

The functional treatment of anterior-open bite: three case reports

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Functional treatment of three skeletal open-bite patients with Bionator, Frankel IV and Posterior bite-block appliances is presented. Pretreatment and post treatment records were evaluated. Correction of malocclusion by changing direction of the mandibular development, adaptive bony development of the condyle, vertical development in posterior region, an increase in ramus length, a decrease in the lower facial height were observed in this report. The results of functional treatment of three appliances had different effect mechanisms.

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INTRODUCTION

In anterior open-bite treatment, correct diagnose can lead to choosing a stable treatment method. Nature and shape of the malocclusion, that it is craniofacial formation and the effect of the abnormality on mastication, swallowing and speech functions, has an important role in treatment planning. It is important to distinguish dental open-bite from skeletal open-bite. Dental open-bite can be corrected naturally and/or by myofunctional and mechanical means, when there is no longer an etiological factor.¹⁻³

In deciduous and mixed dentition, habit control and the elimination of abnormal perioral muscle function as etiological factors, is a goal of treatment. Speech therapy, together with combined various exercises are given as myofunctional treatment, in order to eliminate the negative effects of perioral muscle. In open-bites that are caused by habit, treatment can include a fixed or removable crib or oral screen. This makes a change in alveolar structure, affecting the posture and function of orofacial muscle and the tongue.⁴⁻⁷

According to the researchers, the general principle in open-bite treatment is to slow down the upper and

lower posterior vertical dentoalveolar growth. Then to move the mandibular development, which displays posterior growth, in a horizontal direction. Researchers support the functional approach to correct the skeletal deformities in early treatment of anterior open-bite using forces of masticating muscles, which is an approach used in general orthopedics for years.⁸⁻¹⁰

In general, functional orthopedic treatment is a treatment where tissue changes are needed for jaw position and structure deformities. These changes are obtained through functional stimulation in the oral facial structures.^{4,11}

In functional treatment, muscle stimulation, which is caused by tonus changing and the functions of lip and cheek muscle, chewing and the tongue, causes bony changes via an increase the cellular activities or a decrease in bone appositions by inactivation. Required stimulation is transmitted to the tissues through functional appliances.¹²⁻¹⁴

The skeletal open-bite treatment with functional method is valid for the individuals in active growing period. The purpose of this treatment is:

1. The inhibiting of the maxillary suture and vertical alveolar growth of maxilla and mandible. To provide anterior and lower rotation of the palatal plane, while the vertical alveolar development continues to grow in the anterior region.
2. Moving the vertical direction development to the sagittal direction of the mandible.¹⁵

Various functional appliances are used for the functional treatment of the skeletal anterior open-bite abnormalities.^{9,10,16} Frankel and Frankel⁹ used the Frankel IV appliance together with lip-closing exercises in direction with strategic treatment. In addition

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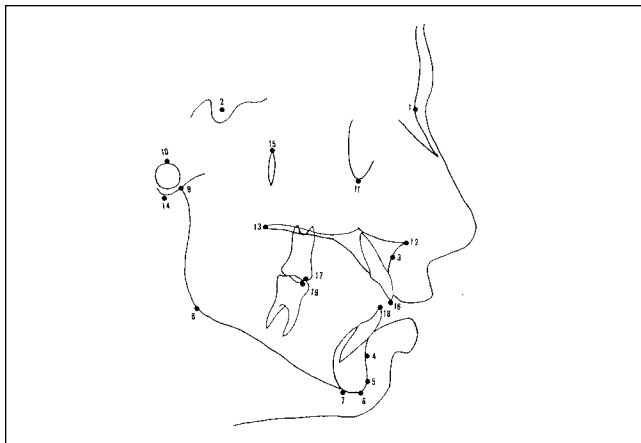


Figure 1. Cephalometric Reference Points

1. N: Nasion
2. S: Sella
3. A
4. B
5. Pg: Pogonion
6. Gn: Gnathion
7. Me: Menton
8. Go: Gonion
9. Ar: Articulare
10. Po: Porion
11. Or: Orbitale
12. ANS: Spina nasalis anterior
13. PNS: Spina nasalis posterior
14. Ba: Basion
15. Ptm: Fissure of Pterygomaxiller
16. Incisal tip of upper 1. incisor
17. Incisal tip of lower 1. incisor
18. Cusp tip of upper 1. molar
19. Cusp tip of lower 1. molar

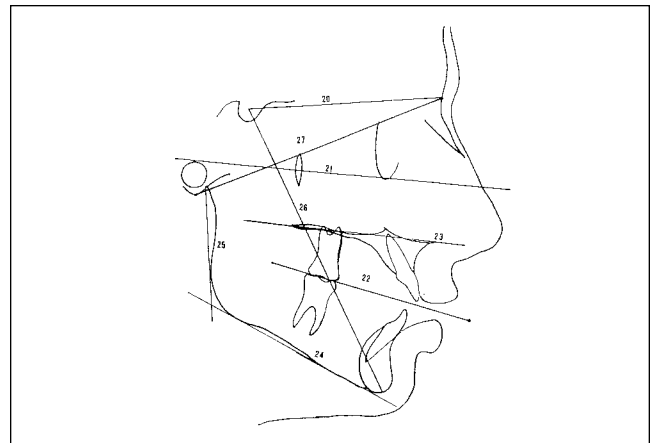


Figure 2. Cephalometric Reference Lines

20. SN
21. FH: Frankfurt horizontal plane
22. OP: Occlusal plane
23. PP: Palatal plane
24. MP: Mandibular plane
25. RP: Ramus plane
26. Y Axis
27. Nasion-Basion plane

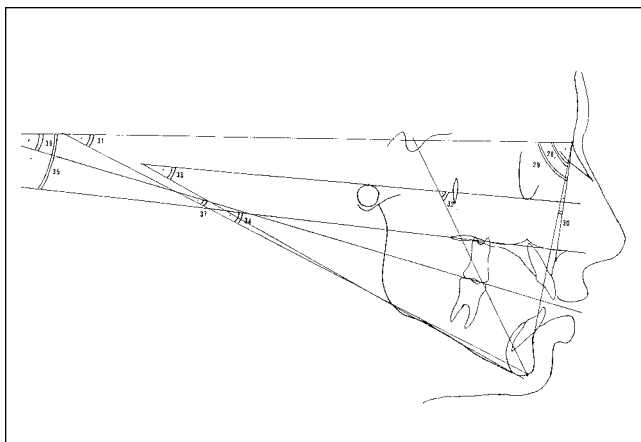


Figure 3. Angular Measurements

28. SNA
29. SNB
30. AN B
31. Go-Gn-SN
32. Y axis
33. FMA
34. ANS-PNS/MP
35. ANS-PNSISN
36. OP/SN
37. OPIMP

to this, many researchers used twin buccal blocks, splint of buccal segment intrusion and intrusive activator, bionator, kinetor, passive spring and magnetic posterior bite-blocks in the open-bite functional treatment.^{10,17,18}

This report presents the functional treatment and treatment responses of three skeletal open-bite patients.

MATERIALS AND METHODS

Of the functional appliances, the Bionator, Frankel IV, Posterior bite-block has been used in 3 patients with dental and skeletal anterior open-bite malocclusion and in this report. The results obtained from this exercise will be presented. Before the appliances were delivered, cephalometric and hand-wrist films have been taken frontal, lateral, facial and intraoral view have been photographed. Films and photographs have been repeated after leaving the appliances. Twenty-six parameters, which consisted of 16 skeletal and 10 dental factors, were used to evaluate the treatment changes. Cephalometric reference lines, points, angular and linear measurements were seen in Figures 1 to 4.

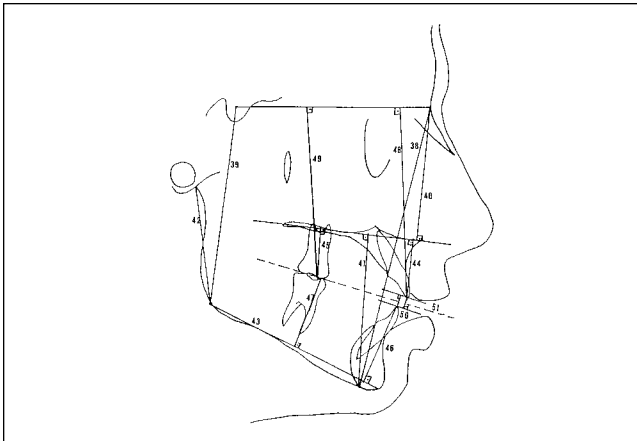


Figure 4. Linear Measurements

- 38. AFH: Anterior facial height
- 39. PFH: Posterior facial height
- 41. UFH: Upper facial height
- 42. LFH: Lower facial height
- 43. Ramus Height
- 44. Corpus Length
- 45. Upper 1. Incisor \pm ANS-PNS: Upper anterior dentoalveolar height
- 46. Upper 1. Molar \pm ANS-PNS: Upper posterior dentoalveolar height
- 47. Upper 1. Incisor I Go-Gn: Lower anterior dentoalveolar height
- 49. Upper 1. Incisor I SN
- 50. Upper 1. Molar \pm SN
- 51. Overjet
- 52. Overbite

CASE I

Diagnosis

First case was a patient whose skeletal age is 9 years 2 months and chronological age is 10 years 3 months.

The patient had the typical facial characteristics of the open bite anomaly with the dolicephalic face, convex facial profile and the increase of the inferior facial height. It was noted that he had difficulty closing his mouth from the wrinkling of the muscles in mental region when he closed his mouth (Figure 5).

Diastemas in lower and upper teeth region were observed as well as 4 mm. open-bite (Figure 6). Together with this, he had an overjet of 7.5 mm. The cephalometric evaluation showed Class II skeletal pattern ($ANB=70$). He had hyperdivergent vertical growth pattern (For example $Go-Gn-SN=38.5^\circ$).

He had a finger sucking habit. He was advised to quit the sucking habit. Nevertheless, when this was not sufficiently accomplished, the patient worked with a child psychologist to quit the habit.

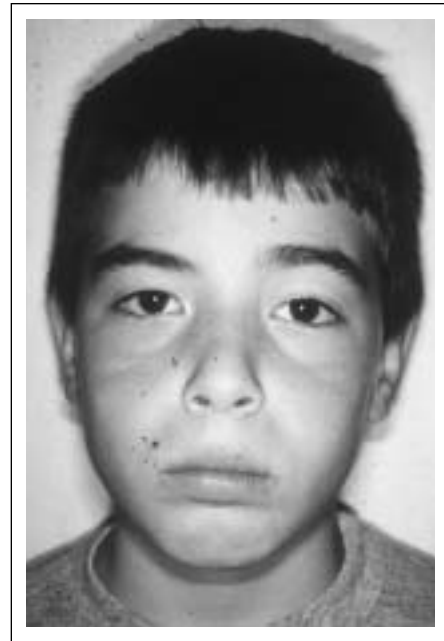


Figure 5. Case 1. Pretreatment facial photographs
a) Frontal view

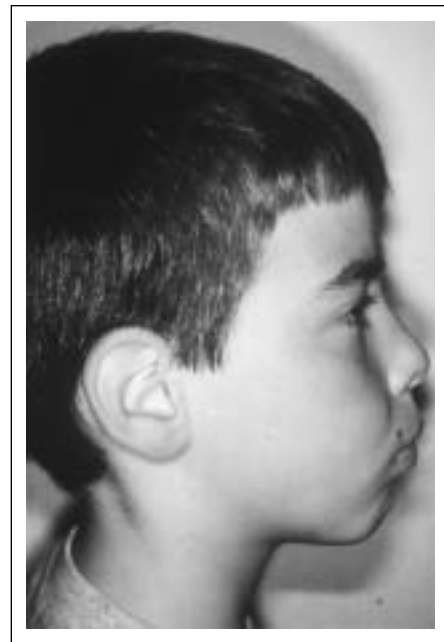


Figure 5. Case 1. Pretreatment facial photographs
b) Profile view



Figure 6. Case 1. Pretreatment intraoral photographs
a) Left
b) Right
c) Frontal

Treatment

The patient wore the open-bite bionator. He used the appliance a minimum of 18 hours a day. In 10 months, the elimination of the open-bite was obtained and a 2mm normal overbite relation was achieved, which was 4 mm open-bite before the treatment. As seen in the pictures, a decrease in the vertical development was obtained. The patient began to



Figure 7. Case 1. Post treatment facial photographs
a) Frontal view
b) Profile view

close his mouth more easily. The difficulty in muscles were eliminated (Figures 7 to 9).

In Table-I, cephalometric evaluation of the pretreatment values and post treatment changes of the patient is seen. The cephalometric super impositions before and after using the appliances are seen in Figure 10.



Figure 8. Case 1. Post treatment intraoral photographs
 a) Left
 b) Right
 c) Frontal

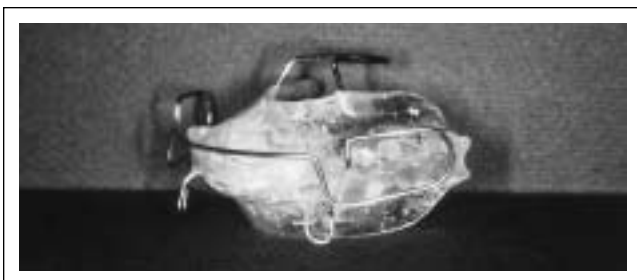


Figure 9. Bionator appliance

Table 1. Cephalometric evaluation of Case 1

MEASUREMENTS	PRETREATMENT	POST TREATMENT
SKELETAL ANGULAR		
SNA	83°	83°
SNB	76°	76°
ANB	7°	7°
So-Gn-SN	38.5°	37°
FMA	33.5°	31.5°
Y Axis	65°	62.5°
ANS-PNS/MP	24.5°	21°
SN/ANS-PNS	12°	13.5°
SKELETAL LINEAR		
Na-Me	116.5 mm	117.5 mm
Se-Go	70 mm	72 mm
Se-Go/Na-Me	60	61
(Na/ANS-PNS)/ (Me/ANS-PNS)	95	98
Na/ANS-PNS	57 mm	60 mm
Me/ANS-PNS	60 mm	61 mm
Ramus Height	45 mm	48.5 mm
corpus Length	71 mm	74 mm
DENTOALVEOLER ANGULAR		
OP/MP	16°	17°
OP/SN	22°	21.5°
DENTOALVEOLER LINEAR		
Overjet	7.5 mm	2.5 mm
Overbite	-4 mm	2 mm
Upper 1. Molar^ANS/PNS	18 mm	21 mm
Lower 1. Molar^Go-Gn	29 mm	29.5 mm
Upper 1. Incisor^ANS-PNS	22.5 mm	25 mm
Lower 1. Incisor^Go-Gn	37 mm	40 mm
Upper 1. Molar^SN	66.5 mm	67.5 mm
Upper 1. Incisor^SN	80 mm	83.5 mm

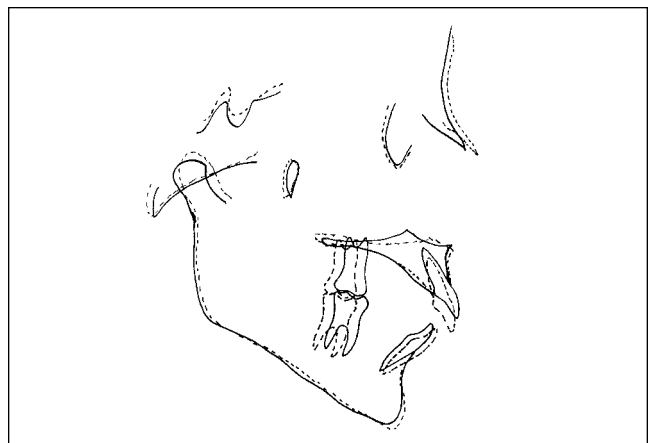


Figure 10. Case 1. Super-impositions of tracings from pretreatment (solid line) to post treatment (dashed lines).



Figure 11. Case 2. Pretreatment facial photographs
a) Frontal view
b) Profile view



Figure 12. Case 2. Pretreatment intraoral photographs
a) Left
b) Right
c) Frontal

CASE 2

Diagnosis

The patient was a girl whose skeletal age is 8 years and chronological age is 9 years, 6 months.

She had the facial characteristics of the open bite anomaly with the dolicephalic face and convex facial profile pattern (Figure 11). In intraoral view there was seen 2mm open-bite, 3mm overjet and lack of space. She had Class I dental pattern in the transitional dentition period (Figure 12). The cephalometric evaluation

showed Class II skeletal pattern ($ANB=3$) and hyperdivergent vertical growth pattern (For example $Co-Gn-SN = 38^\circ$).

Treatment

She was given a Frankel IV appliance. She was advised to use it minimum 18 hours a day. Lip exercises were also given. The appliance was weaned for 8



Figure 13. Case 2. Post treatment facial photographs
a) Frontal view
b) Profile view



Figure 14. Case 2. Post treatment intraoral photographs
a) Left
b) Right
c) Frontal

months eliminating the 2mm. open-bite after this period of time (Figures 13 to 15).

In Table 2, were seen cephalometric evaluations of the pretreatment values and post treatment changes

of the patient. The cephalometric superimpositions before and after using the appliances were seen in Figure 16.



Figure 15. Frankel IV appliance

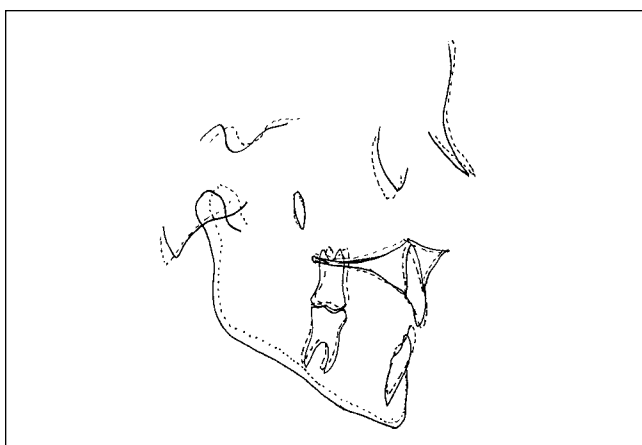


Figure 16. Case 2. Superimpositions of tracings from pretreatment (solid line) to post treatment (dashed lines).

Table 2. Cephalometric evaluation of case 2.

MEASUREMENTS	PRETREATMENT	POST TREATMENT
SKELETAL ANGULAR		
SNA	77.5°	77.5°
SNB	74.5°	75.5°
ANB	3°	2°
Go-Gn-SN	38°	35°
FMA	33°	31°
Y Axis	65°	70.5°
ANS-PNS/MP	30.5°	33°
SN/ANS-PNS	8°	6°
SKELETAL LINEAR		
Na-Me	117 mm	105 mm
Se-Go	63 mm	62.5 mm
Se-Go/Na-Me	37	59
(Na/ANS-PNS)/ (Me/ANS-PNS)	85	90
Na/ANS-PNS	49 mm	49 mm
Me/ANS-PNS	56 mm	54 mm
Ramus Height	36.5 mm	37 mm
corpus Length	64 mm	65 mm
DENTOALVEOLAR ANGULAR		
OP/MP	16.5°	18°
OP/SN	22.5°	21°
DENTOALVEOLAR LINEAR		
Overjet	3 mm	2 mm
Overbite	-2 mm	0 mm
Upper 1. Molar^ANS/PNS	18 mm	17 mm
Lower 1. Molar^Go-Gn	23.5 mm	22.5 mm
Upper 1. Incisor^ANS-PNS	23 mm	24 mm
Lower 1. Incisor^Go-Gn	30.5 mm	31 mm
Upper 1. Molar^SN	61 mm	62.5 mm
Upper 1. Incisor^SN	71 mm	71 mm



Figure 17. Case 3. Pretreatment facial photographs
 a) Frontal view
 b) Profile view



Figure 18. Case 3. Pretreatment intraoral photographs
 a) Left
 b) Right
 c) Frontal

CASE 3

Diagnosis

The patient was a girl whose skeletal age was 10 and chronological age was 11 years 3 months.

She had the most absolute characteristics of the open-bite both in terms of out look and cephalometric aspect. Doliocephalic face, convex facial profile with a hyperdivergent facial pattern, a mildly acute nasolabial angle and quite poor mental muscle activities were

seen. The patient was hardly able to close her mouth (Figure 17).

There was not much of a big problem other than the 4.5mm. open bite in intraoral view. Upper and lower arches are correct. Also, she had Class I dental pattern and an overjet of 8 mm (Figure 18). The cephalometric evaluation showed Class II skeletal pattern ($ANB=7.50$) and a hyperdivergent vertical growth pattern (For example $Go-Gn-SN=48.5^\circ$).



Figure 19. Case 3. Post treatment facial photographs
a) Frontal view
b) Profile view



Figure 20. Case 3. Post treatment intraoral photographs
a) Left
b) Right
c) Frontal

For this patient, the open-bite abnormality showed a hereditary characteristic so that her sister has also been treated for the same abnormality at our clinic.

Treatment

Posterior bite-block was applied to this patient, and she was advised to use it for at least 18 hours a day. In 10 months, the 4.5mm open-bite is eliminated obtaining

of 1mm overbite. Together with this, vertical growth decreased obtaining quite positive changes in frontal and lateral views. It was easier for the patient to close her mouth (Figures 19 to 21).

In Table 3, are seen the cephalometric evaluation of the pretreatment values and post treatment changes of the patient. The cephalometric superimpositions before and after using the appliances are seen in Figure 22.

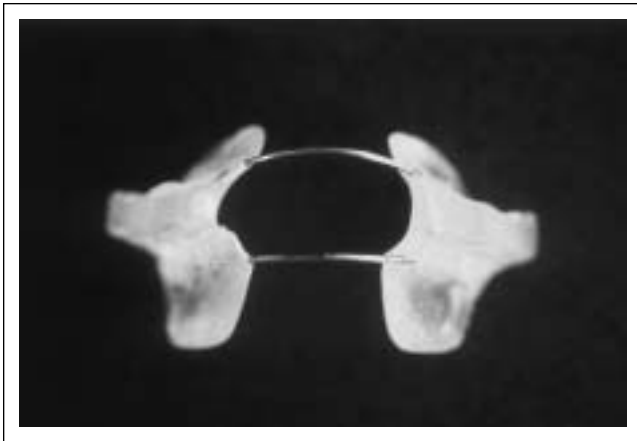


Figure 21. Posterior bite-block appliance



Figure 22. Case 3. Superimpositions of tracings from pretreatment (solid line) to post treatment (dashed lines).

Table 3. Cephalometric evaluation of case 3

MEASUREMENTS	PRETREATMENT	POST TREATMENT
SKELETAL ANGULAR		
SNA	78°	77°
SNB	70.5°	72°
ANB	7.5°	5°
Go-Gn-SN	48.5°	41°
FMA	37°	38°
Y Axis	68.5°	69.5°
ANS-PNS/MP	37°	35°
SN/ANS-PNS	11.5°	11°
SKELETAL LINEAR		
Na-Me	124.5 mm	126.5 mm
Se-Go	68.5 mm	72.5 mm
Se-Go/Na-Me	55	57
(Na/ANS-PNS)/ (Me/ANS-PNS)	78	79
Na/ANS-PNS	54 mm	55 mm
Me/ANS-PNS	69 mm	79 mm
Ramus Height	69mm	41.5 mm
Corpus Length	70mm	71 mm
DENTOALVEOLAR ANGULAR		
DP/MP	23.5°	20.5°
DP/SN	25°	24.5°
DENTOALVEOLAR LINEAR		
Overjet	8mm	5mm
Overbite	-4.5mm	0mm
Upper 1. Molar^ANS/PNS	20 mm	21 mm
Lower 1. Molar^Go-Gn	28.5 mm	29 mm
Upper 1. Incisor^ANS-PNS	28.5 mm	31.5mm
Lower 1. Incisor^Go-Gn	40mm	42mm
Upper 1. Molar^SN	66mm	67mm
Upper 1. Incisor^SN	81.5mm	85mm

DISCUSSION

As seen in the cephalometric superimposition the protrusion and upper and forward rotation of mandible eliminated the open-bite abnormality. In our findings, during the changing direction of the mandibular development, adaptive bony development of the condyle, vertical development in posterior region, an increase in ramus length, and a decrease to the lower facial height were observed.

The direction of development changed from the results, which were observed during the active functional treatment. As is seen in cephalometric evaluations, an increase in the ramus and corpus lengths, a decrease in angles of Go-Gn-SN, OP/MP and ANS-PNS/MP, which showed the inclination of the vertical development, mean a decrease in the mandibular plane obliqueness so that the protrusion and superior rotation of the mandible.

The tongue is the most important factor for developing a malocclusion. With the Bionator appliance, the tongue is kept intraoral. Together with forward rotation of the mandible and existing tongue effects, which increase the development to the upper and lower anterior dentoalveolar region has played such a great role in eliminating of the malocclusion.^{17,19}

Frankel and Frankel⁹ stated that the Frankel IV appliance is an exercising appliance, which can treat poor posture of orofacial muscles.

Especially, as it is seen in the skeletal pattern, it is concluded that, after treatment with FR IV appliance, it can be possible to obtain a suitable posture and a normal contact relation of upper and lower lips.^{12,14} This observation by investigators showed that, the lip exercises that we applied to our patients have a positive result.

Posterior bite-block provides the protrusion and upper rotation of the mandible.¹⁰ In addition to this, forming the most absolute changes both in bases of skeletal and dentoalveolar structure, it provides the correction of malocclusion.

CONCLUSION

Open-bite malocclusion is the one in treatment group, which has the most possibility of relapse. The most important feature for dental treatment is the stability of treatment. The functional treatment methods, when applied in early and active stages of growth and development, provide positive stable results by turning vertical development towards horizontal development.

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