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Treatment Effects of Farmand Functional Appliance on Class II Division 1 Malocclusion

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ABSTRACT

Background and Aim: The aim of the present study was to evaluate the cephalometric changes in Class II division 1 mandibular deficient patients treated with Farmand functional appliance.
Methods and Materials: Twenty-seven subjects (17 girls and 10 boys) with the mean age of 11.1±1.4 years were involved in the present study. All the subjects were treated with Farmand functional appliance. Paired t-test and Wilcoxon test were used to evaluate the data. The significance level was set at P<0.005.
Results: A skeletal Class I relationship and a marked reduction in the overjet were achieved with the use of Farmand appliance. ANB decreased significantly by 3.2±1.7 degrees, while SNB increased from 74.3 ±1.7 degrees to 77.6±2.3 degrees (P<0.001).
Conclusion: The results showed that Farmand functional appliance is effective in the treatment of mandibular deficiency in patients with Class II division 1 malocclusion.

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Introduction:

A Class II malocclusion may result from mandibular deficiency, maxillary excess or a combination of both. However, the most common finding is skeletal mandibular retrusion.[1,2] Approximately 15% of American children have Class II malocclusion; nevertheless, It seems that Class II problems are most prevalent in Caucasians of Northern European descent (for instance, 25% of children in Denmark are reported to be Class II).[3] Different removable functional appliances such as Activator, Bionator, Fränkel-2, Herbst, R-appliance, and Twin Block have been used to treat Class II division 1 malocclusion and mandibular deficiency.[4-12] Functional appliances put the mandible in a forward position and result in stretches of the related attached muscular groups of the mandible, which create bone remodeling and muscular adaptation. Investigators have also proposed that class II correction observed with functional appliances was the result of headgear effect on the nasomaxillary growth.[13]

One of the functional appliances used for the correction of mandibular deficiency is "Farmand Appliance".[14] It has been shown that this appliance causes significant changes in the position and anterior displacement of the Hyoid bone, resulting in improved airway and respiratory status of the patients.[14]

An electronic search in the literature shows that very few studies have evaluated the treatment effects of Farmand appliance; therefore, the aim of this study was to assess the dentoskeletal effects of Farmand appliance on prepubertal patients with Class II division 1 malocclusion and mandibular deficiency.

Methods and Materials:

Twenty-seven subjects (17 girls and 10 boys) were selected from among the individuals who were treated with Farmand appliance. The mean age of the patients was 11.1±1.4 years. All the patients and their parents were informed of the study procedures, and they signed an informed consent. The procedures were carried out according to the criteria of the local Ethics Commission and the Helsinki Declaration.

At the beginning of the treatment, (Figures 1 and 2) all the patients were in prepubertal stage (CS1 and CS2), according to the recently improved version of cervical vertebral maturation (CVM) method described by Franchi et al15 and Baccetti et al.16

All the subjects met the following inclusion criteria:

1- ANB>5°, SNB<77°, overjet>5 mm on the initial lateral cephalograms

2- No syndromic or medically compromised patients;

3- No previous surgical intervention;

4- No use of other appliances before or during the period of functional treatment.

5- A normal mandibular growth pattern; neither horizontal nor vertical growers.

6- No skeletal asymmetry

The patients were instructed to wear the appliance full-time except for eating, contact sports and tooth brushing. The average treatment time was 16±1.7 months. (Figures 3 and 4)

Farmand appliance is a passive tooth borne appliance. It consists of two extended labial bows, a tongue bow, two rests (stops), and an acrylic plate. The acrylic plate extends form the occlusal surface to the lingual shields. A heavy wire (with 1mm diameter), which acts as a tongue bow, is positioned posteriorly to connect the right and left acrylic parts on the palatal aspect in order to reinforce the appliance. Upper and lower labial bows are constructed of 0.7 mm stainless steel wire extended from canine to canine with horizontal loops in the canine region. The rests (stops) are placed on the mesial surface of upper and lower first molars. The construction bites were taken with the upper and lower anterior teeth in an edge to edge occlusion with 2 to 3 mm posterior clearance. Lateral cephalograms were taken in centric occlusion at the start (T1) (Figure 5) and at the completion (T2) (Figure 6) of the functional treatment. Each film was traced by one investigator on 0.003-inch frosted acetate with a 0.3 mm lead pencil and was checked by another investigator to verify the accuracy of the anatomical landmark detection. Images of the bilateral structures were bisected.

Figure 1- Pretreatment intra oral images

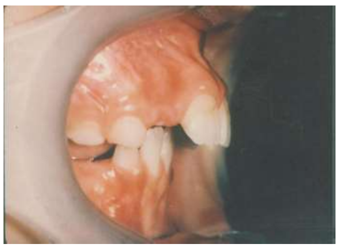

Figure 2- Pretreatment intra oral images

Figure 3- Post treatment intra oral images

Figure 4- Post treatment intra oral images

Figure 5- Pretreatment cephalometric image

Figure 6- Pretreatment cephalometric image

Disagreements were resolved by retracing the landmark or the structure to the satisfaction of both observers.

The SNA, SNB, ANB, Witts (connecting points A and B perpendicular to the occlusal plane), GoGn (the distance between gonion and gnathion, representing the mandibular length), CoGn (the distance from condyle to gnathion), Co-Pog (the distance from condyle to pogonion), overjet, Jarabak index (the ratio between posterior and anterior facial heights; S–Go/N–Me), GoGn-Sn (the angle between SN and the mandibular plane), Palatal-GoGn (the angle between the palatal and mandibular planes), facial angle (the angle formed by the intersection of the Frankfort plane with the nasion-pogonion line), U1 to SN (the angle between the long axis of upper central incisor and the anterior cranial base), IMPA (the angle between the long axis of lower central incisor and the mandibular plane), and interincisal angle (the angle between the upper and lower incisors) were measured on T1, and T2 radiographs.

The reliability of the measurements was determined by randomly selecting 10 cephalograms at the beginning and at the end of the treatment. These cephalograms were re-measured by 2 other blinded investigators. The method error was calculated using Dahlberg's formula17. Values of error in the present study ranged from 0.21 to 0.64, indicating that there was a good reliability of the measurements.

The magnification factor of the cephalograms was standardized at 8%. The Statistical Package for Social Sciences, Version 20 (SPSS Inc. Chicago, Illinois, USA) was used to analyze the data. Kolmogorov-Smirnov normality test was applied to the cephalometric data. Paired T-test was used for evaluations if the distribution was normal; otherwise, Wilcoxon test was applied. Statistical significance was set at P<0.005.

Results:

Paired T-test showed that the SNA decreased from 81.2±1.5 degrees to 81.4±1.3 degrees (P<0.124); while, the SNB significantly increased from 74.3±1.7 degrees to 77.6±2.3 degrees. The ANB decreased by 3.2±1.7 degrees (P<0.617). Upper 1 to SN decreased significantly from 110.1±7 degrees to 104.4±5.7 degrees; while, The IMPA increased by 6.2±3.8 degrees (P<0.001). The GoGn increased from 66.5±3.5 mm to 69.2±3.5 mm (P<0.001). Tables 1 and 2 show the pre and post-treatment values.

Table 1- Pre and post treatment values

Variables		Before		After		P-value
		Mean	SD	Mean	SD	
Sagittal	SNA (°)	81.2	1.5	81.4	1.3	0.124
	SNB (°)	74.3	1.7	77.6	2.3	0.001*
	ANB (°)	6.8	1.6	3.6	2.3	0.001*
	Witts (mm)	4.2	1.6	1.9	1.7	0.001*
	GoGn (mm)	66.5	3.5	69.2	3.5	0.001*
	Co-Gn	103.7	2.9	106.2	2.6	0.001*
	Co-Pog	101.8	1.6	106.3	1.8	0.001*
	Overjet	7.1	2.1	3.6	1.9	0.001*
Vertical	Jarabak (%)	64.1	2.2	62	1.4	0.001*
	GoGn-Sn	31.8	4.2	34.1	4	0.001*
	Palatal-	25.3	2.6	27.5	1.9	0.001*
	Facial	82.9	2.6	85.1	2.5	0.001*
	Gonial	123.7	3	128.7	2.1	0.001*
Dental	U1-Sn (°)	110.1	7	104.4	5.7	0.001*
	IMPA (°)	95.7	7.3	101.9	6.6	0.001*
	Interincisal	117.8	5.5	118	6.7	0.777

Table 2- Changes of the cephalometric data

Variables		Farmand	
		Mean	SD
Sagittal	SNA (°)	0.2	0.7
	SNB (°)	3.3	1.9
	ANB (°)	-3.2	1.7
	Witts (mm)	-2.3	1.5
	GoGn (mm)	2.7	1.5
	Co-Gn (mm)	2.6	1.2
	Co-Pog (mm)	4.5	1.9
	Overjet (mm)	-3.5	2.3
Vertical	Jarabak (%)	-2.1	1.8
	GoGn-Sn (°)	2.3	1.8
	Palatal-GoGn	2.2	2.1
	Facial Angle	2.2	1.2
	Gonial Angle	4.9	3
Dental	U1-Sn (°)	-5.7	4.2
	IMPA (°)	6.2	3.8
	Inter-incisal Angle (°)	0.3	4.7

Discussion:

The treatment methods for Class II Division 1 malocclusion have been abundantly reported in the literature. Treatment can include extra oral headgear, removable or fixed functional appliances, and maxillary molar distalization appliances, followed by anterior retraction. It can be camouflaged by the extraction of maxillary premolars to eliminate the overjet by establishing a Class II molar relationship.[18,19]

The findings of the present study showed that, Farmand appliance could successfully improve the intermaxillary discrepancy in Class II growing patients with mandibular deficiency. After treatment, the SNB and ANB showed significant changes. The Increased SNB and decreased ANB are the indicators of satisfactory changes in the mandibular growth. The increase in the GoGn, Co-Gn, and Co-Pog also indicates positive mandibular growth.

Farmand appliance is a passive tooth-borne appliance, composed of one extended labial bow on each jaw, two rests (stops) on each dental arch, a tongue bow and an acrylic plate. The labial bows with a distance of 1 mm from the labial surfaces of upper and lower anterior teeth, act as an eruptive guidance for the incisors and eliminate the forces of the perioral muscles, especially in the cases of severe contractions of the Mentalis muscle. The tongue bow with the distally-directed loops, helps the patient to redirect his/her tongue to a distal position, thus removing the tongue pressure from the anterior part of the upper jaw. In addition, the patient is instructed to open and close his/her mandible while stabilizing the appliance on the maxillary arch by the tip of his/her tongue. This kind of exercise will improve the patient's adaptation with the new advanced mandibular position. The rests (stops), which are placed on the mesial surfaces of the first molars, restrict the mesial movements of the mentioned teeth, and assist in achieving a Class I molar relationship by forward movement of the mandible. Treatment success has been defined as an improvement in molar relationship of at least a half to three-quarters cusp width, depending on whether or not the leeway space was used during treatment. One of the factors that influenced treatment success in the present study was the level of cooperation of the patients which was influenced by the small size of Farmand appliance.

In two recent studies, Yassaei and Soroush 14 and Yassaei et al 20 evaluated the effects of Farmand functional appliance on the position of Hyoid bone in patients with Class II division 1 malocclusion. They found that the Hyoid bone shifted significantly forwards in the horizontal dimension.

Farmand appliance, similar to Bionator appliance, is not as bulky as many other functional appliances, and shows a better patient tolerance and less interference with speech.

After skeletal correction, further treatments were continued with fixed orthodontics for all the patients involved in the present study.

Conclusion:

Farmand functional appliance can be successfully implemented in the correction of mandibular deficiency in patients with Class II division 1 malocclusion, and can be used as an alternative functional appliance.

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Conflict of interests

Authors report no conflict of interest related to this study.

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