Orthodontic Treatment of Skeletal Class II Adolescent with Anterior Open Bite using Mini-Screws and Modified Palatal Anchorage Plate

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This article presents a non-extraction orthodontic treatment case using mini-screws and a modified palatal anchorage plate (MPAP) to intrude the maxillary posterior teeth, and distalize the whole arch dentition and control the extrusion of the maxillary posterior dentition during distalization.
Keywords: Malocclusion, Skeletal Class II; Anterior Open Bite; Modified Palatal Anchorage Plate (MPAP); mini-screws

INTRODUCTION

Anterior open bite is one of the most challenging malocclusions to treat due to the high rate of relapse.[1] For non-growing patients, treatment of anterior open bite frequently involves orthodontic treatment combined with orthognathic surgery.[1,2] On the other hand, in growing patients, growth control with headgear can be used.[3,4] In addition, habit control appliances,[5] extraction of premolars,[6] and multiloop edgewise archwire[7] are used as means to treat anterior open bite.

Lopez-Gavito et al[8] reported considerable relapse when an open bite was corrected by extrusion of anterior teeth. However, successful and stable results were found when the correction was performed by molar intrusion using temporary skeletal anchorage devices (TSADs).[9,10]

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Recently, different anatomic characteristics of the palatal bone and soft tissue have been identified between adolescents and adults, making it possible to find adequate sites for skeletal anchorage in young age groups.[11-14]

Various approaches to distalize the maxillary posterior teeth with skeletal anchorage have been reported.[15,16] TSADs have been used with conventional molar distalizing appliances to overcome the reactive force on anterior teeth; however, this does not correct the resulting distal tipping and extrusion of the maxillary molars. Palatal anchorage devices can be effectively used for the distalization of maxillary molars without the need for patient compliance.[15-18] The modified palatal anchorage plate appliance (MPAP) was introduced to effectively distalize maxillary molars in adolescents. This case report illustrates a non-extraction treatment of protrusive skeletal Class II in an adolescent female using mini-screws along with a MPAP to intrude maxillary posterior teeth to correct an anterior open bite and distalize the whole arch dentition to improve her profile.

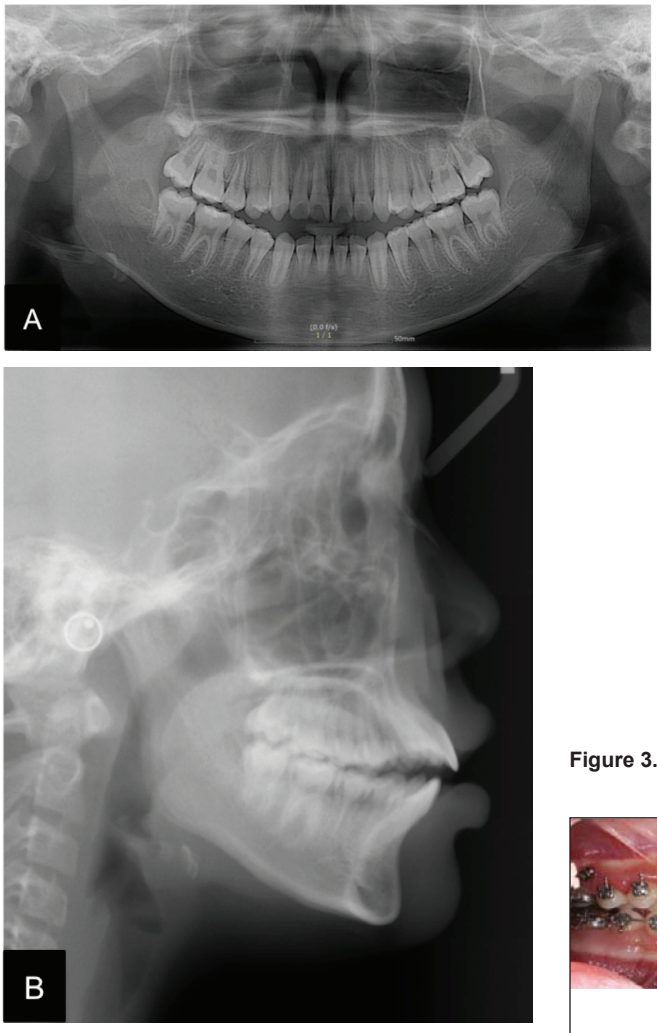
Case Report

A 12-year-old girl visited the clinic with the chief complaint of anterior open bite. She had lip incompetence and an anterior open bite of 1.5 mm with a severe overjet of 5 mm. She had a Class II end-on molar relationship on her right side and Class I molar relationship on her left side (Figure 1). Her initial panoramic radiograph presented eruption of the entire permanent dentition, and development of her maxillary right third molar and both mandibular third molars. Lateral cephalometric analysis revealed a skeletal Class II malocclusion (ANB: 6.7°) with a hyperdivergent growth pattern (FMA: 33.0°). The maxillary and mandibular incisors were proclined (U1-SN: 112.0°, and IMPA: 101.8°) and the nasolabial angle was slightly acute compared to the norm (Figure 2, Table).

When considering treatment options for an open bite patient, the clinician must decide whether to extrude anterior teeth or intrude the posterior teeth. As the patient had adequate maxillary central incisor exposure, the anterior tooth extrusion would not result in an esthetic outcome.[7] Also, the patient and her parents rejected extraction treatment, so extraction of premolars was excluded as a treatment option.

Figure 1. Pretreatment facial and intraoral photograph.

Figure 2. Pretreatment radiographs: A, Panoramic radiograph; B, Lateral cephalogram.



Therefore, to correct her anterior open bite and improve her overjet, intrusion of the maxillary posterior dentition and total distalization of the maxillary dentition was planned.

0.022-in slot brackets were placed on all teeth except for her first molars which were banded. Mini-screws (length, 8mm; diameter, 1.8mm: Jeil, Seoul, Korea) were placed in the palatal slopes and the buccal gingiva between the maxillary first and the second molars for the intrusion of posterior dentition. Archwires started with 0.016-in nickel-titanium and worked up to 0.019 x 0.025-in stainless steel wire.

After 1 year of treatment, the patient has a positive overbite (Figure 3). At this point, a MPAP was placed for the distalization of the maxillary dentition to resolve the maxillary protrusion (Figure 4).

The maxillary dentition was sufficiently distalized, and the skeletal anchorage connected to the first maxillary molars allowed the use of Class III intermaxillary elastics. Class III elastics were utilized to reduce mandibular incisor proclination.

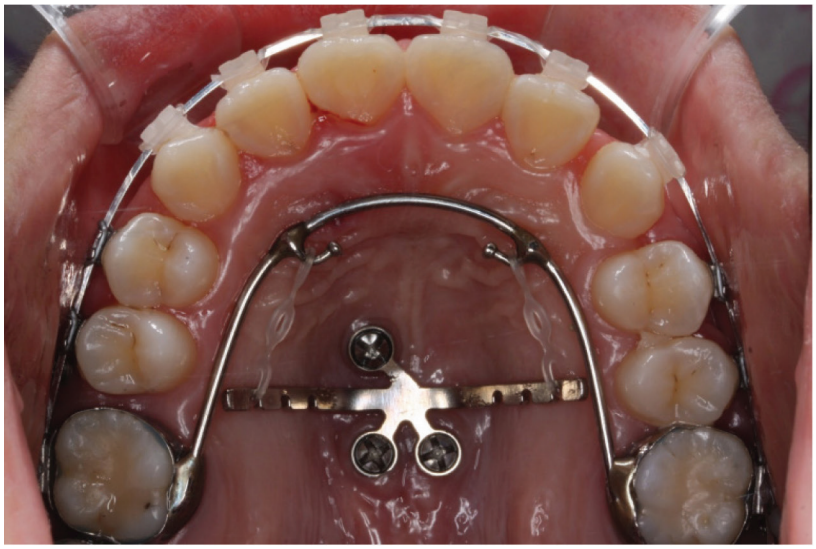
The total treatment period was 3 years and 10 months. The patient's maxillary molars were distalized and intruded (Figure 5). Both the maxilla and mandible grew downward, with the maxillary incisors maintaining a proper relationship to the upper lip (Figure 6). The patient had an improved profile. Lateral cephalometric analysis demonstrated improvement of skeletal parameters (Figure 7, Table). Superimposition of the pre-and posttreatment tracings demonstrates the improvement of her dental relationship (Figure 8). Posttreatment photographs present Class I molar and canine relationships with acceptable overjet and overbite. Although she did not close her lips in the posttreatment photographs, her lip competence has improved (Figure 9).

DISCUSSION

In treatment of anterior open bite, extrusion or eruption of anterior teeth is a common method of bite closure, but extrusion of anterior teeth is less likely to be stable and might compromise esthetics.[19] Since the patient in our case had adequate maxillary central incisor exposure, anterior tooth extrusion would not result in an esthetic outcome.[7] During treatment, considering her maxillary growth, her maxillary anterior teeth were not extruded enough compared to stomion superius.

Figure 3. Progress intraoral photographs showing the intrusion of the maxillary posterior teeth using mini-screws.

Figure 4. Distalization with palatal skeletal anchorage device.



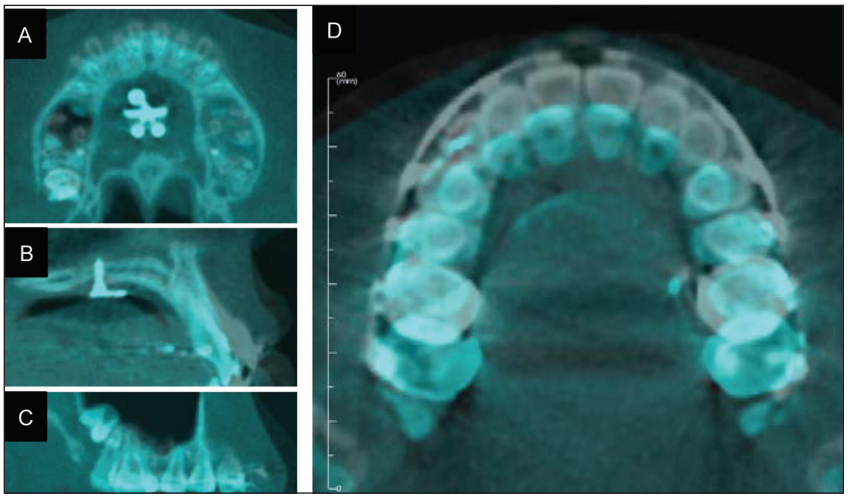


Figure 5. 3D superimposition of pre- and posttreatment CBCT images at MPAP. A, axial section at root level; B, sagittal section at central incisor level; C, sagittal section at molar level; D, axial section at coronal level. As the plate is an absolute reference point, the maxillary dentition shows distal movement after treatment. (Grey, immediate after MPAP placement; Blue, 30 months later)

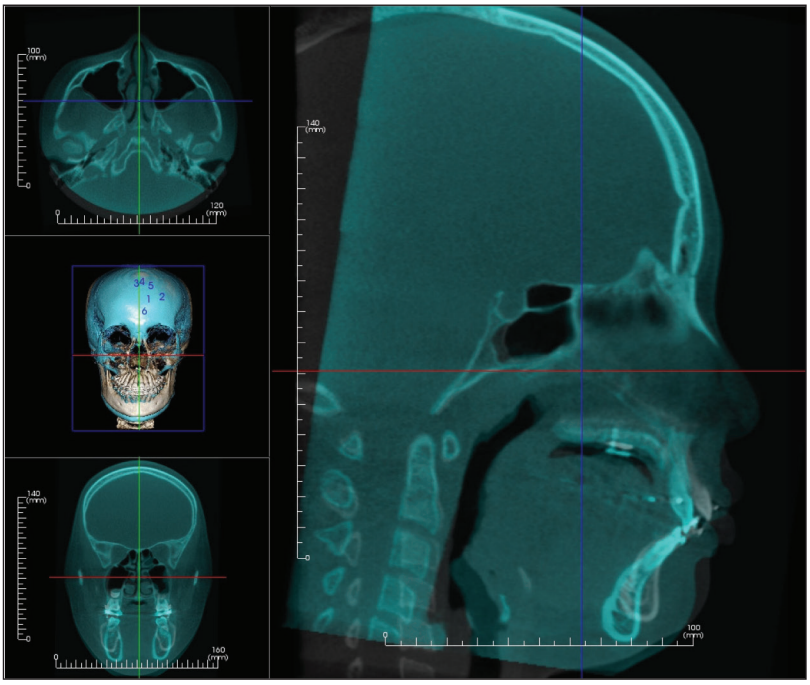


Figure 6. Sagittal section Grey, immediate after MPAP placement; Blue, 30 months later.

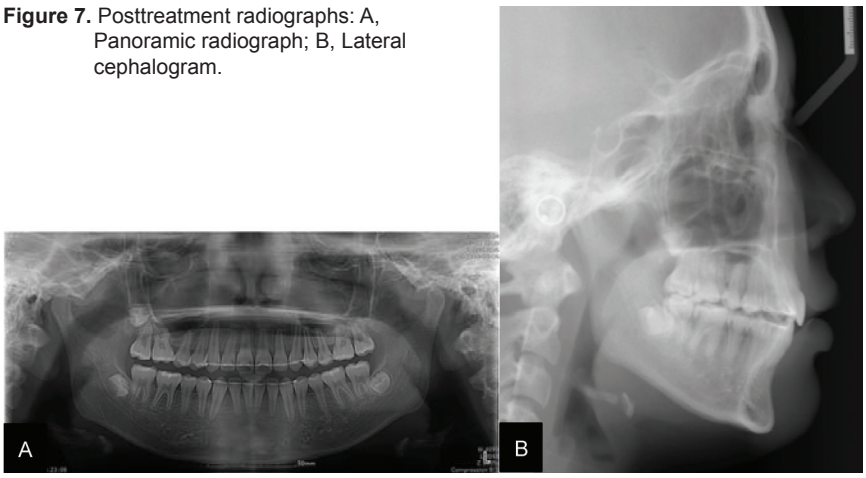


Figure 7. Posttreatment radiographs: A, Panoramic radiograph; B, Lateral cephalogram.

Figure 8. Cephalometric superimposition. Black, pretreatment; Red, posttreatment.

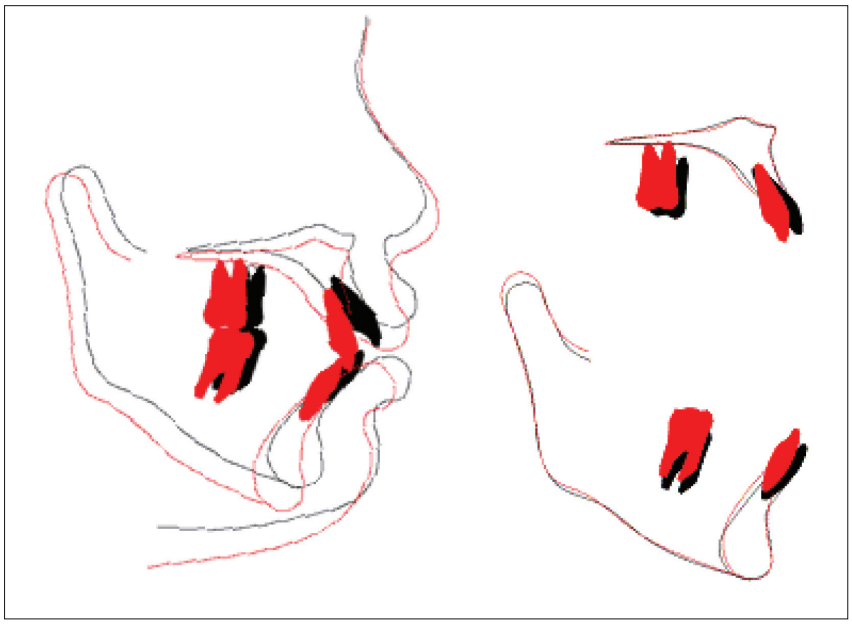


Figure 9. Posttreatment facial and intraoral photographs.

Table. Cephalometric measurements.

Measurement	Norm	Initial	Final
SNA (˚)	81.6	81.1	78.5
SNB (˚)	78.7	74.4	73.1
ANB (˚)	2.5	6.7	5.0
FMA (˚)	24.5	33.0	33.8
Convexity (˚)	4.0	12.0	8.6
U1-SN (˚)	106.8	112.0	98.0
U1 to A Pog (mm)	7.8	11.0	7.5
IMPA (˚)	95.5	101.8	92.0
L1 to A-pog (mm)	3.0	6.8	3.8
Nasolabial angle (˚)	100.0	97.1	113.0
Lower lip to E-plane (mm)	1.0	4.6	0.2
Upper lip to E-plane (mm)	2.0	2.9	0.1

Also, the patient showed a protrusive profile. Therefore, intrusion of her maxillary molars for the correction of open bite and total arch distalization of her dentition was achieved with MPAP. Incisor proclination was reduced as much as if the treatment had been extraction (Table).

MPAPs have been designed to allow placement of mini-screws slightly lateral to the midpalatal suture.[17] The design has been improved by adding tubes to the mini-screw holes and through the use of a silicon jig during placement to lessen soft tissue inflammation, which also makes it easier for clinicians to work with.[20] Our patient was initially treated with molar intrusion using mini-screws, and later was distalized with a MPAP. This may have been a factor in the relatively long treatment period for this case, but with the modified design that features distally curved arms and hook indentations, simultaneous intrusion with distalization can be performed now.[20] This means that the treatment time may be reduced in similar cases with the recent design.

The high failure rate for mini-screws placed in the buccal area and the need to remove and re-insert them due to root proximity during treatment makes the palate a more stable site for anchorage in adolescents.[11,21] In addition, Yu et al[22] recently reported that the palatal approach provides a greater and more bodily movement of molars than with does placing mini-screws in the buccal area. Various studies have been performed to find an optimal site for mini-screw placement in adolescents.[11-14] Palatal bone thickness significantly increases from the early mixed dentition to late mixed dentition and to permanent dentition. MPAPs were designed to be placed in the paramedian palatal area to avoid interference with the growth of the midpalatal suture.[17]

Han et al[11] evaluated the palatal bone density in adults and adolescents for application of skeletal anchorage devices. According to their study, the middle median, and posterior median area of the palate shows different values in the two groups. In adults, middle median and posterior median area had 918 Hounsfield units (HU) and 820 HU respectively, whereas the values of adolescents were 618 HU and 608 HU. The palatal bone density was measured in our 12 year old patient, which corresponds to the mean age of adolescents in the above study. Her values were 776 and 701 HU each, which is slightly higher than the average in adolescents but lower than the average HU value in adults. Successful results with MPAPs have been reported around this age group, which suggests that even with less bone density than in adults, adolescent palatal bone density is sufficient for TSAD placement.

Class III intermaxillary elastics were used during the treatment for retroclination of mandibular incisors. Without the skeletal anchorage, this might cause extrusion of the maxillary molars, a detrimental effect. To evaluate the treatment effect of just the palatal plate and then the overall treatment results, three-dimensional cone-beam computed tomography (CBCT) images were superimposed. First, using the palatal plate as a reference, her maxillary dentition was evaluated. Superimposition of the maxilla shows intrusion of the maxillary molars. In Figure 5C, the molar shows more root distal movement than the crown. The total arch shows overall distalization, along with retroclination of the incisors (Figures 5 and 6).

Yu et al[22] evaluated the tooth movement using MPAP. By applying distalization force on different notches that were easily made on the MPAP, any type of movement is possible according to the clinician's treatment plan.

Also, to evaluate the overall change, superimposition was made on the cranial base, except for the peripheral zone that experiences growth (Figure 6).[23-25] Both the maxilla and mandible grew downward, and with the successful intrusion of the molars, the maxillary incisors were retroclined to improve her lip protrusion. Protrusion and anterior open bite were resolved without any extraction of teeth. The patient was satisfied with the overall outcome in both function and esthetics.

Sa'aed et al[18] recently studied the treatment effect of molar distalization using MPAPs in adolescents. The MPAP group showed slight extrusion of maxillary first molars after treatment. Meanwhile, in other studies on adults, MPAPs usually induce the intrusion of molars.[22,26] Sa'aed et al[18] concluded that the intrusion was masked by the downward growth of the maxilla, resulting in extrusion. The maxillary first molars in our case were also extruded in the overall craniofacial superimposition. However, our patient showed only 0.5 mm of extrusion, whereas the above mentioned study reported a 1.7 mm mean extrusion of the first molars.[18] This minimal extrusion was a favorable treatment response for the open bite considering the maxillary downward growth. In our maxillary superimposition, the maxillary molars showed intrusion, not extrusion. This result is probably due to the intrusion of the molars prior to distalization.

After treatment, the edge-to-edge bite on her right first molars was not improved significantly. It would have been better if we had been able to overcome this transverse discrepancy, but it was a difficult goal to achieve considering the mechanics of the palatal approach we used for intrusion and distalization. In the future, we are considering modifying the appliance by adding a U-loop in the palatal arch to solve this problem.

The mini-screws and MPAPs provide predictable treatment outcomes for movement of the maxillary dentition without the need for patient compliance. The mechanics used in this case helped increase overbite by intruding the maxillary molars without significantly extruding the anterior teeth.. Therefore, application of mini-screws and MPAPs can be used effectively to treat adolescent patients with anterior open bite and protrusion.

CONCLUSION

For skeletal Class II patient with anterior open bite, orthodontic treatment with MPAP combined with mini-screws can effectively correct anterior open bite and improve esthetics. The mechanics with this appliance help intrude maxillary molars and upright mandibular arch at the same time. MPAP provides predictable treatment outcome and could be considered as a treatment option for adolescents.

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