Original Article

Mechanism of Class II correction in prepubertal and postpubertal patients with Twin Force Bite Corrector

Aditya Chhibber[a]; Madhur Upadhyay[b]; Flavio Uribe[c]; Ravindra Nanda[d]

ABSTRACT

Objective: To compare the dentoskeletal effects and treatment efficiency of the Twin Force Bite Corrector (TFBC) appliance in Class II correction of patients treated before or after the pubertal growth spurt.

Materials and Methods: Forty-one normodivergent Class II patients treated with the TFBC appliance were divided into two groups based on their cervical vertebral maturation stage (CVMS). Group 1 (G1) consisted of 23 patients (mean age 12.44 ± 1.59 years) where treatment was initiated before the pubertal growth spurt (CVMS I and II), while group 2 (G2) consisted of 18 patients (mean age 13.76 ± 1.44 years) where treatment was started after the pubertal growth spurt (CVMS III to V). Dentoskeletal measurements were made on lateral cephalograms taken before (T1) and after orthodontic treatment (T2).

Results: During treatment, G1 had significantly greater skeletal correction than G2, with more dentoalveolar effects being observed in G2 than G1. However, on comparing both groups at the end of treatment (T2) when growth is complete, no differences in the parameters measured were observed. Overall, treatment time was significantly longer for G1 (3.67 ± 1.45 years) compared to G2 (2.75 ± 1.07 years).

Conclusions: There is no difference in overall dentoskeletal effects obtained at the end of treatment by the TFBC appliance in normodivergent prepubertal vs postpubertal patients. However, treatment efficiency based on treatment timing is significantly greater for the postpubertal group. (*Angle Orthod.* 2013;83:718–727.)

KEY WORDS: Class II; Prepubertal; Postpubertal; Twin Force; Fixed functional appliance

INTRODUCTION

Class II malocclusion is one of the most common problems in an orthodontic practice.[1] Previous reports[2,3] suggest mandibular skeletal retrusion is its most common characteristic. Moreover, it has been reported that the Class II disharmony does not tend to self-correct with growth and therefore intervention to correct the underlying skeletal discrepancy is necessary.[4] Functional appliances are often the preferred modality of treatment in patients with growth potential. These include a variety of removable or fixed appliances designed to alter the mandibular position sagittally and vertically, resulting in orthodontic and/or orthopedic changes.[5] Of all appliances, fixed functional appliances (FFAs) are gaining popularity because compliance may be better than removable appliances.[6] Class II correction with a FFA is a combination of skeletal and dentoalveolar changes,[7,8] which include restraining maxillary growth, dubbed as the "headgear effect,"[8] retroclination of maxillary[9] and proclination of mandibular incisors,[9–11] distalization of upper and

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Figure 1. Clinical set up with the TFBC appliance.

mesial movement of lower molars,[10,11] along with clockwise rotation of the occlusal plane.[9]

Historically, FFAs are advocated towards the end of the pubertal growth spurt.[7,9] Ruf and Pancherz[7] evaluated the Herbst appliance in early and young adolescent patients and found it most effective for young adults. Ruf and Pancherz[12] evaluated the outcome of the Herbst appliance in prepubertal, peak and post peak pubertal patients based on peak height velocity and found that the Herbst appliance is most suitable for patients in their peak height velocity stage of growth. In contrast to the Herbst appliance, which is a rigid appliance, treatment outcomes produced by semi-rigid FFA might be different. Frye et al.[13] evaluated the treatment outcomes in prepubertal and postpubertal groups and concluded that skeletal contributions to sagittal corrections decline with increasing patient age, while dental effects increase. However, they had a mixed sample of Herbst and functional mandibular advancer appliances, and sample distribution was based on chronologic age rather than skeletal maturational methods.[14] Chronologic age, however, may not be an accurate way to assess maturational status of an individual.[14,15]

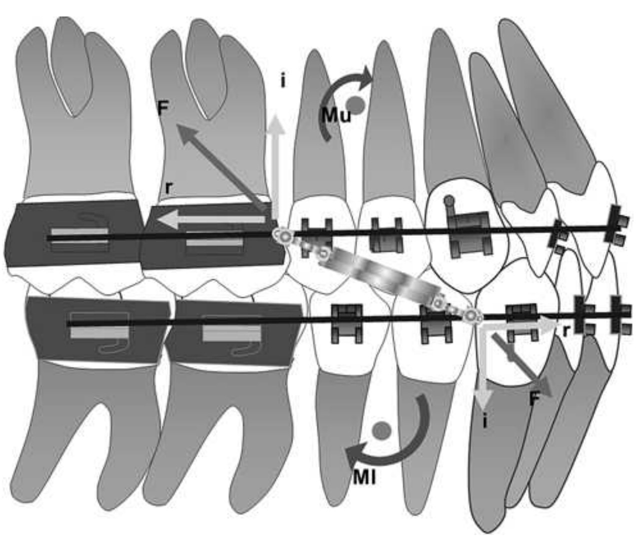

Figure 2. The force system involved with the TFBC appliance. F indicates total force; i, vertical (intrusive) component; r, horizontal component; Mu, moment created on the upper arch; and Ml, moment created on the lower arch.

Therefore, further research is required to evaluate the differences in dentoskeletal effects with the Twin Force Bite Corrector (TFBC) appliance, a semi-rigid FFA appliance, in prepubertal and postpubertal patients to assess the best possible time for Class II correction with such appliances—ie, should these patients be treated early or late? Are there any differences in the final outcome? There appears to be a complete lack of information about this in the orthodontic literature. The intent of this study was to evaluate the treatment efficiency and dentoskeletal effects of the TFBC appliance in prepubertal and postpubertal Class II patients in a one-phase comprehensive orthodontic treatment. The null hypothesis was that there is no difference in the dentoskeletal effects with the TFBC appliance between prepubertal and postpubertal Class II patients.

MATERIALS AND METHODS

The study design was retrospective and involved a systematic analysis of all Class II patients treated with the TFBC appliance[16,17] from 2002 to 2008 acquired from the Division of Orthodontics at the University of Connecticut, Health Center. TFBC is a semi-rigid push type FFA clamped on upper and lower archwires mesial to the upper molars and distal to the lower

Table 1. Results of Analysis of Agreement Between Examiner 1 and 2

Analysis	Quadratic Weighted Kappa	Degree of Agreement
E1 × E2	0.808 ± 0.122	Almost perfect agreement

Kappa Coefficient Interpretation

<0.0	Poor agreement
0.0–0.20	Slight agreement
0.21–0.40	Fair agreement
0.41–0.60	Moderate agreement
0.61–0.80	Substantial agreement
0.81–1.00	Almost perfect agreement

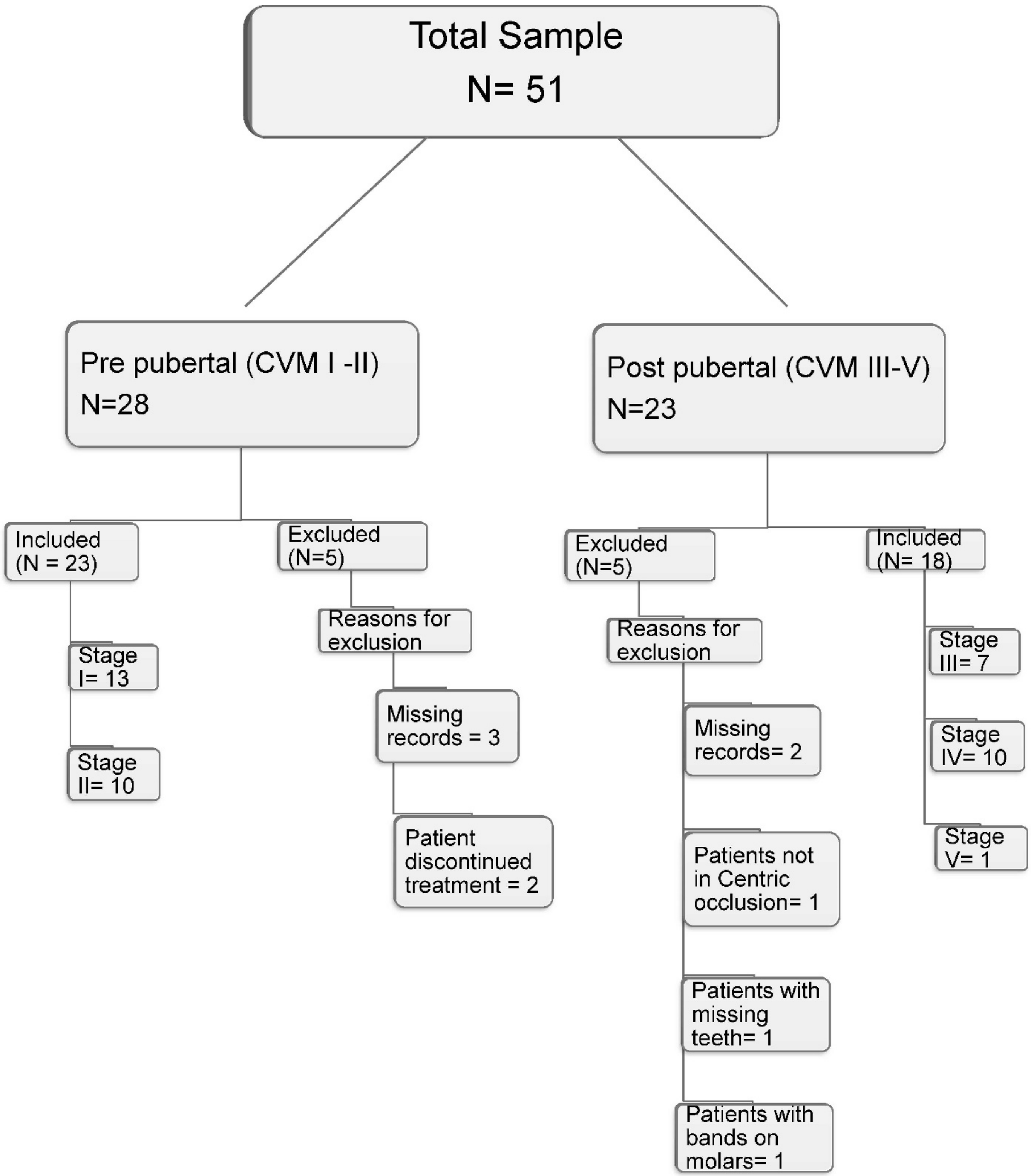

Figure 3. Sample distribution.

canines (Figure 1). The theoretical prediction of the forces and moments produced by the TFBC appliance is shown in Figure 2. Approval from the Institutional Review Board of the University of Connecticut Health center was obtained (IRB HSRDF 1-23-2012).

Subjects fulfilling the following requirements were selected: (1) Class II molar relation, defined as having at least an "end on" molar relation with no subdivision malocclusion, (2) ANB angle $\geq$ 3.5°, (3) SN-GoGn $\leq$ 36°, (4) Overjet $\geq$ 3.5 mm, and (5) up to 3–4 mm

Table 2. Demographics of Study Sample

Variable	Prepubertal Group (G1) n = 23		Postpubertal Group (G2) n = 18			*P* Value
Pretreatment age, y	12.44 ± 1.59		13.76 ± 1.44			.008*
CVMS[a]	I	II	II	IV	V	
Sex, n						
Male	9	8	3	3		
Female	4	2	4	7	1	
Total	13	10	7	10	1	
Treatment time, y	3.67 ± 1.45		2.75 ± 1.07			.028*

[a] CVMS indicates cervical vertebral maturation stage.
* $P < .05$.

crowding or spacing. The initial data pool consisted of 51 consecutively treated Class II patients who were divided into two groups of prepubertal and postpubertal samples based on the modified cervical vertebral maturation stage (CVMS) by Bacetti et al.[18] This method was chosen because appearance of concavity at the lower border of C4 (which occurs at onset of stage III, ie, past the pubertal growth spurt) is easily identifiable. The assessment was carried out by two experienced investigators familiar with CVMS. Analyses using the quadratic weighted kappa test were performed to assess interexaminer agreement using MedCalc for Windows, version 11.5.1.0 (MedCalc Software, Mariakerke, Belgium) (Table 1). There was almost perfect agreement between the two examiners using the quadratic weighted kappa test.

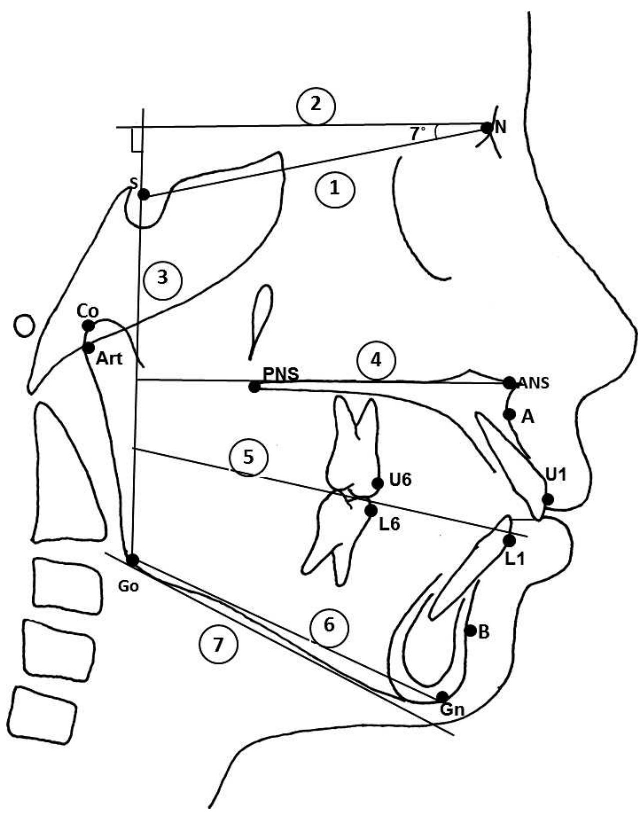

Figure 4. Cephalometric landmarks and planes: 1, S–N plane; 2, sella horizontal (Sh or constructed FH plane or x axis); 3, sella vertical (Sv or y axis); 4, palatal plane (ANS-PNS); 5, occlusal plane (OP); 6, mandibular plane (Go-Gn); 7, tangent to lower border of the mandible.

Five patients in each group were rejected due to reasons mentioned in Figure 3. The final study sample had 41 patients. Patients in CVMS I (N = 13) and II (N = 10) were classified in the prepubertal group (G1), while those in CVMS III (N = 7), IV (N=10), and V (N = 1) were in the postpubertal group (G2) (Table 2). G1 (N = 23) comprised six female and 17 male patients (mean age 12.44 ± 1.59 years), while G2 (N = 18) had 12 female and six male patients (mean age 13.76 ± 1.44 years) (Table 2).

In both groups the MBT prescription preadjusted edgewise appliance was used. The TFBC appliance was placed on 0.019 × 0.025-inch stainless steel archwire in the upper arch and 0.021 × 0.025-inch stainless steel archwire in the lower arch. Both wires were cinched to consolidate the arches as a single unit. Three patients reported appliance breakage, which was immediately replaced so that there was no discontinuation in treatment. The appliance duration was similar in both groups with the time duration being 3.67 ± 0.21 and 3.53 ± 0.27 months for G1 and G2, respectively. In all patients, an overcorrection of the overjet was attained to allow for mild relapse after discontinuation of the FFA. Class II elastics were used to maintain the corrections, and finishing was performed as per individual patient requirements.

Cephalometric radiographs taken at two time points—T1, pretreatment, and T2, end of orthodontic treatment—were analyzed. All lateral cephalograms were taken with the same cephalostat (PM 2002 EC Proline; Planmeca, Helsinki, Finland). The Frankfort horizontal plane was constructed by adding 7° from the sella-nasion line at nasion. This was the x-axis, and a line perpendicular to it through sella was the y-axis. The horizontal and vertical positional changes of certain landmarks were measured in relation to this

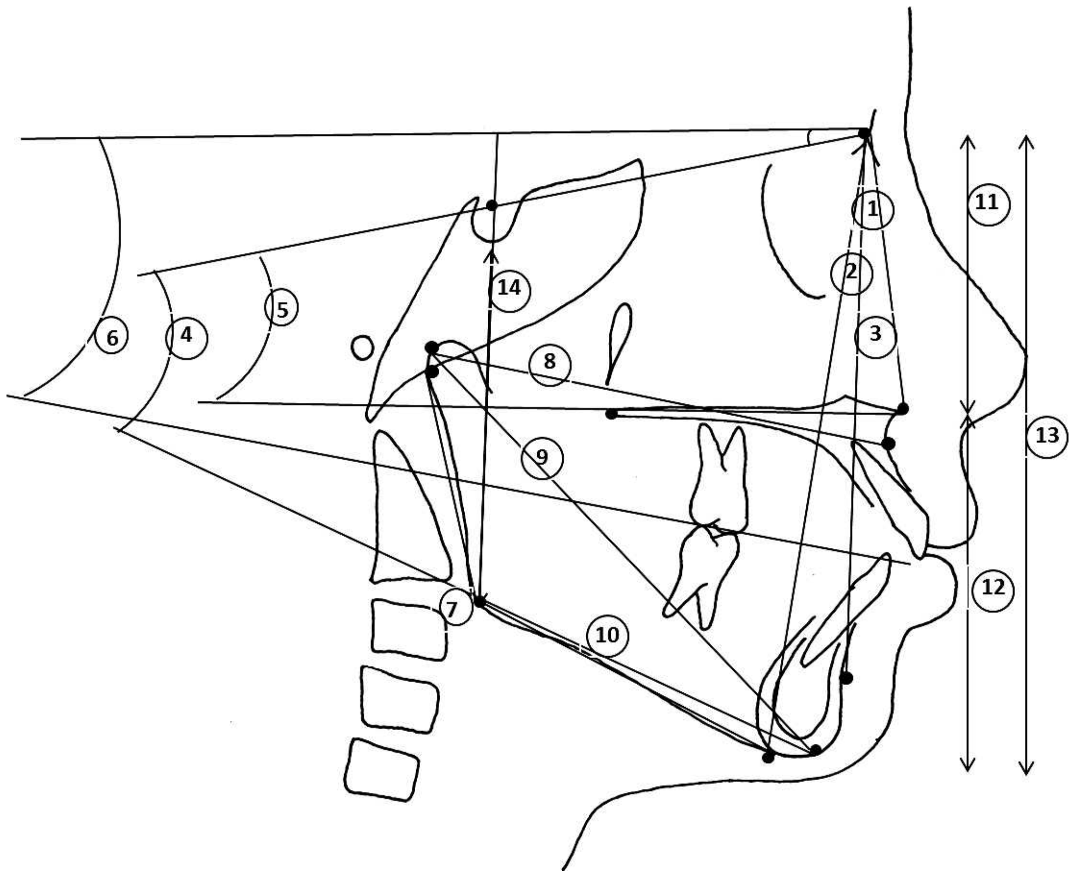

Figure 5. Skeletal parameters. (A) Angular measurements (in degrees): 1, SNA; 2, SNB; 3, ANB; 4, SN Go-Gn; 5, PP-SN; 6, OP-Sh; 7, ArGoMe. (B) Linear measurements (in mm): 8, Co-A; 9, Co-Gn; 10, Go-Gn; 11, UFH; 12, LFH; 13, AFH; 14, PFH.

"x–y" Cartesian coordinate system. Angular and linear measurements were recorded to the nearest 0.5° or 0.5 mm. Research assistants, who were blinded to the treatment groups, entered all data into computer databases. Landmarks, cephalometric planes, and linear and angular parameters used in this study are shown in Figures 4 through 6.

For regional superimpositions, the maxilla was superimposed along the palatal cortex by registering on the bony internal details and the superior and inferior surfaces of the hard palate. The mandible was superimposed posteriorly on the outline of the mandibular canal and anteriorly on the anterior contour of the chin and internal bony structures of the symphysis.

Statistics

For a power of 85% and an alpha level of .05, a sample size of 15 patients in each group was considered suitable. All statistical analyses were performed with the SPSS software package (version 17.0, SPSS Inc, Chicago, Ill). Data were examined to ensure that the assumptions for normality of distribution and homogeneity of variance for planned parametric statistical tests were satisfied. The mean and standard deviation for each cephalometric variable were determined. We used parametric statistical tests: two-tailed paired *t*-tests to determine the significance of changes in the groups after the corresponding treatment. A confidence level less than 5% ($P < .05$) was considered statistically significant.

Method error was calculated using Dahlberg formula, $Se^2 = \Sigma d^2/2n$, where d is the difference between duplicate measurements, and n is the number of double measurements. Ten patients from G1 and G2 were randomly selected 4 weeks after the initial tracing. Pretreatment and posttreatment radiographs were retraced by the same investigator (A.C.). No significant differences ($P > .05$) were found between any of the measured variables (Table 3).

RESULTS

Treatment changes for each measurement were calculated by subtracting the measurements taken at T1 from T2. Linear measurements showing a negative (−) sign are synonymous with distal, backward, or

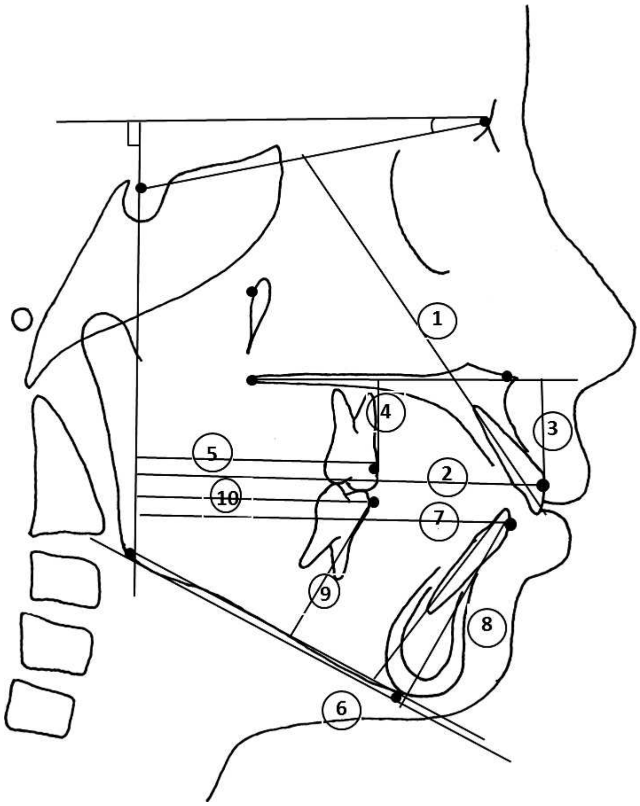

Figure 6. Dental measurements. (A) Angular measurements (in degrees): 1, U1-SN; 6, IMPA. (B) Linear measurements (in mm): 2, U1-Sv; 3, U1-PP; 4, U6-PP; 5, U6-Sv; 7, L1-Sv; 8, L1-MP; 9, L6-MP; 10, L6-Sv.

Table 3. Error of the Method

	Measurement	Casual Error (Dahlberg)	Systematic Error *P* Value
1	SNA, degrees	0.186	.774
2	Co-A, mm	0.224	.675
3	SNB, degrees	0.186	.854
4	Co-Gn, mm	0.932	.405
5	Go-Gn, mm	0.77	.387
6	ANB, degrees	0.124	.804
7	Co-Gn–Co-A, mm	0.161	.234
8	Overjet, mm	0.286	.976
9	SN-GoGn, degrees	0.261	.306
10	LFH/UFH, %	0.562	.658
11	AFH/PFH, %	0.378	.303
12	PP-SN, degrees	0.373	.210
13	Occ-Sh, degrees	0.932	.965
14	Ar-Go-Me, degrees	0.373	.770
15	U1-SN, degrees	0.161	.744
16	U1-Sv, mm	0.186	.062
17	U1-PP, mm	0.311	.093
18	U6-PP, mm	0.248	.239
19	U6-Sv, mm	0.236	.070
20	IMPA, degrees	0.112	.823
21	L1-Sv, mm	0.137	.475
22	L1-MP, mm	0.087	.697
23	L6-MP, mm	0.149	.368
24	L6-Sv, mm	0.124	.909

* $P < .05$.

Table 4. Comparison of Morphologic Characteristics of Prepubertal Group 1 (G1) and Postpubertal Group 2 (G2) at Pretreatment

	G1 (n = 23)		G2 (n = 18)		
	Mean	SD	Mean	SD	*P* Value
Maxillary skeletal					
SNA, degrees	81.54	4.7	82.33	2.82	.527
Co-A, mm	96.1	4.77	99.78	6.81	.043*
Mandibular skeletal					
SNB, degrees	75.48	3.68	77.03	2.7	.138
Co-Gn, mm	114.54	7.17	122	7.65	.002*
Go-Gn, mm	74.72	4.57	80.64	6.33	.001*
Maxilla-mandible					
ANB, degrees	6.08	2.27	5.36	2.15	.301
Co-Gn–Co-A, mm	5.26	2.3	3.22	2.35	.007*
Overjet, mm	6.66	2.66	5.86	2.69	.339
Vertical skeletal					
SN-GoGn, degrees	31.88	5.06	31.67	4.5	.887
LFH/UFH, %	121.98	8.47	129.81	14.30	.03*
AFH/PFH, %	156.50	11.02	154.45	8.46	.511
PP-SN, degrees	8.02	2.7	6.86	2.56	.164
Occ-Sh, degrees	12.76	3.61	12.06	3.98	.549
Ar-Go-Me, degrees	128.86	5.86	126.44	4.45	.15
Maxillary dentoalveolar					
U1-SN, degrees	103.8	8.22	101.47	8.76	.378
U1-Sv, mm	77.5	5.58	79.28	7.2	.367
U1-PP, mm	21.16	2.81	23.69	3.18	.009*
U6-PP, mm	18.72	2.03	20.69	2.78	.01*
U6-Sv, mm	44.18	4.94	46.31	5.23	.182
Mandibular dentoalveolar					
IMPA, degrees	97.7	6.97	96.03	7.19	.448
L1-Sv, mm	68.78	6.08	71.03	6.71	.259
L1-MP, mm	38.24	3.14	41.72	4.69	.006*
L6-MP, mm	29.72	2.26	32.72	3.49	.001*
L6-Sv, mm	41.9	4.83	43.67	4.75	.24

* $P < .05$.

intrusive movement to a relevant reference line, while a positive (+) value indicates forward, mesial, or extrusive movement. Clockwise rotation of any plane was assigned a positive value and counterclockwise rotation, a negative value.

Patient ages and pretreatment differences among variables for the groups are shown in Tables 2 and 4. Significant differences in linear pretreatment variables between the two groups due to variation in their growth status were observed; however, other morphologic characteristics were similar between both groups. The mean treatment time was significantly longer for G1 compared to G2. G1 had significantly greater skeletal correction than G2 with more dentoalveolar effects being observed in G2 than G1 (Table 5). However, on comparing both groups at the end of treatment (T2, Table 6), no differences in the parameters measured were observed, indicating that at T2 both groups were similar in their final outcome.

Table 5. Intragroup and Intergroup Comparisons Between Prepubertal Group 1 (G1) and Postpubertal Group 2 (G2)

	T2–T1[a]			T2–T1[a]			*P* Value
	G1 (n = 23)			G2 (n = 18)			
	Mean	SD	*P* Value	Mean	SD	*P* value	G1 vs G2
Maxillary skeletal							
SNA, degrees	−1.22	1.32	0*	−1.22	1.22	.001*	.996
Co-A, mm	3.8	2.09	0*	1.67	1.98	.002*	.002*
Mandibular skeletal							
SNB, degrees	1.54	1.61	0*	0.28	0.88	.197	.002*
Co-Gn, mm	9.14	3.22	0*	4.94	3.06	0*	0*
Go-Gn, mm	6.07	2.73	0*	5.17	4.13	0*	.39
Maxilla- Mandible							
ANB, degrees	−2.7	1.29	0*	−1.6	0.95	0*	.004*
Co-Gn–Co-A, mm	5.26	2.3	0*	3.22	2.36	.033*	.007*
Overjet, mm	−4.14	2.51	0*	−4.0	2.84	0*	.868
Vertical skeletal							
SN-GoGn, degrees	−0.86	2.03	.045*	0.06	2.09	.911	.157
LFH/UFH, %	0.95	6.00	.702	2.32	6.66	.627	.484
AFH/PFH, %	−2.3	5.11	.477	−0.4	4.9	.892	.224
PP-SN, degrees	0.68	2.3	.384	1.39	2.19	.131	.868
Occ-Sh, degrees	−2.48	2.79	0*	−1.36	2.14	.015*	.162
Ar-Go-Me, degrees	−1.12	2.58	.04*	−1.42	3.29	.085	.742
Maxillary dentoalveolar							
U1-SN, degrees	−0.36	10.87	.755	1.56	8.69	.311	.992
U1-Sv, mm	−0.92	2.21	.061	−0.33	1.65	.625	.348
U1-PP, mm	1.28	1.43	0*	0.75	1.45	.007*	.001*
U6-PP, mm	2.14	1.35	0*	1.33	1.60	0*	0*
U6-Sv, mm	1.12	1.69	0*	0.31	1.54	.006*	.008*
Mandibular dentoalveolar							
IMPA, degrees	4.40	6.59	.277	5.47	4.70	0*	.005*
L1-Sv, mm	1.14	1.76	0*	1.53	1.71	0*	.008*
L1-MP, mm	0.82	2.3	0*	0.19	1.39	.022*	.077
L6-MP, mm	3.04	1.79	0*	3.17	2.91	0*	0*
L6-Sv, mm	1.80	1.38	0*	1.47	1.33	0*	0*

[a] T2 indicates posttreatment; T1, pretreatment.
* $P < .05$.

DISCUSSION

Despite the growing popularity of semi rigid FFA, clinical studies on the optimum timing for the use of such appliances are scarce in the literature. In order to provide the missing information, the present study analyzed the dentoskeletal changes in a single-phase treatment of Class II patients with the TFBC appliance. The null hypothesis—that there was no difference in the final dentoskeletal effects with the TFBC appliance between prepubertal and postpubertal Class II patients—was accepted.

All subjects in G1 had their pubertal growth spurt during treatment, while treatment was initiated after the growth spurt for subjects in G2. If treatment efficiency is assumed to be a function of treatment duration, then G2 fared significantly better because treatment time for G2 (2.75 ± 1.07 years) was significantly less than G1 (3.67 ± 1.45 years) (Figure 7). The longer treatment duration in G1 may be attributed to the time spent waiting for the eruption of permanent teeth, thereby prolonging the overall treatment time. The outcomes of the study demonstrated that although there might be differences in dentoskeletal changes produced during treatment (Table 5) between the two groups, the final results at the end of treatment were remarkably similar (Table 6).

Skeletal Effects

At the beginning of treatment, there was a significant difference in linear maxillary and mandibular skeletal parameters between G1 and G2 (Table 4). During treatment, there was an increase in length of the maxilla and mandible, which was significantly greater for G1 than G2, most likely due to the longer treatment time and the fact that patients in G1 were developmentally younger than G2 predisposing them to greater growth during treatment. However, when G1

Table 6. Comparison of Prepubertal Group 1 (G1) and Postpubertal Group 2 (G2) at the End of Treatment

	G1 (n = 23)		G2 (n = 18)		
	Mean	SD	Mean	SD	*P* Value
Maxillary skeletal					
SNA, degrees	80.32	4.76	81.11	2.97	.538
Co-A, mm	99.9	5.12	101.44	7.34	.420
Mandibular skeletal					
SNB, degrees	77.02	4.51	77.31	2.61	.811
Co-Gn, mm	123.68	7.91	126.94	9.05	.216
Go-Gn, mm	80.79	5.95	85.81	7.92	.022*
Maxilla-mandible					
ANB, degrees	3.34	2.17	3.72	2.14	.569
Co-Gn–Co-A, mm	23.78	4.80	25.44	4.84	.270
Overjet, mm	2.52	0.94	1.86	0.78	.019*
Vertical skeletal					
SN-GoGn, degrees	31.02	6.03	31.72	5.02	.689
LFH/UFH, %	122.94	9.02	132.14	14.15	.013*
AFH/PFH, %	154.22	11.5	154.08	7.73	.965
PP-SN, degrees	8.7	2.78	8.25	2.82	.605
Occ-Sh, degrees	10.28	4.23	10.69	4.38	.756
Ar-Go-Me, degrees	127.74	6.71	125.03	4.59	.146
Maxillary dentoalveolar					
U1-SN, degrees	104.5	7.11	103.28	6.15	.560
U1-Sv, mm	78.76	7.00	79.58	6.50	.697
U1-PP, mm	23.1	2.70	25.36	2.41	.007*
U6-PP, mm	21.14	2.20	22.86	3.12	.039*
U6-Sv, mm	47.02	5.33	47.69	5.35	.685
Mandibular dentoalveolar					
IMPA, degrees	99.2	6.93	102.33	7.28	.159
L1-Sv, mm	73.44	7.35	74.53	6.73	.623
L1-MP, mm	41.38	3.87	43.39	5.68	.175
L6-MP, mm	34.64	3.20	36.81	4.30	.065
L6-Sv, mm	47.5	5.71	47.56	5.28	.974

* $P < .05$.

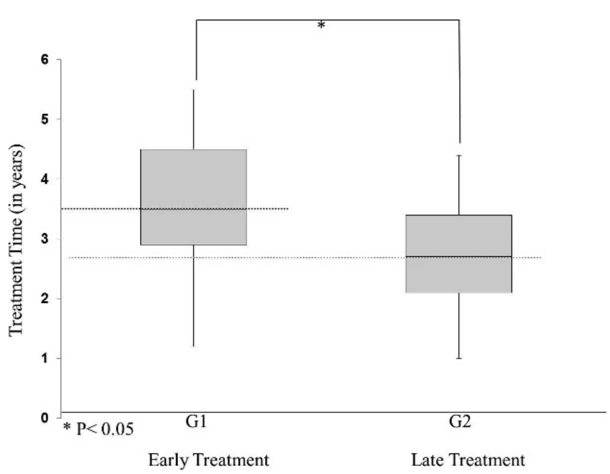

Figure 7. Treatment duration for prepubertal (G1) and postpubertal (G2) treatment groups.

and G2 were compared at the end of treatment, presumably when growth was complete, (T2, Table 6) no significant differences were observed. Early use of a functional FFA appliance during the growth spurt has been advocated[19] for greater skeletal correction by harnessing growth for Class II correction. However, our study did not show any advantage of doing so. The final skeletal outcomes were similar in both groups whether treatment was initiated before or after the growth spurt. These findings suggested that skeletal results of early (prepubertal) treatment are not different from late (postpubertal) treatment and confirmed previous observations[13,20,21] on the similarity of results obtained before and after the pubertal growth spurt.

Despite extrusion of upper and lower molars in both groups, there was no change in the vertical parameters. Previous studies[22,23] showed control over the vertical dimension due to mesial movement of posterior teeth along with extrusion as observed here. Minimal changes were observed in the palatal and occlusal plane angles, although the mechanics of a

FFA suggests a tendency towards canting the occlusal plane due to the moments being generated (Figure 2). However, it is important to remember that observations made in this study were before and after treatment and not before and after the TFBC appliance phase. Therefore, any palatal or occlusal plane rotation that occurred with the TFBC appliance may have reverted once it was removed. Pancherz and Anehus-Pancherz[24] also observed a similar reversion of the palatal plane rotation once the Herbst appliance was discontinued.

Dentoalveolar Effects

The upper incisors in both G1 and G2 were distalized under the "headgear effect"[8,10] of the FFA, while the molars moved to the mesial. Based on the biomechanical model (Figure 2) and despite there being a distal and intrusive force on the upper molars, they underwent extrusion and mesial movement. Similar observation of mesialization and extrusion of the upper molars and extrusion after use of the FFA has been reported.[10,11,24–26] This may be attributed to the mechanics involved during finishing of treatment after removal of the FFA or natural tendency of teeth to drift mesially and occlusally with growth.[27]

The dentoalveolar correction was achieved primarily by protraction of the lower molars and proclination of lower incisors in both groups under the mesially directed force from the FFA. Evaluation of the groups at T2 (Table 6) showed no difference in the anteroposterior position of the incisors and molars. Similar results were observed by Frye et al.[13] but stand in contrast with those made by Pancherz and Hägg[12] and Konik et al.[20] who noted greater increase in A–P position of the lower incisors in their postpubertal groups. However, observations in both studies were made immediately after removal of the Herbst appliance and not after fixed appliance treatment.

This study is subject to several strengths and limitations. The strengths of the study were that the skeletal maturation method (CVMS) was used to differentiate the prepubertal and postpubertal groups. In addition, no previous study has compared the effects of treatment at the end of orthodontic correction to observe if there were actual morphologic differences between prepubertal and postpubertal Class II correction. However, the limitation was that the sample was restricted to normodivergent patients. In addition, other semi-rigid FFA appliances were not considered. Future studies should possibly include hyperdivergent patients and analyze other appliances. Studies on long-term retention are also desirable.

CONCLUSIONS

- There were no differences in the overall dentoskeletal features in prepubertal vs postpubertal Class II patients treated with the TFBC appliance in normodivergent patients.
- The postpubertal phase (late treatment) is the preferred phase for Class II intervention with the Twin Force Bite Corrector.

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