Available online at www.sciencedirect.com

ScienceDirect

journal homepage: http://www.elsevier.com/locate/poamed

Case Report

Interception of developing class III malocclusion with temporary anchorage devices: A case report

Maciej Dobrzyński [a,1,*], *Katarzyna Miśków* [a], *Krzysztof Dowgierd* [b]

[a] *Stomatological Outpatient Clinic in Olsztyn, Poland*
[b] *Maxillo-Facial, Reconstructive and Esthetic Clinical Department in Children Hospital in Olsztyn, Poland*

ARTICLE INFO

Article history:
Received 1 July 2014
Accepted 24 July 2014
Available online 15 August 2014

Keywords:
Class III malocclusion
Anterior crossbite
Temporary anchorage devices
Miniplates
Class III elastics

ABSTRACT

Introduction: Class III malocclusion is a result of maxillary deficiency, mandibular prognathism or a combination of both, often accompanied by an anterior crossbite and a concave profile.
Aim: The aim of this work was to report and analyze a case of class III malocclusion.
Case study: The patient, a 12-year-old boy, attended Maxillo-Facial Clinic with the complaint of his lower jaw being in front. The pre-treatment examination showed a slight flattened subnasal area and the reverse overjet. For the maxillary protraction, de Clerck method of bone anchors and class III elastics were applied. After previous palatal expansion, the bone-anchored maxillary protraction was applied. The surgery was performed under general anesthesia. The surgical procedure consisted in placing four miniplates – one in each infrazygomatic buttress of the maxilla, and one in the anterior mandible between, and inferior to the left and right permanent lateral incisor and canine. The miniplates were loaded 3 weeks after the surgical procedure. After 7 months of treatment, the anterior crossbite was corrected.
Results and discussion: Cephalometric evaluation between the beginning of treatment and the end of maxillary protraction showed marked increase in ANB and Wits. A counter-clockwise rotation of the mandible was observed, as well as a slight clockwise rotation of the maxillary bone. The obtained results correspond to de Clerck's cephalometric investigations in class III patients who were treated with the use of bone-anchored maxillary protraction.
Conclusions: Temporary anchorage devices application enabled correction of the anterior crossbite and enhanced midfacial growth in young maxillary-deficient patient.

* *Correspondence to*: Stomatological Outpatient Clinic in Olsztyn, Żołnierska 18, 10-561 Olsztyn, Poland. Tel.: +48 604 795 947.
E-mail address: maciejdobrzynski@op.pl (M. Dobrzyński).
[1] Dentist, during specialization in Orthodontics. Specialization carried out at Specialist Orthodontics Outpatient Clinic, Mickiewicza 33/1, 10-508 Olsztyn, Poland.

http://dx.doi.org/10.1016/j.poamed.2014.07.014
1230-8013/

1. Introduction

Class III malocclusion is a result of maxillary deficiency, mandibular prognathism or a combination of both, often accompanied by an anterior crossbite and a concave profile.[1,2]

The prevalence of this malocclusion differs among various ethnic groups. The frequency among Caucasian individuals reaches 4%, and within the Asian population, it ranges between 4% and 14% as a result of a high percentage of patients with maxillary deficiency.[3]

For a long time, orthodontists have been trying to modify facial growth by application of orthopedic forces to the teeth to be farther transmitted to the skeletal base of the maxillary and mandibular bone.[1] Typical treatments of class III malocclusion include the use of a protraction facemask to advance the maxilla.[4] By the use of such an appliance, heavy anterior traction is applied on the maxillary bone to stimulate its growth and to limit or redirect mandibular bone growth.[1,5] On the other hand, the abovementioned devices often have unwanted side effects[4] including maxillary incisor proclination and clockwise rotation of the mandible contributing to increased vertical dimension of the face.[1,5,6] Furthermore, the time of wearing a facemask is usually reduced to 14 hours per day at best.[1]

To eliminate the aforementioned disadvantages of a facemask, Hugo de Clerck proposed the use of temporary anchorage devices in maxillary protraction. In this innovative technique bone anchors and class III elastics are applied.[7,8] Bone anchors used for anchorage allow applying pure bone-borne orthopedic forces between the maxillary and the mandibular bone for 24 hours, avoiding any dentoalveolar compensations.[1] The original de Clerck's bone anchor consists of a miniplate with 2–3 holes, a round connecting bar and a fixation unit with a blocking screw or a hook to fix the elastics directly. Within the maxilla, a 3-hole miniplate is used, whereas in the area of mandible only 2-hole miniplates are used.[4]

2. Case study

The patient, a 12-year-old boy, attended Maxillo-Facial, Reconstructive and Esthetic Clinical Department in Children Hospital in Olsztyn with the complaint of his lower jaw being in front. The pre-treatment examination showed that the patient had slightly flattened subnasal area, regular vertical proportions, facial symmetry and lip competence. Intraorally, reverse overjet (−2.5 mm) was observed (Fig. 1). Left upper first premolar had been extracted due to severe caries and there was a partial lack of space in the dental arch for the right upper permanent canine (Fig. 2). The cephalometric analysis confirmed a class III skeletal relationship with maxillary deficiency.

Fig. 2 – Pre-treatment panoramic radiograph.

The treatment purposes include the prevention of progressive unchangeable soft tissue and bony changes as well as the improvement of skeletal discrepancy and occlusal function. In the case of mild and moderate class III malocclusions, early orthopedic treatment allows eliminating the necessity for future orthognathic surgery treatment. Maximizing the growth potential of the maxilla coupled with correction of its transverse dimension may minimize the extent of the possible orthognathic procedures.

To achieve these objectives in a patient, after previous palatal expansion, the method of bone-anchored maxillary protraction was applied. The surgery was performed under general anesthesia. As the anchor, we used a 5-hole titanium miniplate for the maxilla and a 4-hole miniplate for the mandible (Synthes, Switzerland) (Fig. 3). The surgical procedure consisted in placing four miniplates – one in each infrazygomatic buttress of the maxilla, and one in the anterior mandible between and inferior to the left and right permanent lateral incisor and canine. Flaps were reflected in these sites, and the devices were fastened to the bone by using titanium miniscrews (1.55 mm diameter, 6 mm length). The titanium miniplates combined an intraoral attachment with a locking

Fig. 1 – The reverse overjet before the treatment.

Fig. 3 – Four-hole titanium miniplate (Synthes, Switzerland).

fixation screw to allow customizable traction hooks (Fig. 1). Miniplates were placed with the attachment arm exiting through the tissue attached at or near the mucogingival junction. The surgical sites were allowed to heal for 2–3 weeks before orthopedic loading.

The miniplates were loaded 3 weeks after the surgical procedure. One elastic was placed on each side to give vectors of force downward and forward for the maxillary bone and backward and upward for the mandibular bone[9] (Fig. 4). According to de Clerck's recommendations, the elastics were selected to supply an initial force of approximately 150 g to each side, increased to 200 g after 1 month of traction.[4–6,8] The patient was instructed to wear the elastics 24 hours per day and to replace them at least once a day. On the day of loading,

Fig. 4 – Location of the bone anchors.[4]

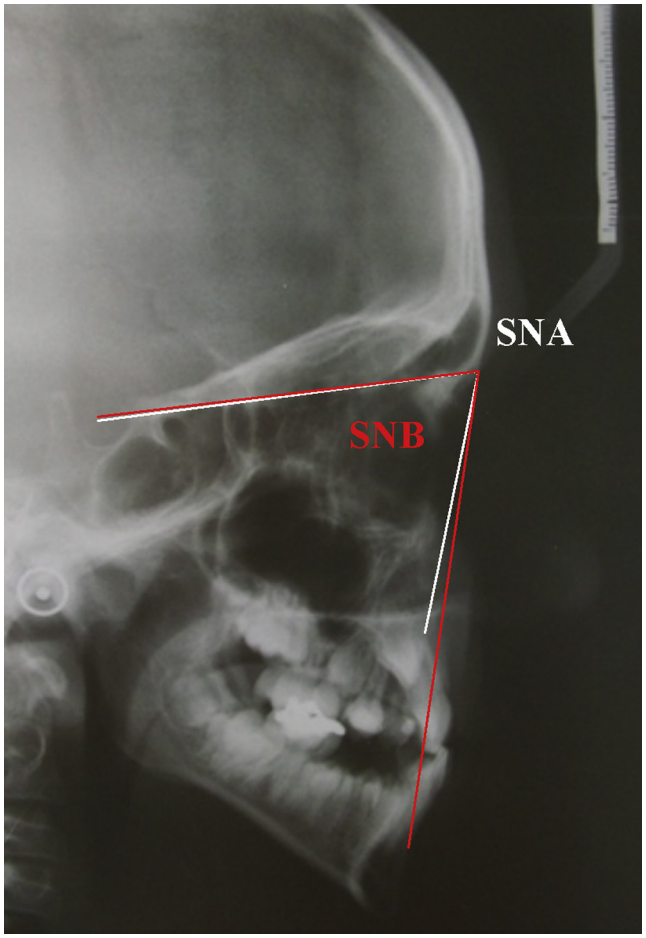

Fig. 5 – Initial values of SNA and SNB on lateral cephalometric radiograph.

oral hygiene instructions were given with particular attention to cleaning the tissues around the miniplates with a soft toothbrush. Three months after bone-anchor placement, the upper fixed appliance was inserted to align teeth and to create more space for permanent canines by the use of open coils springs. Cephalometric radiographs were taken twice – before the placement of the miniplates (T1), and after approximately 16 months (T2) (Figs. 5 and 6). In the meantime, the patient had a lower jaw injury resulting in fracture of the crowns of right mandibular incisors. However, the anchorage devices were not damaged.

After 7 months of treatment, the anterior crossbite was corrected (Fig. 7). The analysis of the cephalometric radiograph and a clinical examination revealed a marked improvement of occlusal conditions, and a slight fullness in the maxillary anterior region.

3. Results and discussion

Cephalometric evaluation between the beginning of treatment and the end of maxillary protraction showed a marked increase in ANB and Wits (Tables 1 and 2). A counterclockwise rotation of the mandible bone was observed, as well as a slight

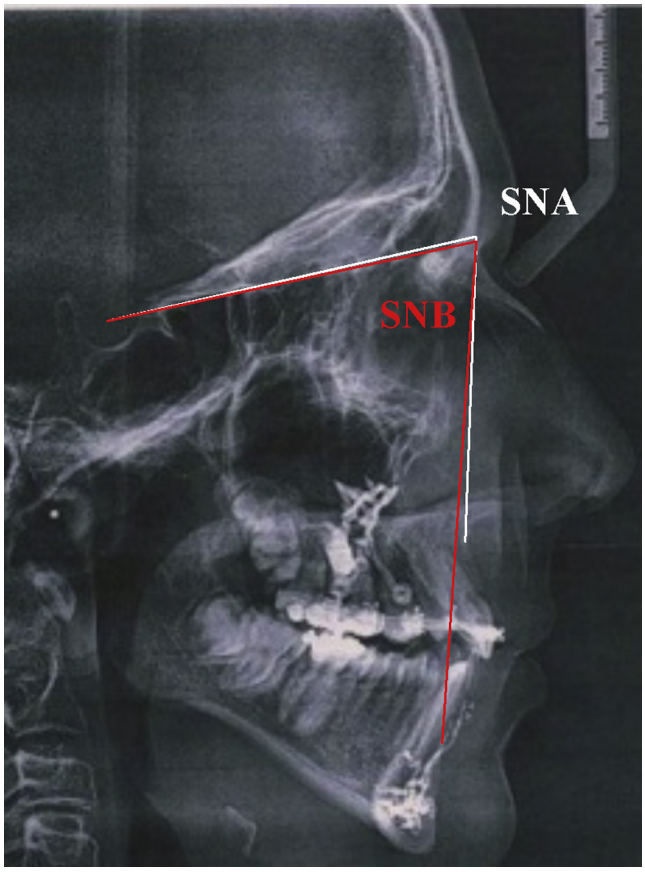

Fig. 6 – Post-treatment values of SNA and SNB on lateral cephalometric radiograph.

clockwise rotation of the maxillary bone. The obtained results correspond to de Clerck's et al. cephalometric investigations in class III patients who were treated with the use of bone-anchored maxillary protraction.[5,10] Furthermore, the proclination of upper and lower incisors was noticed. This could be explained by the use of the upper fixed appliance and increased tongue pressure on the lower incisors (previously shielded by the upper incisors).[1]

The conventional approach using a facemask allows generating only intermittent forces, and the palatal expansion device which is used as an anchorage for a facemask involves side effects as some proclination of the upper incisors. Temporary anchorage devices constitute a new approach to class III treatment. This method enables application of continuous forward traction on the maxillary bone resulting in stretching of the fibers in the sutures and stimulation of bone apposition.[6] The resistance of zygomatico-maxillary suture against its opening is greater when separating the zygomatico-frontal or zygomatico-temporal suture so two maxillary bones and two zygomas move forward as one unit.[10]

Bone-anchored maxillary protraction is particularly recommended in patients with maxillary hypoplasia and a normal or slightly overgrown mandible, both in cases where the discrepancy is too large to attain camouflage.[7] According to de Clerck, the best age to apply this method is around 12 for boys and 11 for girls, respectively. Under this age, the thickness of the bone in the maxilla is not sufficient to achieve a stable mechanical retention of the screws.[6] Moreover, the growth potential within the sutures decreases with age. The forces of elastics which are used, do not exceed 200 g representing the maximum resistance of the infrazygomatic crest.

From the technical point of view, the great advantages of the anchor system include the compatibility with a variety of orthodontic devices, such as archwires, elastics and springs, as well as the possibility for miniplates adaptation to the patient's bony anatomy. Wearing the elastics is easier accepted by young patients than the social impact of an extraoral appliance.[1,6]

It must be emphasized that before the surgery, the patient must be instructed not to touch the anchors repeatedly by pressuring the fingers or tongue because of the possibility of the occurrence of the miniplates mobility. After the placement of the anchors, the patients are instructed to reduce swelling by applying ice, and rinsing the mouth with chlorhexidine twice a day for at least a few days. Before the elastics are applied, the orthodontist must detect if there are any premature contacts which might block or prevent the reciprocal movement of the dental arches.[7] Thus, in some cases a removable discluding plate must be applied.[4,5] After active treatment, application of elastics for the night as retention is recommended. However, the miniplates should not be removed to maintain the possibility of intermaxillary traction in the case of a relapse tendency of the class III malocclusion.

Complications of temporary anchorage include loosening of the miniplate (especially in the maxillary bone, if it is poor quality), rarely a fracture of the anchor.[6] The inventor of this

Fig. 7 – Correction of the anterior crossbite.

Table 1 – Initial (T1) and post-active (T2) treatment cephalometric values (in degrees).

Measurement time	SNA	SNB	ANB	Wits	MPA	PPA	U1-SN	IMPA
T1	74	75	−1	−4	44	8	90	85
T2	77	74	3	0	42	10	102	90

SNA – sella-nasion-A point angle; SNB – sella-nasion-B point angle; ANB – computed as a difference of the mean SNA and SNB angle values; Wits – appraisal is calculated by the horizontal distance between the perpendicular line drawn on the occlusal plane from point A and B; MPA – mandibular plane angle; PPA – palatal plane angle; U1-SN – upper incisor to SN angle; IMPA – incisor mandibular plane angle.

Table 2 – Cephalometric values (in degrees) of dentoalveolar changes.

Treatment time, months	ΔSNA	ΔSNB	ΔANB	ΔWits	ΔMPA	ΔPPA	ΔU1-SN	ΔIMPA
14	3	−1	4	4	−2	2	12	5

Markings as in Table 1.

method emphasizes that contrary to the face mask therapy, no clockwise rotation of the mandible is observed.[10] It was also confirmed in our case.

Although bone-anchored maxillary protraction seems to be an effective treatment, modality for the correction of class III malocclusion requires further studies connected with longitudinal observations of correction stability.

4. Conclusions

Temporary anchorage devices application enabled the correction of the anterior crossbite and enhanced midfacial growth in young maxillary-deficient patient.

Conflict of interest

None declared.

REFERENCES

1. De Clerck HJ, Cornelis MA, Cevidanes LH, Heymann GC, Tulloch CJ. Orthopedic traction of the maxilla with miniplates: a new perspective for treatment of midface deficiency. *J Oral Maxillofac Surg*. 2009;67(10):2123–2129.
2. Maciejak M, Maciejak D, Stopa Z, Wanyura H. Morphological assessment of facial skeleton in patients with skeletal Class III malocclusions. *J Stomatol*. 2011;64(11):851–864.
3. Parayaruthottam P, Antony V, Francis PG, Muhamed Shaloob KM, Hassan KJ. Interception of a developing Class III malocclusion with facemask therapy. *J Orthod Res*. 2014;2:38–41.
4. Nguyen T, Cevidanes L, Cornelis MA, Heymann G, de Paula LK, De Clerck H. Three-dimensional assessment of maxillary changes associated with bone anchored maxillary protraction. *Am J Orthod Dentofacial Orthop*. 2011;140(6):790–798.
5. Cevidanes L, Baccetti T, Franchi L, McNamara Jr JA, De Clerck H. Comparison of two protocols for maxillary protraction: bone anchors versus face mask with rapid maxillary expansion. *Angle Orthod*. 2010;80(5):799–806.
6. De Clerck H. Interview. *Dent Press J Orthod*. 2012;17(3):7–13.
7. Antoszewska J, Kosior M, Antoszewska N. Treatment approaches in Class III malocclusion with emphasis on maximum skeletal anchorage – review of literature. *J Stomatol*. 2011;64(9):667–683.
8. Baccetti T, De Clerck HJ, Cevidanes LH, Franchi L. Morphometric analysis of treatment effects of bone-anchored maxillary protraction in growing Class III patients. *Eur J Orthod*. 2011;33(2):121–125.
9. Heymann GC, Cevidanes L, Cornelis M, De Clerck HJ, Tulloch JF. Three-dimensional analysis of maxillary protraction with intermaxillary elastics to miniplates. *Am J Orthod Dentofacial Orthop*. 2010;137(2):274–284.
10. De Clerck H, Cevidanes L, Baccetti T. Dentofacial effects of bone-anchored maxillary protraction: a controlled study of consecutively treated Class III patients. *Am J Orthod Dentofacial Orthop*. 2010;138(5):577–581.