Distalization of maxillary arch and correction of Class II with mini-implants: A report of two cases

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Abstract

This article reports the successful use of mini-screws in the maxilla to treat two patients of age 21-year and 17-year-old girls. Both the patients had a skeletal Class II malocclusion with protrusive maxillary teeth and angels Class II mal-occlusion. Temporary anchorage devices (TADs) in the posterior dental region between maxillary second premolar and maxillary first molar teeth on both sides were used as anchorage for the retraction and intrusion of her maxillary anterior teeth. Those appliances, combined with a compensatory curved maxillary archwire, eliminated spacing, deep bite, forwardly placed and proclined upper front teeth and the protrusive profile, corrected the molar relationship from Class II to Class I. With no extra TADs in the anterior region for intrusion, the treatment was workable and simple. The patient received a satisfactory occlusion and an attractive smile. This technique requires minimal compliance and is particularly useful for correcting Class II patients with protrusive maxillary front teeth and dental deep bite.

Keywords: Class II malocclusion, distalization, intrusion, retraction, temporary anchorage devices

Introduction

During the past two decades, the use of temporary anchorage devices (TADs) for absolute anchorage has been increased greatly in orthodontic practice. The use of skeletal anchorage systems has become a new orthodontic treatment strategy.[1,2] Skeletal orthodontic anchorage systems provide stationary anchorage for various tooth movements without the need for active patient compliance and with no undesirable side effects.[3] Recently, titanium mini-screws have gradually gained acceptance for use in stationary anchorage because they provide clinical advantages such as minimal anatomic limitation on placement, lower medical cost, and simpler placement with less-traumatic surgery.[4]

Orthodontic movements such as anterior retraction and intrusion of over-erupted teeth are difficult to achieve without undesirable reciprocal movements of the anchorage units. The orthodontic mini-implant has some advantages for orthodontic anchorage, providing its use at various sites because of its small size and simple operative procedure. Placement of mini-screws in the buccal interradicular bone is one of the most common approaches used to provide skeletal anchorage.[4,5] Maxillary molar distal movement is often required to treat patients with Class II malocclusion. Several techniques have been proposed to move maxillary molars distally such as extraoral traction, Schwarz plate–type appliances, Wilson distalizing arches, removable spring appliances, distal jet appliances, intermaxillary elastics with sliding jigs and pendulum appliance.[4-7] However, these conventional techniques often are accompanied by unwanted side effects of flaring or mesial movement of the anterior teeth.

In contrast, the mini-screws provide sufficient anchorage for incisor retraction in Class II treatment without unwanted orthodontic side effects. With Class II treatment in premolar extraction cases, it had been showed that mini-screw anchorage could provide more effective incisor retraction than the traditional anchorage method in which a headgear and a transpalatal arch were used.[7]

In this case report, we aimed to introduce the treatment of a patient with Class II Division 1 malocclusion with deep bite, and the use of mini-screws for distalization of maxillary arch and correction of Class II molar relationship to Class I molar relationship.

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Case Reports

Case 1

The patient, 21-year-old girl, had a convex profile and angles Class II malocclusion. Her chief complaints were forwardly placed upper front teeth and spacing in front

teeth. The clinical examination reveals that the skeletal Class II base with prognathic maxilla and orthognathic mandible relationship, proclined and forwardly placed maxillary and mandibular anteriors, spacing in upper front teeth, increased overjet, deep bite, accentuated deep curve of spee, protrusion of upper and lower lips and incompetent lips. The functional examination reveals that incisal and canine guidance without prematurity and shift. The patient had no temporomandibular joint symptoms. No deviation and pain during the border movement of the mandible were discovered. No short or hyperactive upper lip or vertical maxillary excess was found.

A pretreatment extra-oral, intra-oral photographs [Figure 1] and cephalogram and a panoramic radiograph [Figure 2] were taken before treatment. The cephalometric analysis [Table 1] demonstrated a Class II skeletal relationship (ANB, 6°) as a result of the prognathic maxilla. The A-point was (SNA 86.5°), and B-point was (SNB 81°). The angle between the maxillary incisors and the S-N plane was 127°, and the IMPA was 101°, which indicated that the protrusive profile was mainly caused by the proclined maxillary and mandibular anterior teeth.

Treatment Objectives

The treatment objectives were to create a satisfactory occlusion with a Class I molar relationship and closure of spaces in maxillary anteriors and decrowding in mandibular anteriors. Correction of axial inclination of maxillary and mandibular anteriors with retraction and intrusion of the maxillary anterior teeth were indicated to reduce deep bite and the convex profile, protruded upper and lower lip and incompetent lips.

Treatment Alternatives

The treatment alternatives were presented to the patient.

- Extract the maxillary first premolars and the mandibular second premolars, and use KSIR arch for simultaneous retraction and intrusion of maxillary anterior teeth. It requires precise wire bending and anchorage preparation
- Extract the maxillary first premolars and the mandibular second premolars, and use J-hook headgear as anchorage for retraction and intrusion. The disadvantage was that the effect of this treatment depended on the patient's cooperation
- Use TADs to provide absolute anchorage for maximum retraction of the proclined maxillary teeth and maxillary incisor intrusion to correct deep bite and to harmonize the molar relationship. The disadvantage was that the retruded mandible would not be corrected.

Table 1: Represents cephalometric analysis for case I

Parameter	Mean	Pretreatment	Posttreatment
Skeletal			
SNA	82	86.5	86
SNB	80.5	81	81
ANB	2	6	5
N perp. to point A	0±2	2	−4
N perp. to point Pog	0 to −4	−5	−2
Go-Gn to SN	32	26	27
J angle	85	87	90
Y-axis	66	64	64
Facial axis angle	0	+3	+3
Sum of posterior angles	396±6	388	389.5
Dental			
U1 to NA angle	22	40	22
U1 to NA	4	12	2
U1 to SN angle	102	127	110
L1 to NB angle	32.5	30	36
L1 to A-Pog	1-2	5	4
L1 to mand plane angle	90	101	101
Inter-incisal angle	130	102	115
Soft tissue			
S line to upper lip	−2	+5	+2
S line to lower lip	0	+5	+3
Naso-labial angle	90-110	72	90

Figure 1: Pretreatment intra-oral and extra-oral photographs of case I

Figure 2: Pretreatment lateral cephalogram and orthopantomogram of case I

After we had discussed these alternatives with the patient, she chose the third option. She didn't want to extract her teeth, and the headgear was unacceptable.

Treatment Progress

Orthodontic treatment began on July, 2011, and lasted for 23 months. Preadjusted 0.022 MBT brackets (3M Unitek) were bonded to all teeth. With sequential nickel-titanium archwires, alignment and leveling were achieved in 2 months. Then, after closure of anterior spaces in upper arch and decrowding in lower anterior teeth 0.019-0.025 SS wire place in with crimpable hooks on maxillary archwire between maxillary lateral incisor and canine teeth.

The mini-screws 13-0.06 mm (Dentos) were placed in the buccal interradicular space between second premolar and maxillary first molar [Figure 3] on the both sides. The micro-implant is tapered type and having SH head type with dimension 1.3 mm in width and 6 mm in length. Prior to the surgical procedure, the required arnamentrum and the mini-implant kit is sterilised well. The surface anesthetics is applied at the site of implant placement. Once the area is anesthetized, mini-implant is inserted at attached gingiva 2-3 mm above the level of hook of molar buccal tube between maxillary second premolar and maxillary first molar on the both sides. After a period of 1-month, nickel-titanium closed-coil springs were attached from implant to the soldered hook on 0.019-0.025 SS wire for retraction and intrusion of maxillary anterior teeth.

Further maxillary retraction was achieved by nickel-titanium closed coil springs on the TADs. After 3 months of retraction of the maxilla, both overbite and overjet were achieved properly. In the 20th month of treatment, the first molars were in a Class I relationship, facial profile and smile is improved. No Class II elastics were used during the treatment progress. Posttreatment intra-oral and extra-oral photographs are shown in Figure 4. Posttreatment lateral cephalogram and orthopantomogram (OPG) is shown in Figure 5. Figure 6 indicates the superimposition with black color pretreatment and green for posttreatment.

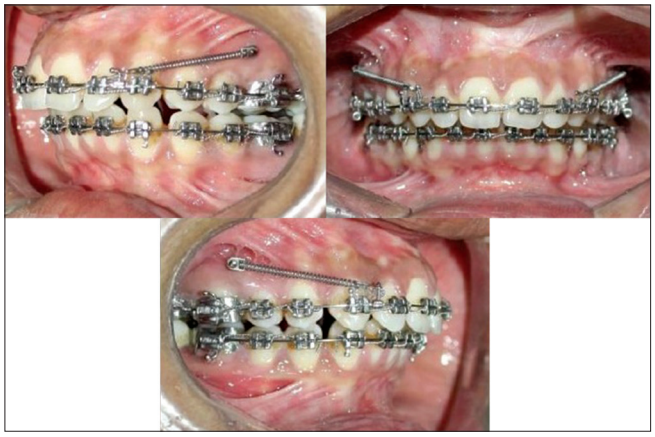

Figure 3: Placement of mini-implacent in buccal inter-radicular region of case I

Figure 4: Posttreatment extra-oral and intra-oral photographs of case I

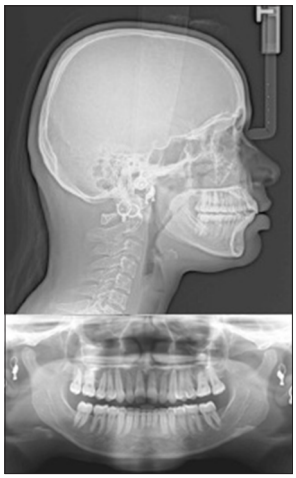

Figure 5: Posttreatment lateral cephalogram and orthopantomogram of case I

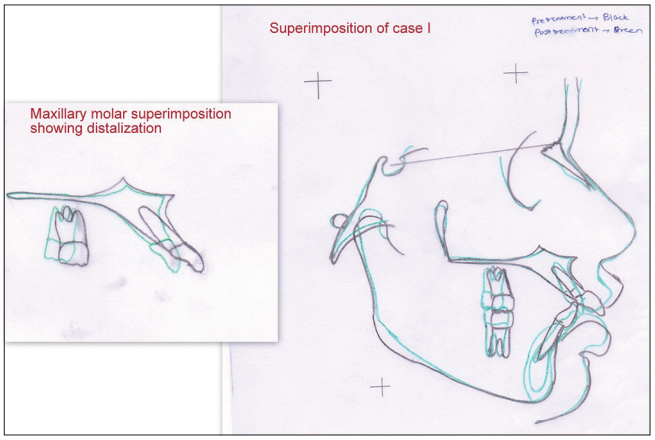

Figure 6: Superimposition of case I

Case 2

The patient, 17-year-old girl, had a convex profile and angles Class II malocclusion. Her chief complaints were forwardly placed upper front teeth and crowding in upper and lower front teeth. The clinical examination reveals that the skeletal Class II base with prognathic maxilla and orthognathic mandible relationship, proclined and forwardly placed maxillary and mandibular anteriors, crowding in upper and lower front teeth, increased overjet, deep bite, accentuated deep curve of spee, protrusion of upper and lower lips and incompetent lips. The functional examination reveals that incisal and canine guidance without prematurity and shift. The patient had no temporomandibular joint symptoms. No deviation and pain during the border movement of the mandible were discovered. No short or hyperactive upper lip or vertical maxillary excess was found. Pretreatment extraoral and intra-oral photographs are shown in Figure 7.

A cephalogram and a panoramic radiograph [Figure 8] were taken before treatment. The cephalometric analysis [Table 2] demonstrated a Class II skeletal relationship (ANB, 7°) as a result of the prognathic maxilla. The A-point was (SNA 87°), and B-point was (SNB,80°). The angle between the maxillary incisors and the S-N plane was 110°, and the IMPA was 86°, which indicated that the protrusive profile was mainly caused by the proclined maxillary anterior teeth.

Treatment Objectives

The treatment objectives were to create a satisfactory occlusion with a Class I molar relationship, and decrowding in maxillary and mandibular anteriors teeth. Correction of axial inclination of maxillary and mandibular anteriors with retraction and intrusion of the maxillary anterior teeth were indicated to reduce deep bite and the convex profile, protruded upper and lower lip and incompetent lips.

Treatment Alternatives

The treatment alternatives were presented to the patient.

- Extract the maxillary first premolars and the mandibular second premolars, and use J-hook headgear as anchorage for retraction and intrusion. The disadvantage was that the effect of this treatment depended on the patient's cooperation
- Extraction of first premolar in maxillary and mandibular arch and use of TADs to provide absolute anchorage for maximum retraction of the proclined maxillary teeth and maxillary incisor intrusion to correct deep bite and to harmonize the molar relationship
- Use of soldered power arm on the first molar tube for simultaneous retraction and intrusion of maxillary anterior teeth. But it won't have corrected the molar relationship.

After we had discussed these alternatives with the patient, she chose the second option. The headgear was unacceptable.

Treatment Progress

Orthodontic treatment began on May, 2011, and lasted for 24 months. Extraction of all first premolar done in

Figure 7: Pretreatment extra-oral and intra-oral photographs of case II

Table 2: Represents cephalometric analysis for case II

Parameter	Mean	Pretreatment	Posttreatment
Skeletal			
SNA	82	87	81
SNB	80	80	79
ANB	2	7	2
N perp. to point A	0±2	−2	−7
N perp. to point Pog	0 to −4	−12	−15
Go-Gn to SN	32	26	26
J angle	85	90	85
Y-axis	66	66	66
Facial axis angle	0	+2	−2
Sum of posterior angles	396±6	386	386
Dental			
U1 to NA angle	22	24	24
U1 to NA	4	4	2
U1 to SN angle	102	110	104
L1 to NB angle	25	30	23
L1 to A-Pog	1-2	1	1
L1 to mand plane angle	90	86	94
Inter-incisal angle	130	118	131
Soft tissue			
S line to upper lip	−2	+0.5	−3
S line to lower lip	0	+1	0
Naso-labial angle	90-110	105	132

maxillary and mandibular arch done, Preadjusted 0.022 MBT brackets (3M Unitek) were bonded to all teeth. With sequential nickel-titanium archwires, alignment and levelling were achieved in 3 months. Then maxillary second molars were banded, and 0.019-0.025 NiTi wire is placed for 6 weeks. Then, 0.019-0.025 SS wire place in upper and lower arch with soldered post on archwire between lateral incisor and canine teeth. The mini-screws 13-0.06 mm (Dentos) were placed in buccal interradicular space between the second premolar and maxillary first molar [Figure 3] on the both sides. The micro-implant is tapered type and having SH head type with dimension 1.3 mm in width and 6 mm in length. Prior to the surgical procedure, the required arnamentrum and the mini-implant kit is sterilised well. The surface anesthetics is applied at the site of implant placement. Once the area is anaesthetized, mini-implant is inserted at attached gingiva 2-3 mm above the level of the hook of the molar buccal tube between maxillary second premolar and maxillary first molar on the both sides. After a period of 1-month, nickel-titanium closed-coil springs were attached from implant to the soldered hook on 0.019-0.025 SS wire for retraction and intrusion of maxillary anterior teeth.

After a period of 1-month, nickel-titanium closed-coil springs was used for retraction and intrusion of maxillary anterior teeth and active lie backs in lower arch for space closure [Figure 9].

Figure 8: Pretreatment lateral cephalogram and orthopantomogram of case II

Figure 10: Posttreatment extra-oral and intra-oral photographs of case II

In the 22nd month of treatment, the first molars and canine were in a Class I relationship. No Class II elastics were used during the treatment progress. Figure 10 shows the posttreatment extra-oral and intra-oral photographs. Figures 11 and 12 indicate the posttreatment lateral cephalogram and OPG and superimposition respectively.

Discussion

Orthodontic treatment with mini-screw anchorage is more comfortable for the patient than traditional reinforced anchorage such as multi-brackets combined with intraoral or extraoral anchorage, because there is no requirement for the patient's cooperation. Nevertheless, the success rate was approximately 80-95%, and minimum invasion for placement surgery was necessary; the patients complained of little pain and discomfort after placement of the mini-screws.

Before the development and application of TADs, orthodontists' choices were limited to appliances such as

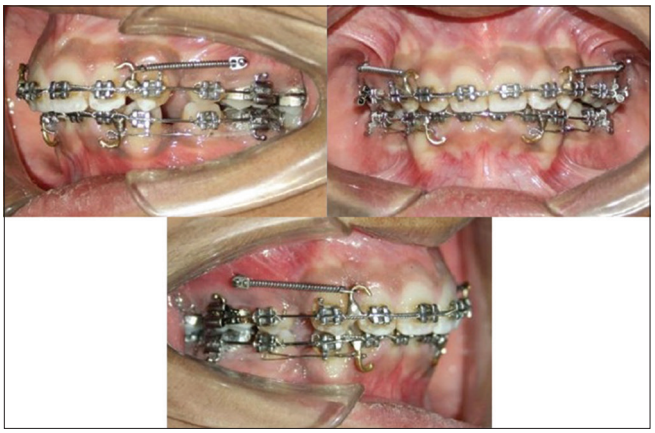

Figure 9: Placement of mini-implacent in buccal inter-radicular region of case II

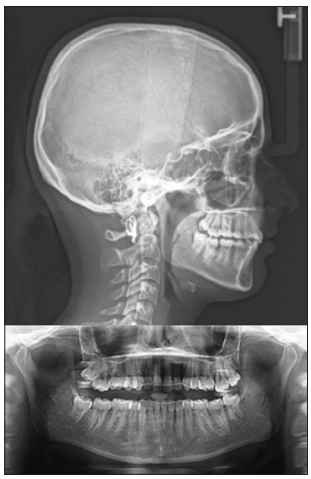

Figure 11: Posttreatment lateral cephalogram and orthopantomogram of case II

transpalatal arches, Nance arches, and headgears.[8] These appliances have disadvantages, such as their unesthetic appearance, undesirable intermittent forces, and dependence on patient cooperation. Also, mesial movement of the molars was inevitable even with these appliances. Correction of Class II Division 1 with deep bite could be accomplished by extraoral intrusion appliances such as headgear and J-hook. Traditional intrusion techniques, such as utility arches and three-piece intrusion arches,[9] were not optimal for this patient, because they require anchorage on the molars and produce undesirable moments on the anterior teeth. Currently, several cases have been reported in the literature with TADs for enmasse retraction and intrusion of teeth. With time, TADs are gradually replacing the aforementioned appliances and have become the preferred anchorage option for orthodontists. For Class II Division 2 patients, TADs in the anterior alveolus could provide an intrusion force and proclining moments on the maxillary incisors; this is ideal for extruded and retruded teeth. But in this case Class II Division 1 patient, the incisors are forwardly place and proclined with deep bite. Therefore, the mechanical system for such patients is to retract and intrude the anteriors. TADs in the anterior alveolus were not appropriate.[5,8] We adopted TADs between the maxillary second premolars and first molars combined with nickel-titanium closed-coil springs that could provide a continuous total force passing near the center of resistance of the six anterior teeth.[9] The force could be divided into two parts: A greater horizontal force for retraction of the protrusive anterior dentoalveolar complex and a smaller vertical force for intrusion of the anterior teeth.[2,7] To ensure maximal retraction and prevent excessive lingual tipping of the anterior teeth, we placed a compensatory curve in the maxillary archwire, which could counteract the deformation of archwire, provide torque control on the anterior teeth, and assist in correcting the deep overbite. Torque control of the anterior teeth also prevented the roots from approximating the cortical plate, which, when combined with continuous light retraction forces, effectively reduced root resorption.[1,2,7] The posttreatment radiographs might have underestimated root resorption but did not show any apparent root shortening. The treatment with our appliance produced a satisfactory outcome. The schematic representation about molar distal movement achieved with the mini-screw.

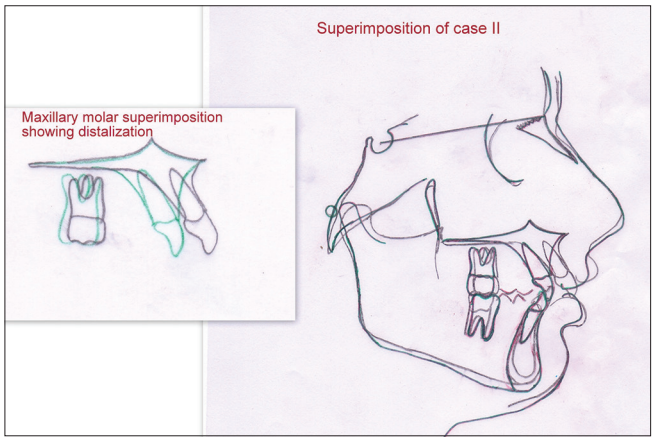

Figure 12: Superimposition of case II

In the case I, there was no third molar seen in the OPG, and also in the case II the third molars were in developing stage. So space distal to maxillary second molar was utilized for the distalization of the maxillary arch. The force exerted by the nickel-titanium coil springs (bilaterally) had two distinct components: A larger retraction force and a smaller intrusive force causing en-masse retraction and some intrusion of the maxillary anterior teeth. After space closure, contact between the canine and the second premolar was established. At this point, any further continuation of the retractive force resulted in its transmission to the posterior segment through the interdental contacts. The coil springs in most patients were left in place for at least 2-3 months after space closure to obtain a tight overjet. This might have caused some distalization of the molars, as observed cephalometrically. Park *et al*.[1] previously reported that the maxillary first molars were moved to the distal by 1.64 mm with statistical significance in their study of group distal movement using mini-screw anchorage. Interradicular mini-screws predictably induced total arch distalization, leading to the correction of Class II.[10] Additional mini-screws in the premolar area appear to facilitate intrusion and distalization of the entire arch according to the position of the force vectors.[10-12]

Interradicular mini-screws have been shown to provide stationary anchorage for various types of orthodontic tooth movement. However, mini-screws inserted into the interradicular space should not interfere with tooth movement when adjacent teeth are moved in an anterior-posterior direction.[13] In the present study, we quantified the treatment effects of interradicular mini-screw anchorage and confirmed the validity of its clinical usage for the distal movement of maxillary molars as in previous case reports.[1,12] Sugawara *et al*.[11] reported that the maxillary first molars were moved to the distal by approximately 4 mm at the crown level with miniplate anchorage. However, the disadvantage of this technique is the requirement of a mucoperiosteal incision or flap surgery when the plates are placed and removed. Therefore, surgical invasiveness is not minor, and the medical cost is high.

It was reported that the proximity of mini-screws to the root was a major risk factor for the failure of screw anchorage. To avoid close screw proximity to the surrounding root, we chose as the insertion site the buccal interradicular space between the maxillary second premolar and the first molar because several reports have indicated that the interradicular space is widest in the maxillary buccal region[5,8] In the present study, mini-screws with a 1.3 mm diameter were placed at 20-30° to the long axis of the proximal tooth. In previous reports, distances between the mesiodistal central grooves of proximal teeth were calculated with a panoramic

radiograph or three-dimensional computed tomography and were defined as interradicular distances. Therefore, the interradicular distance might be longer than 3 mm in the buccal root area around screws that are placed at an oblique angle. Because of the implantation methods used, the maxillary molars in this study could be moved to the distal without screw contact with the proximal root. In addition, there was no root resorption, which is one of the side effects of molar distal movement that causes great concern.

Conclusion

- Mini-screws placed in the maxillary buccal interradicular space between the second premolar and the first molar at an oblique angle were useful for moving maxillary molars distally in nongrowing patients
- Retraction and intrusion of anterior teeth are best accompanied with TADs placed in maxillary buccal interradicular space between the second premolar and the first molar. Compensatory curve given in maxillary arch plays an important role in anchorage control of the molars, torque control of the anterior teeth, and correction of the deep overbite.

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