Original Article

Comparison of the Change in Inferior Sclera Exposure after Maxillary Protraction with or Without Skeletal Anchorage

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Abstract

Aim: The aim of this retrospective study was to evaluate the change in inferior sclera exposition after maxillary protraction with or without skeletal anchorage in patients with maxillary retrognathia. **Materials and Methods:** Fifteen patients (Group 1) who applied maxillary protraction with teeth-supported appliance and fifteen patients who applied maxillary protraction with skeletal anchorage (Group 2) were compared in order to investigate the effect of different maxillary protraction methods on the visibility of sclera. The patients in both groups had dental and skeletal Class III malocclusion with maxillary retrusion (ANB <0; SNA <80), increased vertical growth pattern (SnGoGn >32) (long face), increased sclera exposure, and no congenital anomalies and dentofacial deformities. Pre- and posttreatment records were used to assess the amount of visible sclera on facial photographs using Adobe Photoshop CS6 program and the change in the movement of maxilla on cephalometric film. The pretreatment and after maxillary protraction values were compared statistically by the Wilcoxon signed-rank test (level of significance, $P < 0.05$). **Results:** The amount of inferior sclera exposure to eye height decreased in the right and left eyes of the 30 patients with maxillary protraction. The amount of inferior sclera exposure to eye height of the right and left eyes decreased from 3.59 to 3.5 and from 3.44 to 3.39, respectively, in Group I ($P = 0.001$ and $P < 0.001$, respectively). The amount of inferior sclera exposure to eye height of the right and left eyes decreased from 4.17 to 3.93 and from 3.86 to 3.68, respectively, in Group II ($P = 0.001$ and $P < 0.001$, respectively). **Conclusion:** There were important results in both of the two methods. Although more improvement was obtained in the skeletal anchorage group, statistically no significant differences were found between the groups.

Keywords: *Maxillary protraction, sclera exposure, skeletal anchorage*

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Introduction

The orbital region is important component of the facial esthetics.[1] In examination of the orbital region of the position of the eyes, their relative distance and visibility are significant.[1] The visible part of the eye accounts for approximately one-sixth of the entire eye globe and is made up of 3 vital constituents: the white sclera, the colored iris, and the black pupil.[1,2] The contrast between the exposed sclera and the colored iris and pupil relieves the eye movement.[1,2] The position of the moveable lower eyelids can change after maxillary movements and lead to a change in inferior sclera exposure.[2,3]

When facial photographs are investigated for esthetic evaluation, sclera should not be exposed between the lowermost point of the iris (inferior limbus) and the lower lid margin in the orbital view when the head is in a neutral position and the forehead and the eyebrows are relaxed.[2,4]

The increase in the exposure of sclera below the iris is a clinical indication and a characteristic orbital feature of patients with midfacial hypoplasia or maxillary

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retrognathia. The movements of maxilla can affect the amount of visible sclera.[2,4]

Maxillary retrognathia is the most common condition in skeletal Class III malocclusion, and maxillary protraction with face mask is the most effective treatment approach in growing patients.[5,6] There are face mask applications that support directly from the maxilla with skeletal anchorage as well as applications which are supported by the teeth.[6] Although the amount of visible sclera has been analyzed according to the orthognathic surgical procedures,[2,7] there is no study analyzing the change of sclera in maxillary orthopedic applications.

The aim of this study was to evaluate the change in inferior sclera exposition after maxillary protraction with or without skeletal anchorage in patients with maxillary retrognathia.

Materials and Methods

Ethical approval for this retrospective study was obtained from the local ethics committee of Akdeniz University.

The study included skeletal Class III individuals treated between 2014 and 2017 at the Department of Orthodontics of the Faculty of Dentistry of the Akdeniz University. All patients who were routinely selected from the records before and after the treatment were eligible for the study criteria. These records include lateral cephalometric radiographs, intraoral and facial photographs. Fifteen patients (Group 1) who applied maxillary protraction with teeth-supported appliance [Figure 1] and fifteen patients who applied maxillary protraction with skeletal anchorage (Group 2) were compared in order to investigate the effect of different maxillary protraction methods on the visibility of sclera [Figure 1]. The patients in both groups had dental and skeletal Class III malocclusion with maxillary retrusion (ANB <0; SNA <80), increased vertical growth pattern (SnGoGn >32) (long face), increased sclera exposure, and no congenital anomalies and dentofacial deformities.

Standardized pretreatment and posttreatment facial photographs were taken with an SLR digital camera (Canon EOS 450 D; Canon, Inc, Tokyo, Japan) mounted with a wide-angle lens. The same studio, ambient lighting, and camera were used to obtain the photographs for all patients. The camera was placed at a distance of 1 m from the patient. All photographs were taken in the natural head position while the patient was seated. The submandibular line of the patients was kept parallel to the floor.

Pre- and posttreatment records were used to assess the amount of visible sclera [Figure 2] on facial photographs using Adobe Photoshop CS6 program and the change in the movement of maxilla on cephalometric film [Figures 3 and 4].

The proportional relations of the pre- and posttreatment facial photographs were measured twice, and statistical analysis of the mean of the measurements was performed. Pre- and post-treatment values were compared statistically by the Wilcoxon signed-rank test (level of significance, $P < 0.05$).

Results

The maxilla moved forward (SNA 4.50 and 4.59) ($P < 0.001$) in Groups I and II, respectively. Descriptive demographics [Table 1] and results of the statistical comparison of the pre- and postprotraction proportions of inferior sclera exposure to eye height in all 30 patients are presented in Table 2. Statistical results of Groups I

Table 1: Comparison of the chronological ages and gender distributions between the groups

	Group I	Group II	*P*
Gender (*n*)			
Female	7	7	0.642
Male	8	8	
Age (year)	11.04±0.93	10.87±0.67	0.563

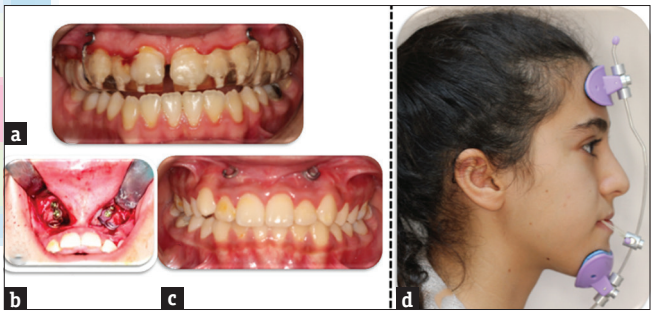

Figure 1: (a) İntraoral appliance for maxillary protraction in Group I. (b and c) The placement of skeletal anchorage units in Group II. (d) Petit-type face mask appliance for maxillary protraction in Groups I and II

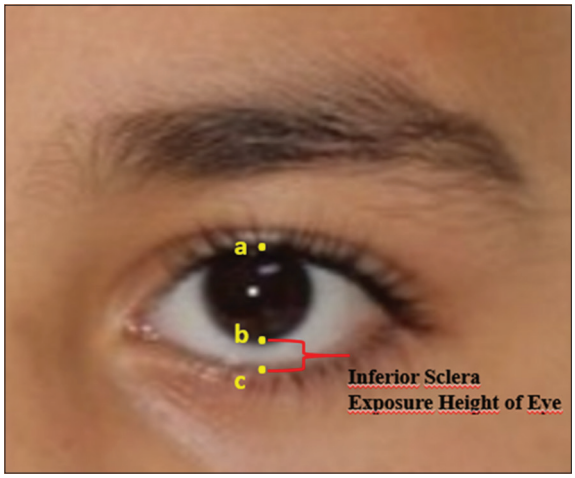

Figure 2: Landmarks used for evaluation: (a) inferior limbus; (b) lower eyelid margin; and (c) upper eyelid margin. The distance of b and c: Inferior sclera exposure height of the eye

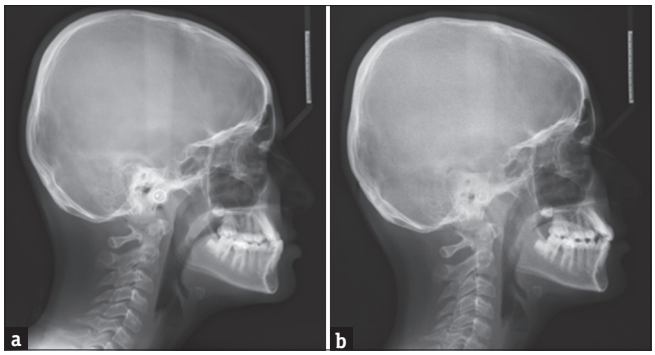

Figure 3: Pretreatment (a) and posttreatment (b) lateral cephalometric radiographs in Group I

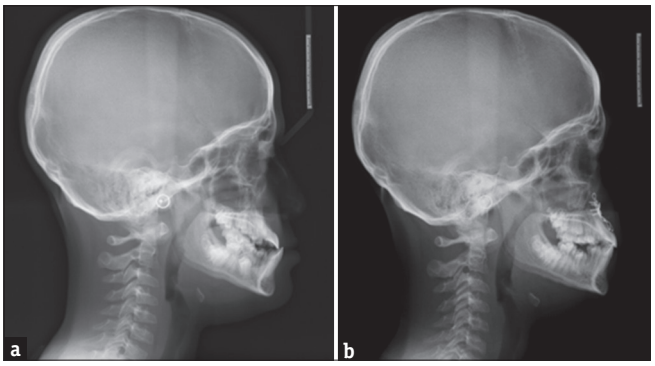

Figure 4: Pretreatment (a) and posttreatment (b) lateral cephalometric radiographs in Group II

Figure 5: Pretreatment (a) and posttreatment (b) frontal view of a male patient with skeletal Class III deformity in Group I

Figure 6: Pretreatment (a) and posttreatment (b) frontal view of a male patient with skeletal Class III deformity in Group II

Table 2: Assessment of the changes in each groups

	Pretreatment			Posttreatment			*P*
	Mean±SD	Minimum	Maximum	Mean±SD	Minimum	Maximum	
Group I							
SNA (°)	74.8±1.33	72.8	77.2	79.3±1.33	77.3	81.7	<0.0001
Right eye (mm)	3.58±1.15	2.12	6.46	3.5±1.13	2.08	6.35	0.001
Left eye (mm)	3.44±1.07	2.07	5.98	3.39±1.06	2.03	5.89	<0.0001
Group II							
SNA (°)	75.23±2.02	71	75.5	79.82±2.04	78.3	82.8	<0.0001
Right eye (mm)	4.17±0.88	2.79	6.28	3.93±0.86	2.53	5.97	0.001
Left eye (mm)	3.86±0.81	2.61	5.78	3.68±0.81	2.42	5.58	<0.0001

SD=Standard deviation, P: $P < 0.001$: ***(Level of Significance), $P > 0.05$: (NS) Non-significant

Table 3: Statistical comparison of the mean changes between the groups

	Mean±SD		*P*
	Group I	Group II	
SNA (°)	4.5±1.33	4.59±2.02	NS
Right eye (mm)	0.07±0.03	0.24±0.04	NS
Left eye (mm)	0.05±0.03	0.18±0.06	NS

NS=Not significant; SD=Standard deviation

and II are presented in [Tables 2 and 3]. The proportion of inferior sclera exposure to eye height in the right eye decreased from 3.58 to 3.5, and the proportion of inferior sclera exposure to eye height in the left eye decreased from 3.44 to 3.39 in Group I [Figure 5]. The decrease in inferior sclera exposure was statistically significant for the right and left eyes in Group I ($P < 0.001$). The proportion of inferior sclera exposure to eye height in the right eye decreased from 4.17 to 3.98, and the proportion of inferior sclera exposure to eye height in the left eye decreased from 3.86 to 3.68 in Group II [Figure 6]. The decrease in inferior sclera exposure

was statistically significant for the right and left eyes in Group I ($P < 0.001$). The difference in decrease of inferior sclera exposure between the two groups was not statistically significant for the right and left eyes ($P > 0.05$).

Discussion

An evaluation of the orbital region should be included in the pretreatment clinical examination of patients scheduled for planning of orthodontic treatment.[2,8] Facial analysis of the patient can be performed not only by clinical examination but also by facial photographs or radiographs.[2,8] Standardized facial photographs were used for the assessment in the present study. Millimetric measurements can be performed on photographs by performing calibration.

Inferior sclera exposure may be a sign of exophthalmos, trauma, lower eyelid laxity, or dentofacial deformities related to maxillary retrognathia.[2,8] Patients who had exophthalmos or previous trauma were removed in the present study. All patients included in the present study were adolescent 9–13 years old.

The lower eyelids of patients with midfacial retrognathia are at an inferior position owing to insufficient support provided by the maxillary bone. This leads to increased inferior sclera exposure, even in younger individuals.[2,9,10] The results of this study showed that maxillary protraction with skeletal anchorage can improve the position of the lower eyelids in patients with midfacial retrusion. Although the dimensional changes seem to be small, clinical observations of the results are remarkable [Figures 5 and 6].

Although there have been studies showing the change of the appearance of sclera exposure with orthognathic surgery in recent studies,[2,7] there is no study that investigates the change of the appearance of sclera exposure with maxillary orthopedic treatment. This study is the first to assess the height of inferior sclera exposure in patients with maxillary retrognathia and changes after maxillary protraction. According to the overall results of this study, the amount of inferior sclera exposed decreased significantly when maxillary protraction was performed. The height of inferior sclera exposure to the left eye height decreased by 0.18 mm after maxillary protraction with skeletal anchorage and decreased by 0.05 after conventional maxillary protraction. The height of inferior sclera exposure to the right eye height decreased by 0.19 mm after maxillary protraction with skeletal anchorage and decreased by 0.08 mm after conventional maxillary protraction. As a result, the amount of the maxillary protraction and inferior scleral exposure in the two groups are similar in this study.

Visible sclera is clinically undesired and is common in patients with maxillary retrognathia.[2] The amount of visible sclera is generally related to the severity of the anomaly.[2] The level and type of maxillary protraction affect the amount of correction of the lower eyelid position.[2] The position of the lower eyelids should be evaluated for treatment planning in patient with skeletal Class III malocclusion due to maxillary retrognathia.[2] In severe anomalies, even a small decrease in the exposure of the sclera has a major esthetic result on this dramatic area.[2]

Conclusion

- The increase in the visibility of sclera, which is symptom of midfacial hypoplasia, is reduced by successfully treating maxillary protraction in adolescent patients
- Patients with maxillary retrognathia are successfully treated with teeth or skeletal anchorage supported maxillary protraction
- There were important results in both of the two methods. Although more improvement was obtained in the skeletal anchorage group, statistically no significant differences were found between the groups.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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