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ORIGINAL ARTICLE

Cephalometric Comparison of a Modified Bionator (Farmand Appliance) and Twin-Block Appliance in Treatment of Skeletal Cl II Malocclusion

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background & aim: functional appliances with various designs have been introduced in the treatment of Class II malocclusions .The aim of this study was to evaluate dentoskeletal effects of a modified bionator (FA) and Twin Block (TB) functional appliance in treatment of skeletal Class II malocclusion.

Method and material: in this retrospective study 30 treated cl II patients with overjet greater than 4 mm have been selected from each of two private offices .in each office either FA or TB were used .Pre-treatment and post-treatment lateral cephalograms were digitized and traced with Dolphin Imaging software. ANCOVA and paired T test were used for analysis with SPSS software (19).

Results: FA group consisted of 17 girls and 13 boys(mean age: 9.53± 1.1),TB group consisted of 12 boys and 18 girls(mean age: 10.26 ±.944) .ANB angle and overjet were reduced significantly in both groups.(p=.000) Mandibular body length demonstrated a significant increase in both groups.(3.06±4.98mm with TB and 3.03±5.52mm with FA).In Both appliances significant retrusion of upper lip occurred as a result of decrease in overjet (TB=002,FA=.000).No statistical significant difference were found between two appliances.

Conclusions: Treatment with both appliances resulted in correction of Class II discrepancy, reduction of overjet, and retrusion of upper lip. No significant dento-skeletal differences were observed between the 2 appliances

Key words:angle cl II malocclusion,activator appliances,cephalometry,treatment

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Introduction

various skeletal and dental configurations can cause class II malocclusions.[1-4] Most Class II patients have a deficiency of the mandible.[4] functional appliances have been used for many years in the treatment of Class II Division 1 malocclusions.[5-9] Several varieties of functional appliances are currently in use that aim to improve skeletal imbalances. Alteration of maxillary growth, possible improvement in mandibular growth and position, and change in dental and muscular relationships are the expected effects of functional appliances. It has been shown that the forward growth of the maxilla can be inhibited[10-12],redirected[13], or unaffected[14,15] by functional appliances. The effect of functional appliances on mandibular growth is controversial. Some authors suggested that mandibular growth can be increased with functional appliance treatment[16-19], but others believe the appliances have no real effect on mandibular length.[20] most researchers agree that the appliances produce retroclination of the maxillary incisors[7,21] and proclination of the mandibular incisors. [22,23]

Two of the more popular functional appliances used today in IRAN are the modified bionator(farmand)functional appliance and Clark's Twinblock.[24]. Twin-block is designed for full-time wear to take advantage of all functional forces applied to the dentition, including the forces of mastication. Because of its small size, patients adopt to it easily and speech disturbance is minimized. Farmand introduced his customized bionator appliance (FAII) that is wildly used in private clinics and dental schools in Iran. He created FAII by modifying wire components of Baionator between 1967 to 1970. This appliance is claimed to be comfortable due to the low volume and minimum amount of bite opening. skeletal and dental changes in condylar growth after treatment with this device has been investigated.[25]

The purpose of this retrospective study was to compare the skeletal and dentoalveolar changes in Cl II patients treated with modified bionator (FA) and twin-block.

Material &Methods

In this retrospective investigation , The pretreatment and posttreatment cephalometric records of 30 patients treated with the Twin-block appliance with mean age of 10.26 ±.944 (figure 1) & 30 patients treated with FA appliance with mean age of 9.53± 1.1 (figure 2) were collected from 2 private orthodontic offices in hamedan city/IRAN.

Figure 1.modified bionator (Farmand) appliance

Figure 2. twin -block appliance

The inclusion criteria were: Class II Division 1 malocclusion with normal or slightly protrude maxilla and retrusion of mandible, age between 8-11 years, overjet >4mm, ANB>4degrees, Available pre and post treatment lateral cephalograms.

Exclusion criteria were :any craniofacial syndromes,history of trauma to the jaws,history of orthodontic treatment or extraction of premolars.

Table I. Comparison of the pre and post treatment mean values between the groups

variable	*Twin-block*		*pvalue*	*Farmand*		*P value*	*homogeneity***
	pretreatment	*Posttreatment*		*pretreatment*	*posttreatment*		
	Mean ±SD	*Mean ±SD*		*Mean ±SD*	*Mean± SD*		
Maxillary & mandibular skeletal							
SNA	83.45± 4.43	81.9± 4.4	.004*	83 ±3.61	82 ± 3.72	.059	.668
SNB	75.53 ± 3.18	75.70 ±2.97	.709	75.59 ± 3.19	76.41 ± 3.31	.135	.939
NA prep to A point	2.03± 3.65	.67± 4.89	.032	2.79 ± 2.84	1.55 ± 3.99	.067	.376
NA prep to pog	-10.58 ±4.85	-10.45 ±5.73	.875	-7.45 ± 5.79	-6.83 ±7.67	.662	.027
Co- ANS	90.52 ±7.36	93.37 ±6.72	.000*	88.01 ± 7.66	89.46± 7.73	.087	.201
GO-GN	73.91 ±5.80	76.98 ±6.05	.002*	72.40± 5.54	75.43 ± 5.73	.005*	.307
GO-POG	69.31 ±5.08	71.88± 5.80	.011	68.81 ± 4.86	71.68 ±5.23	.006	.699
SN/GO-GN	31.94 ± 5.70	32.79± 6.54	.145	32.40± 5.45	33.20± 5.14	.153	.747
Maxilla to mandible							
ANB	7.92 ± 1.99	6.19± 2.2	.000*	7.39 ±1.72	5.58 ± 1.99	.000*	.281
wits	6.18 ± 2.85	3.28 ±2.12	.000*	5.91± 2.46	3.06 ± 2.57	.000*	.700
Harvold	17.28 ±4.76	19.89 ±4.37	.002*	18.42 ± 2.98	21.49 ± 3.95	.000*	.273
Maxillary dental							
U1/SN	104.99 ±8.41	102.56 ±5.73	.073	104.56 ± 7.33	101.71 ± 6.94	.011	.831
U1/PP	111.65 ± 7.81	109.32 ±6.76	.067	109.97± 7.53	107.04± 7.13	.008	.400
U1/NA	21.55 ±9.08	20.66 ±7.96	.533	21.55 ±6.85	19.71 ± 6.86	.125	.997
U1-NA(mm)	2.51 ± 3.28	2.32± 3.11	.747	2.24 ±2.39	2.14±2.14	.808	.721
U6/PP	19.30 ± 2.10	19.72 ±2.12	.198	19.17± 2.48	19.09± 2.65	.827	.832
Mandibular dental							
impa	98.94 ±7.97	100.73 ±7.57	.113	94.75 ± 7.55	96.51± 7.82	.150	.041
L6/mp	29.353 ±3.09	31.44 ±3.66	.000*	27.85 ±2.81	29.60 ± 2.88	.000*	.055
L1/MP	40.4267± 3.78	41.44± 4.17	.005	38.85 ±3.28	40.34 ± 3.34	.001*	.090
L1/NB	28.06 ± 5.78	30.64 ±5.67	.020	23.87 ±6.23	27.28 ±5.45	.002*	.009
L1-NB(mm)	5.63 ± 2.46	6.85 2.73	.003*	4.33±9.44	5.85 ±2.2	.001*	.042
interdental							
Interincisal angle	122.47 ±10.28	122.50± 9.41	.985	127.17 ± 9.44	127.42 ±9.22	.889	.071
overbite	2.81 ±2.54	1.07 ±2.04	.000*	2.15 ±2.77	1.57 ± 1.65	.192	.337
overjet	7.97 ± 2.58	4.54 ±1.77	.000*	8.04 ± 2.59	4.27 ± 1.53	.000*	.917
vertical							
Posterior Face Height	74.96 ± 7.19	79± 7.30	.000*	74.08 ±7.94	76.72 ±8.10	.003*	.653
Anterior Face Height	113.67 ± 7.31	120.02 ±8.46	.000*	112.56± 9.85	116.7 ± 9.72	.000*	.623
PFH/AFH	65.99± 5.030	65.06± 5.65	.896	65.88 ±5.10	65.75 ± 4.39	.817	.935
Upper face height	43.62 ±2.48	43.59 ±2.38	.922	43.08 ± 2.00	43.39± 2.22	.200	.355
Lower face height	56.37 ± 2.48	56.40 ±2.38	.922	56.92± 2.00	56.60 ±2.22	.200	.355
UFH/LFH	52.08 ± 3.516	52.25 ±3.58	.797	51.38 ±2.62	52.20± 3.02	.222	.383
Soft tissue							
Nasolabial angle	110.06± 15.17	108.99 ±16.54	.807	111.16 ±10.11	110.13± 11.3	.684	.742
Lower lip-Eline	1.19± 3.61	.76± 3.95	.414	.15 ±3.19	-.65± 3.14	.153	.243
Upper lip-Eline	-.42 ± 2.49	-2.10 ±3.49	.002*	-1.18 ±2.52	-3.40± 2.76	.000*	.250

*:significance level <0.05

**:homogeneity of pretreatment measures

Table II. Descriptive statistics: Average sex ,starting ages and overjet

variable	Twin-block n(%) or Mean(SD)	farmand n(%) or Mean(SD)	pvalue
sex **Female**	18(60)	17(56)	.197
male	12(40)	13(43)	
age	10.26 ±.944	9.53± 1.1	0.08
overjet	7.97 ± 2.58	8.04 ± 2.59	.917

Nondigital lateral cephalograms were scanned into Dolphin by using a Professional Scanner (hp Scanjet,G3110), and the images were digitized.Digital tracing and cephalometric measurement analysis of lateral cephalograms were performed with Dolphin Imaging software (version 10.5,Dolphin Imaging and Management Solutions, Chatsworth, Calif). all lateral cephalograms of 1 subject were traced on the same occasion to reduce the error variance in each subject.Magnification was controlled by using the Dolphin calibrated fiduciary points. angular and linear measurement were used to report skeletal , dental and soft tissue effects.(table I)

Search Strategy and Selection of studies:

Statistical analyses were performed with SPSS (version 19, SPSS Inc., Chicago, Illinois, USA). The data were found to be normally distributed and there was homogeneity of variance among groups according to the normality test of Shapiro–Wilks test. The comparisons of the mean values of pretreatment measures in both groups were made by independent t test. treatment effect in each group determined by pair t test. Analysis of covariance (ANCOVA) was used to compare the influence of the 2 appliances on the dentoskeletal measurements . Pretreatment measures, ANB,age and sex of the patients were treated as covariate in model for adjusting confounder effects.

Results

The mean age of the subjects at the beginning of the study ,sex distribution and initial overjet in each group are shown in table II .mean and SD for pre and post treatment measures and the results for independent and paired t-test are described in table I. The results of all of the measurements after treatment are shown in table III.

Skeletal changes:

Reduction in the anteroposterior apical base discrepancy via an angular assessment of ANB angle was observed in both groups (p=.000).SNA decreased significantly in twin block group (p=.004).The distance of Co-ANS increased significantly in twin block group (p=.000),wits decreased significantly in both groups.(TB=.000,FA=.002)

mandibular body length demonstrated a significant increase in both groups (TB:3.06±4.98, FA:3.03±5.52),harvold also increased significantly(p=.000).

No statistical significant difference was found between twin block and modified bionator for these measurements. assessment of the effect of pretreatment ANB on post treatment SNB and vertical measurements showed no statistical significant effect.

Dentoalveolar changes:

The change in interincisal angle did not differ significantly among the 2 samples .Significant decrease in the overjet was seen within both treatment groups (p=.000), also a significant decrease in the overbite was seen in twin block group (p=.000) .The inclination of lower incisors showed significant increase in both of the treatment groups (TB=.003,FA=.001). No statistical significant difference were found between two groups in regard to dentoalveolar effect.

Vertical changes:

Posterior and anterior face height increased significantly after treatment in both groups (p=.000).No statistical significant differences were found between two groups.

Soft tissue changes:

The change in nasolabial angle did not differ significantly among the 2 samples .Upper lip to Eline decreased significantly in both groups after treatment (TB= 002,FA=.000), no statistical significant difference were found between two groups in regard to soft tissue changes.

Table III. Coefficients for the effect of appliance type on outcome variables

Variable	Twin-block Post treatment Mean ±SD	farmand Posttreatment Mean± SD	Intergroup comparisons
Maxillary & mandibular skeletal			
SNA	81.9± 4.4	82 ± 3.72	.509
SNB	75.70 ±2.97	76.41 ± 3.31	.297
NA prep to A point	.67± 4.89	1.55 ± 3.99	.900
NA prep to pog	-10.45 ±5.73	-6.83 ±7.67	.526
Co- ANS	93.37 ±6.72	89.46± 7.73	.122
GO-GN	76.98 ±6.05	75.43 ± 5.73	.759
GO-POG	71.88± 5.80	71.68 ±5.23	.691
SN/GO-GN	32.79± 6.54	33.20± 5.14	.873
Maxilla to mandible			
ANB	6.19± 2.2	5.58 ± 1.99	.744
wits	3.28 ±2.12	3.06 ± 2.57	.875
Harvold	19.89 ±4.37	21.49 ± 3.95	.256
Maxillary dental			
U1/SN	102.56 ±5.73	101.71 ± 6.94	.351
U1/PP	109.32 ±6.76	107.04± 7.13	.221
U1/NA	20.66 ±7.96	19.71 ± 6.86	.288
U1-NA(mm)	2.32± 3.11	2.14	.646
U6/PP	19.72 ±2.12	19.09± 2.65	.491
Mandibular dental			
impa	100.73 ±7.57	96.51± 7.82	.496
L6/mp	31.44 ±3.66	29.60 ± 2.88	.791
L1/MP	41.44± 4.17	40.34 ± 3.34	.320
L1/NB	30.64 ±5.67	27.28 ±5.45	.372
L1-NB(mm)	6.85 2.73	5.85 ±2.2	.879
interdental			
Interincisal angle	122.50± 9.41	127.42 ±9.22	.160
overbite	1.07 ±2.04	1.57 ± 1.65	.066
overjet	4.54 ±1.77	4.27 ± 1.53	.786
vertical			
Posterior Face Height	79± 7.30	76.72 ±8.10	.203
Anterior Face Height	120.02 ±8.46	116.7 ± 9.72	.993
PFH/AFH	65.06± 5.65	65.75± 4.39	.615
Upper face height	43.59 ±2.38	43.39± 2.22	.615
Lower fac height	56.40 ±2.38	56.60 ±2.22	.565
UFH/LFH	52.25 ±3.58	52.20± 3.02	.895
Soft tissue			
Nasolabial angle	108.99 ±16.54	110.13± 11.3	.429
Lower lip-Eline	.76± 3.95	-.65± 3.14	.212
Upper lip-Eline	-2.10 ±3.49	-3.40± 2.76	.120

Discussion

Several studies revealed that the majority of discrepancies between the jaws leading to cl II malocclusion have a component of mandibular deficiency.[4]

Forcing the patient to function with forwarding the lower jaw and changing the function could stimulate mandibular growth, thereby correcting a Class II problem. [26]

In this study ,The ANB angle and wit's showed a significant decrease in both of the treatment groups. When the mandible was postured forward by the functional appliances, a reciprocal force acted distally on the maxilla, redirecting growth.The stimulation of mandibular growth can be shown as a reason for this decrease. It can be concluded that in addition to the stimulation of the mandible in both groups, the inhibition of the forward growth of the maxilla is an important factor for the decrease of this angle.[10,11,17,20,27-30]

Controversial results exist for the restraining effect of TB therapy on maxilla. Some studies showed restriction [29,31-33], whereas others did not [24,30].

In the literature Many researchers have claimed that extra mandibular growth occurs with the Twin-block and bionator appliances. Toth and McNamara found 3.0 mm additional increase in condylion to gnathion length during a standardized 16-month period of Twin-block therapy[31], Lund and Sandler found 2.4 mm extra mandibular growth in a 12-month period[34], and Mills and McCulloch found 4.2 mm more growth.[29] Illing et al reported a 3.9 mm increase in mandibular growth with the bionator appliance[30]. In our study, mandibular body length increased 3.06±4.98mm with TB and 3.03±5.52mm with FA. A randomized controlled trial by Tulloch et al[35] reported small mandibular changes with the bionator. Keeling et al[36] made similar conclusions about growth modification with the bionator. However, O'Brien et al reported more mandibular changes with the bionator than with the Twin-block.[33]

A widely accepted consensus is that the Twin-block and bionator appliances cause retroclination of the maxillary incisors and proclination of the mandibular incisors .[29-31,33,37]A decrease in the degree of overjet was seen in both of the treatment groups. Some authors believe that the decrease in the degree of overjet is absolutely dependent on the changes of the dentoalveolar structures at the end of the treatment.[14,18,20,38] By the retrusion of upper incisors and the protrusion of lower incisors, the degree of overjet decreases. Reey and Eastwood claim that the reason for the decrease of overjet is the stimulation of the forward growth of the mandible, in addition to the retraction of the upper incisors.[18] In most of the studies, a response to the anterior displacement of the mandible occurs within the dental arch. The force returning the mandible to its original position is transmitted by the appliance and its labial bow to the maxillary dentition and particularly to the maxillary incisors. The result is palatal plane tipping. By the opposite effect of the appliance upon the lower incisors, an increase in the lower incisor angulation occurs.

In this study overbite decreased significantly in twin block group.

Increases in anterior and posterior face heights are a consistent finding after TB therapy. Toth and Mcnamara reported 3.0 mm increase in anterior face height and 3.2 mm increase in posterior face height.[31] Lund and Sandler

found 2.6 mm increase in total anterior face height after TB therapy compared with control groups.[34] Mills and McCulloch noted significant increases relative to controls; 3.8 mm in total anterior face height and 2.9 mm for posterior face heights.[29] in our study both appliances increased posterior and anterior face height significantly. (PFH:3.34 ±4.26mm, AFH:5.19± 4.75mm)

In Both appliances significant retrusion of upper lip occurred as a result of decrease in overjet.

so Treatments with both appliances resulted in correction of Class II discrepancy, reduction of overjet, and retrusion of upper lip. both appliances can be used effectively in treatment of cl II Div I patients with mandibular deficiency.This study was retrospective and we could not match the samples completely according to developmental stage, treatment time , therapist and patient cooperation so further prospective clinical trial studies are suggested to assess differences between two appliances.

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