in the TB group. Nonetheless, Quintão et al. (29) reported no significant change in any lower lip variable.

The nasolabial angle in the GFA group showed no change at the end of treatment;

however, this angle slightly decreased in the TB group in the present study. Also, the mentolabial angle increased in both groups, but this increase was greater in the TB group.

This study had some limitations. The most important limitation was unavailability of the lateral cephalograms of patients taken at the end of functional treatment phase, which prevented precise comparison of the two functional appliances without the confounding effect of the fixed treatment phase. Considering no tooth extraction, crowding < 4 mm, and its correction with fixed orthodontic treatment after achieving Class I canine relationship, changes in dental angulations are highly unlikely to occur. Nonetheless, the results of dental analyses should be interpreted with caution.

Absence of a control group was another limitation, which made it impossible to precisely analyze the change in parameters. Considering the novelty of the GFA, further studies are required to assess the effects of this appliance with other functional appliances at the end of the first phase of treatment.

Conclusion

The present results showed that both appliances improved facial esthetics in patients by a combination of skeletal and dental changes. Treatment with both appliances reduced Wits, ANB and overjet in patients. As a result, GFA can be useful in improving class II skeletal relationships.

Acknowledgement

None

Authors'contributions

Davood Atrkarrowshan: Conceptualization, Methodology, Writing - Review & Editing **fatemeh masoomi**: Resources, Investigation, Visualization **Amirhossein Toghrolian:** Data curation, Writing - Original Draft **Forough moghassem hamidi:** Project administration, Supervision, Funding acquisition

Conflict of Interests

The study protocol was approved by the ethics committee of Guilan University of Medical Sciences

Ethical declarations

(IR.GUMS.REC.1400.421)

Financial support

None

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

1. McLain JB, Proffit WR. Oral health status in the United States: prevalence of malocclusion. J Dent Ed. 1985; 49:386-96.https://doi.org/10.1002/j.0022-0337.1985.49.6.tb01898.x
2. Proffit WR, Fields HW, Moray LJ. Prevalence of malocclusion and orthodontic treatment need in the United States: estimates form the N-HANES III survey. Int J Adult Orthod Orthognath Surg. 1998; 13:97-106.
3. McNamara JA. Components of Class II malocclusion in children 8-10 years of age. Angle Orthod .1981; 51:177-202.
4. Yitschaky O, Redlich M, Abed Y, Faerman M, Casap N, Hiller N. Comparison of common hard tissue cephalometric measurements between computed tomography 3D reconstruction and conventional 2D cephalometric images. Angle Orthod .2011; 81:11-6.https://doi.org/10.2319/031710-157.1
5. Cozza P, Baccetti T, Franchi L, De Toffol L, McNamara Jr JA. Mandibular changes produced by functional appliances in Class II malocclusion: a systematic review. Am J Orthod Dentofac Orthop. 2006;129(5):599-e1.https://doi.org/10.1016/j.ajodo.2005.11.010
6. Clark WJ. The Twin Block technique, A functional orthopedic appliance system. Am J Orthod Dentofac Orthop. 1988; 93:1-18. https://doi.org/10.1016/0889-5406(88)90188-6
7. Behroozian A, Kalman L. Clear Twin Block: A Step Forward in Functional Appliances. Dental Hypotheses. 2020 Jul 1;11(3):91https://doi.org/10.4103/denthyp.denthyp_14_20
8. Atrkar Rowshan D, Moghassem Hamidi F, Masoomi F, Gholizade H. Introduction of a New Functional Appliance Called Guilan Functional Appliance(GFA). Journal of Dentomaxillofacial Radiology, Pathology and Surgery. 2023; 12(1):27-38.
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.https://doi.org/10.1016/j.ajodo.2005.02.025

10. Ricketts RM. Perspectives in the clinical application of cephalometrics: the first fifty years. Angle Orthod. 1981 Apr; 51(2):115-50.

11. Steiner CC. Cephalometrics for you and me. American journal of orthodontics. 1953 Oct 1; 39(10):729-55.https://doi.org/10.1016/0002-9416(53)90082-7

12. 3. Downs WB. The role of cephalometry in orthodontic case analysis and diagnosis. Am J Orthod. 1952; 38:162-182.https://doi.org/10.1016/0002-9416(52)90106-1

13. de Araújo Brito DB, Henriques JF, Fiedler CF, Janson G. Effects of Class II division 1 malocclusion treatment with three types of fixed functional appliances. Dental press journal of orthodontics. 2019; 24(5):30-9.https://doi.org/10.1590/2177-6709.24.5.030-039.oar

14. Ajami S, Morovvat A, Khademi B, Jafarpour D, Babanouri N. Dentoskeletal effects of class II malocclusion treatment with the modified Twin Block appliance. Journal of Clinical and Experimental Dentistry. 2019 Dec 1;11(12):e1093-8.https://doi.org/10.4317/jced.56241

15. Franchi L, Pavoni C, Faltin Jr K, McNamara Jr JA, Cozza P. Long-term skeletal and dental effects and treatment timing for functional appliances in Class II malocclusion. Angle Orthod. 2012;83:334-40https://doi.org/10.2319/052912-450.1

16. Ghaffar F, Jan A, Akhtar O, Mughal AT, Shahid R, Shafique HZ, Bibi K, et al.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; 16(03):680-7.https://doi.org/10.1055/s-0041-1739543

17. Proffit WR, Fields Jr HW, Sarver DM. Contemporary orthodontics .6th edition: Elsevier Health Sciences; Amsterdam, 2019. p.457.

18. Illing HM, Morris DO, Lee RT. A prospective evaluation of Bass, Bionator and Twin Block appliances. Part I--The hard tissues. Eur J Orthod. 1998;20(5):501-16.https://doi.org/10.1093/ejo/20.5.501

19. Heinig N, Göz G. Clinical application and effects of the Forsus spring. A study of a new Herbst hybrid. J Orofac Orthop. 2001 Nov;62(6):436-50https://doi.org/10.1007/s00056-001-0053-6

20. Jones G, Buschang PH, Kim KB, Oliver DR. Class II non-extraction patients treated with the Forsus Fatigue Resistant Device versus intermaxillary elastics. Angle Orthod. 2008; 78(2):332-8.https://doi.org/10.2319/030607-115.1

21. Gilmore WA. Morphology of the adult mandible in Class II, Division 1 malocclusion and in excellent occlusion. Angle Orthod. 1950 20(3):137-46.

22. Khoja A, Fida M, Shaikh A. Cephalometric evaluation of the effects of the Twin Block appliance in subjects with Class II, Division 1 malocclusion amongst different cervical vertebral maturation stages. Dental Press J Orthod. 2016;21(3):73-84.https://doi.org/10.1590/2177-6709.21.3.073-084.oar

23. Toth LR, McNamara Jr JA. Treatment effects produced by the Twin-Block appliance and the FR-2 appliance of Fränkel compared with an untreated Class II sample. Am J Orthod Dentofacial Orthop. 1999; 116:597-609.https://doi.org/10.1016/S0889-5406(99)70193-9

24. Lund DI, Sandler PJ. The effects of Twin Blocks: a prospective controlled study. Am J Orthod Dentofacial Orthop. 1998; 113(1):104-10. https://doi.org/10.1016/S0889-5406(98)70282-3

25. DeVincenzo JP. Changes in mandibular length before, during, and after successful orthopedic correction of Class II malocclusions, using a functional appliance. Am J Orthod Dentofacial Orthop. 1991; 99(3):241-57.https://doi.org/10.1016/0889-5406(91)70006-I

26. - Baysal A, Uysal T. Soft tissue effects of Twin Block and Herbst appliances in patients with Class II division 1 mandibular retrognathy. Eur J Orthod.2011;35:71-81.https://doi.org/10.1093/ejo/cjq187

27. O'Brien K, Wright J, Conboy F, Sanjie Y, Mandall N, and Chadwick S, et al. Effectiveness of early orthodontic treatment with the Twin-Block appliance: a multicenter, randomized, controlled trial. Part 1: dental and skeletal effects. Am J Orthod Dentofacial Orthop. 2003; 124:234-43.https://doi.org/10.1016/S0889-5406(03)00352-4

28. Morris DO, Illing HM, Lee RT. A prospective evaluation of Bass, Bionator and Twin Block appliances. Eur J Orthod. 1998; 20(6):663-84.https://doi.org/10.1093/ejo/20.6.663

29. Quintão C, Helena I, Brunharo VP, Menezes RC, Almeida MA. Soft tissue facial profile changes following functional appliance therapy. Eur J Orthod. 2006 Feb;28(1):35-41.https://doi.org/10.1093/ejo/cji067