http://dx.doi.org/10.35630/2199-885X/2021/11/1.31

THE EFFICIENCY OF ORTHODONTIC TREATMENT OF CLASS II MALOCCLUSION IN CHILDREN WITH B -THALASSEMIA MAJOR

Received 10 February 2021;
Received in revised form 24 February 2021;
Accepted 26 February 2021

Ramida Shadlinskaya ✉, ***Zaur Novruzov***,

Department of Child Dentistry, Azerbaijan Medical University, Baku, Azerbaijan

✉ *r.shadlinskaya@yahoo.com*

ABSTRACT — Aims: Evaluation of the effectiveness of orthodontic treatment of Class II malocclusion with the Twin-block appliance in children withβ-thalassemia major. Methods: The study was conducted with 49 patients with Class II malocclusion aged 10-14 years. The control group included 23 healthy patients. The main group included 26 patients with β-thalassemia major. Patients had received orthodontic treatment with a Twin-block appliance. The duration of orthodontic treatment was 1.5–2 years. Results: In both groups, a statistically significant increase in the SNB angle was observed. Subsequently, the ANB angle was normalized. The effective length of the maxilla growing and mandibular length increasing was observed. Overjet distance is decreased due to favorable torque changes. Pre-treatment assessment revealed that overbite was smaller in children with β-thalassemia major. As the effect of orthodontic treatment, statistically, significant changes were observed on both overjet and overbite distances ($p < 0.001$). Conclusions: Orthodontic treatment of β-thalassemia major of patients with Twin-block appliance in mixed dentition stage is effective in improving inter arch relationships and the orofacial functions.

KEYWORDS — β –thalassemia, orthodontic treatment, distal occlusion, twin-block.

INTRODUCTION

β-thalassemia major, which is based on the defect in the synthesis of the β-chain of hemoglobin, caused by a mutation in 11 pairs of chromosomes, is one of the life-threatening hereditary blood diseases. Severe anemia underlying β-thalassemia major causes intense but ineffective erythropoiesis and extramodular hematopoiesis [1]. The main treatment for the disease is regular blood transfusions, which reduces the degree of bone marrow activity. Untimely blood transfusion regimen causes hyperplasia and bone marrow proliferation. This leads to pronounced changes in the development of the bones of the face and skull and forms the characteristic appearance of patients: an increase in the parietal regions (*tower* skull), zygomatic bones, flattening of the bridge of the nose, a wide distance between the orbits of the eyes (Fig. 1). The strongly protruding upper jaw creates the typical pathognomic appearance of a thalassemic patient — the face of a *chipmunk*. The lateral skull radiograph shows a widening of marrow cavities.

Fig. 1. *Photo of β-thalassemia major patient (13-year-old)with Class II malocclusion*

According to the literature, the main facial changes in patients with β-thalassemia major who are on permanent blood transfusion include the distal position of the lower jaw in combination with the underdevelopment of its body, which creates conditions for the formation of a skeletal Class II dentoalveolar anomaly (distal occlusion) [2, 3].

Class II anomaly is one of the most common dentoalveolar anomalies among children [4, 5]. Class II is distinguished by the anterior position of the maxilla relative to the mandibula, dental arch discrepancies, masticatory muscle hyperactivity, etc. Distal occlusion also leads to functional and aesthetic defects [6, 7].

Since dentists have little awareness of the essence of β-thalassemia major, there is no algorithm for the

provision of orthodontic care for patients with this pathology. Treatment of craniofacial disorders in the appropriate age period is of great practical importance for the prevention of the following changes in the stomatognathic system and social adaptation of patients with β-thalassemia [3, 8].

Aim

Evaluation of the effectiveness of orthodontic treatment of Class II malocclusion with the Twin-block appliance in children withβ-thalassemia major.

MATERIAL AND METHODS

The work was carried out in the dental clinic of the Azerbaijan Medical University from 2015 to 2017. Observations were performed on data from 49 patients with distal occlusion at the age of 10–14 years. The surveyed patient population was divided into 2 groups. The control group (group 1) consisted of 23 patients with Class II skeletal due to underdevelopment of the lower jaw, without any syndromic and systemic diseases (mean age 11.8 ± 2.4 years). The main group (group 2) included 26 patients with β-thalassemia major (mean age 12.2 ± 1.9 years). All patients of group 2 underwent regular transfusion of erythrocyte mass, due to which the level of hemoglobin in the blood was normalized. All patients had not previously received orthodontic treatment. Since the type of growth and development of the upper and lower jaws is of decisive importance for the harmonious shaping of the face during growth, in our treatment, we used a functional Twin-block orthodontic appliance, which is used to modify the growth of the lower jaw and to completely correct the ratio of the jaws in the sagittal plane. In each group, the duration of orthodontic treatment was 1.5–2 years. All patients underwent complex clinical and radiological examinations before and after treatment. Changes in the parameters of the jaws, dentition, and soft tissues were studied on lateral cephalograms. To determine the effectiveness of orthodontic treatment, comparative cephalometric analyzes were carried out before and after treatment between the study groups. For statistical analysis, analysis of variance and Student's t-test was used.

RESEARCH RESULTS

In patients with β-thalassemia major, an enlargement of the maxilla and zygomatic bones, a change in the configuration of the midface due to flattening of the bridge of the nose, was observed. Also, a lag in the growth of the body of the lower jaw and vertical rotation of the lower jaw was observed. In most cases, the upper lip was shortened and protruded, as a result of which the frontal teeth of the upper jaw were significantly exposed. As a result of abnormal perioral muscle tone, nasal breathing disorders were observed.

Healthy children with distal occlusion demonstrated a slightly prominent maxilla and the middle third of the face, but the incomponent lips, changes in the labiomental angle, and retropositon of the chin attract the attention (Fig. 2). As can be seen in figure 2, the profile is corrected by the forward displacement of the mandibula induced by the Twin-block appliance.

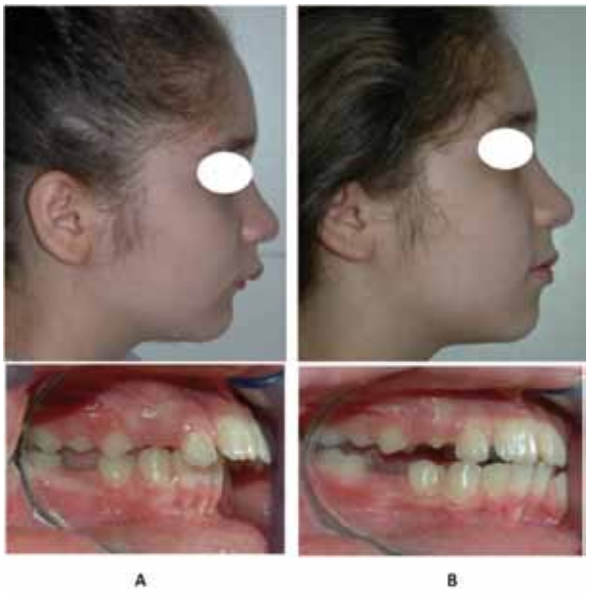

Fig.2. *11-year-old patient with Class II. A-before treatment, B-after treatment*

In group 1, parameter SN, which represents the length of the anterior cranial base, increased to 1.15 m (p <0.001). There was also a decrease in the SNA angle at 0.29° (p <0.001). Under the treatment effect of the Twin-block appliance, the SNB angle, which characterizes the position of the mandibular basal arch towards the anterior cranial base, increased at 1.25° (p <0,01). In the main group, the SNB angle increased at 2.78° (p <0.001). The SNA angle, which characterizes the position of the mandibular basal arch towards the anterior cranial base, was somewhat reduced in both groups. The angle of sagittal inter jaw relationship ANB decreased at 1.46° (p <0.001) in group I and 2.36° in group 2(p <0.001). The length of maxilla PNS-ANS (ANS-PNS) and the length of the mandibular (Co-Gn) increased in both groups. A relatively stable angle Go-Gn/SN indicates that the mandibula is not rotated downwards and backward towards the cranium base. There was a statistically significant increase in the parameters of N-ANS, ANS-Me, and N-Me, which

determine the anterior face height. The change in the N-S-Ar and S-Ar-Go angles during the observation period was statistically significant. The value of overjet in group 1 before treatment was 8.36 mm, and after treatment decreased to 3.78 mm (p <0.001), which is within the limits of the norm. In group 2, the value of the overjet was not greatly increased due to the rotation of the lower and upper incisors (3.68 ± 1.63 mm) (p <0.01). The overbite distance was 4.46 ± 1.98 mm in group 1 and 1.56 ± 0.98 mm in group 2. In group 1, as the result of treatment, there was a statistically significant reduction in the value of the overjet and overbite (p <0.001).

DISCUSSION

The increase in cranial base length was consistent with normal growth-development processes in both groups, where we believe that the main factor is the opposition of the Nasion area. The reason for the small decrease in the SNA angle is the prevention of maxillary growth caused by Twin-block treatment. Also, the change in torque values due to the effect vestibular arch of the appliance on the upper incisors, in turn, affects the point A region. Guilherme et al., Hagg et al. obtained similar results in their studies [9, 10]

Jena et al., Candir et al. observed anterior displacement in the mandible in their study of patients

Table 1. *Cephalometric parameters in groups*

Cephalometric parameters	Groups	Before treatment	After treatment	Difference	P
		M1±σ	M2±σ	M3±σ	
S-N	1	70,49±3,09	71,64±3,09	1,15±0,56	***
	2	67,78±3,83	69,04±2,76	1,26±0,43	***
SNA	1	82,43±3,19	82,14±3,23	-0,29±1,02	
	2	78,14±4,04	78,36±3,28	0,22±1,18	
SNB	1	75,54±3,15	76,79±3,24	1,25±1,39	**
	2	71,48±2,94	74,26±2,45	2,78±1,24	***
ANB	1	6,45±2,13	4,99±2,30	-1,46±1,01	***
	2	6,59±3,01	4,23±2,16	-2,36±1,14	***
ANS-PNS	1	58,41±3,64	59,34±4,70	0,93±1,94	*
	2	47,42±3.84	48,58±3.53	1,16±1,72	*
Co-Gn	1	110,00±8,40	113,70±9,33	3,70±2,49	***
	2	108,92±4,51	112,48±3,57	3,56±1,92	***
SN/GoGn	1	33,66±3,93	33,79±3,77	0,13±1,59	
	2	28,61±4,21	28,36±3,17	-0,25±1,12	
N-S-Ar	1	128,13±6,09	127,36±6,32	-0,77±3,17	
	2	127,22±5,62	128,36±5,62	1,14±2,36	
S-Ar-Go	1	137,21±5,80	138,46±4,53	1,25±4,25	
	2	139,72±7,35	141,84±5,46	2,12±3,88	*
Overjet	1	8,36±1,63	3,78±0,75	-4,58±1,59	***
	2	3,68±1,53	1,44±1,28	-2,28±1,45	**
Overbite	1	4,46±1,98	2,31±1,41	-2,15±1,72	**
	2	1,56±0,98	1,12±0,85	0,44±0,35	
N-ANS	1	55,33±4,16	55,75±3,84	1,39±1,35	**
	2	46,11±3,74	48,25±3,21	2,14±2,85	***
ANS-Me	1	64,41±6,28	67,46±7,21	3,05±1,41	***
	2	63,01±4,06	66,12±3,78	3,11±2,89	***
N-Me	1	115,26±8,97	119,76±9,48	4,5±1,66	***
	2	106,67±6,56	109,76±5,34	3,08±1,45	***

*Statistical significance of p p-value - p<0,05 ** — p<0,01 *** — p<0,001*

with distal occlusion [11,12]. In our groups, as a result of orthodontic treatment, the mandible moved forward. This is an expected result of the effect of Twin-block therapy. Correction of the sagittal inter-jaw relationship is ensured by the forward displacement of the mandible.

The effective length of the maxilla has increased according to the dynamics of normal growth. We think that the length of the mandible increases during the treatment with functional appliances. This is evidenced by the increase in both the SNB angle and the Co-Gn parameter. A bigger mandibular growth is a desirable outcome in the treatment of distal occlusion. Kanuru at all., in his study, highlighted the effect of activators on mandibular growth [13].

Against the background of the relatively stable Go-Gn/SN angle in the results of our study, the increase in vertical face size may seem contradictory. We think that this is due to the parallel downward movement of the mandibular bone. In this case, the angle does not change, but the anterior height of the face increases. The presence of statistically significant increases in N-ANS, ANS-Me, and N-Me parameters can be considered normal because patients are in the growth period. Overjet distance decreased by 4.58 mm in group 1. The reduction of the overjet was caused by mandibular displacement and, to a lesser extent, the torque movement of the incisors.

We observed a large amount of displacement in the incisors, especially in patients with β-thalassemia major. We think this is related to bone structures. Also in thalassemic patients, before treatment, the overjet distance is latent due to the lower-back rotation of the upper incisors. The overbite distance is smaller in main group patients before treatment due to protrusion of the lower incisors.

CONCLUSION

Analysis of the cephalometric data of patients with β-thalassemia major and healthy children with Class II revealed a significant difference of the parameters, which indicate anteroposterior jaw relationships. Orthodontic treatment β-thalassemia major patients with Twin-block appliance in mixed dentition stage is effective in improving interarch relationships and the functioning of the orofacial appliances.

REFERENCES

1. **Weatherall, D.J.** Thalassemia Syndromes / D.J.Weatherall, J.B.Clegg The //3rd ed., Oxford: Blackwell, 2001, p. 132–174
2. **Başsimitçi Ş, Yücel-Eroğlu E, Akalar M.** Effects of Thalassaemia Major on Components of the Craniofacial Complex. British Journal of Orthodontics [Internet]. Maney Publishing; 1996 May;23(2):157–62.http://dx.doi.org/10.1179/bjo.23.2.157
3. **Abu Alhaija, E.S.J.** Cephalometric Measurements and Facial Deformities in Subjects with Beta – thalassemia Major / E.S.J.AbuAlhaija, F.N.Hattab, M.A.Al – Omari // Eur. J. Orthod., 2002, vol. 24 (1), p. 9–194.
4. **NovruzovZ.G., AliyevaR.K., GarayevZ.I., KuliyevaS.K.** Effect on the stomatognathic system of the modified twin-block appliance used in the treatment of distal bite// Kazan med.j. 2018, vol. 3, p. 426–432
5. **Proffit W.R., Fields H.W.J, Sarver D.M.** Contemporary Orthodontics. 5th edn. Elsevier Mosby, St Louis, 2013. 754 p.
6. **Angelieri F., Franchi L., Cevidanes Lh., Scanavini M.A., and Mcnamara, JA** Long-term treatment effects of the FR-2 appliance: a prospective evalution 7 years post-treatment // Eur. J. of Orthod., 2014, № 36, p. 192–199.
7. **Bock N.C., Saffar M., Hudel H., Evälahti M., Heikinheimo K.** Long-term (≥15 years) post-treatment changes and outcome quality after Class II:1 treatment in comparison to untreated Class I controls // European J. Orthod., 2018, Vol 40, №2, p. 206–213
8. **Shadlinskaya, R. & Gasymova, Z. & Gasymov, O.** (2019). Cephalometric evaluation of patients with β-thalassemia major living in Azerbaijan. Stomatologiya. 98. 65 10.17116/stomat20199804165.
9. **Guilherme J., Nuria C.B., Aron Aliaga-Del C., José F.C. H.Juliana F.M.** Soft tissue treatment changes with fixed functional appliances and with maxillary premolar extraction in Class II division 1 malocclusion patients // European Journal of Orthodontics. 2018, №40(2), p. 214–222.
10. **Hagg U., Du X., Rabie B.M., Bendeus M.** What does headgear add to Herbst treatment and to retention? // Seminars in Orthodontics, 2003, №9, p.57–66.
11. **Jena A.K., Singh S.P., Utreja A.K.** Effectiveness of twin-block and Mandibular Protraction Appliance-IV in the improvement of pharyngeal airway passage dimensions in Class II malocclusion subjects with a retrognathic mandible // Angle Orthod, 2013, №83(4), p. 728–734.
12. **Candir M., Kerosuo H.** Mode of correction is related to treatment timing in Class II patients treated with the mandibular advancement locking unit (MALU) appliance // Angle Orthod, 2017, №87, p. 363–370.
13. **Kanuru R.K., Bhasin V., Khatri A., et all.** Comparison of Complications in Removable Mandibular Acrylic Splint and Cantilever Herbst for Management of Class II Malocclusion: A Retrospective Study // J. Contemp. Dent. Pract., 2017, №18(5), p. 363–365.