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Nonextraction treatment of Class II division 2 in an adult patient using microimplant anchorage (MIA)

Jong-Moon Chae, DDS, MSD, PhD

Maxillary anterior teeth were intruded and lingually root torqued with two maxillary anterior microimplants between the lateral incisors and canines. Overerupted maxillary canines were intruded with two other microimplants between the maxillary canines and first premolars. Maxillary posterior teeth and canines were distalized, then the maxillary incisors were retracted with two maxillary posterior microimplants between the first and second molars. The mandibular anterior teeth were intruded and the mandibular posterior teeth were extruded with conventional method such as anterior bite plane, intrusion arch and Class II elastics. The mandible moved slightly forward after the correction of deep bite and retroclination of the upper incisors. Consequently, microimplant anchorage (MIA) provided absolute anchorage for simultaneous correction of Class II canine and molar relationships and deep overbite.

(**Key words**: Class II division 2, Microimplant anchorage (MIA), Intrusion, Lingual root torque)

INTRODUCTION

Class II division 2 malocclusion is characterized by hypodivergent facial pattern, posterior displacement of the mandibular dental arch, distoocclusion of the teeth, deep bite with a deep curve of Spee, lingually tipped upper incisors and deep mentolabial sulcus.[1,2]

Class II division 2 malocclusions are usually transformed into Class II division 1 malocclusions by proclination of upper incisors and then treated as division 1 from that point on. Also a nonextraction approach in the treatment of Class II division 2 malocclusion may be necessary because of some specific morphologic characteristics, primarily the retroclination of upper incisors and deepbite with a tendency for a hypodivergent facial pattern and a normal soft tissue profile.[3,4]

About 2 decades ago, Creekmore and Eklund[5] described the possibility of skeletal anchorage in the treatment of Class II division 2 with a surgical vitallium screw which was implanted in the area of the anterior nasal spine. He achieved elevation and torque

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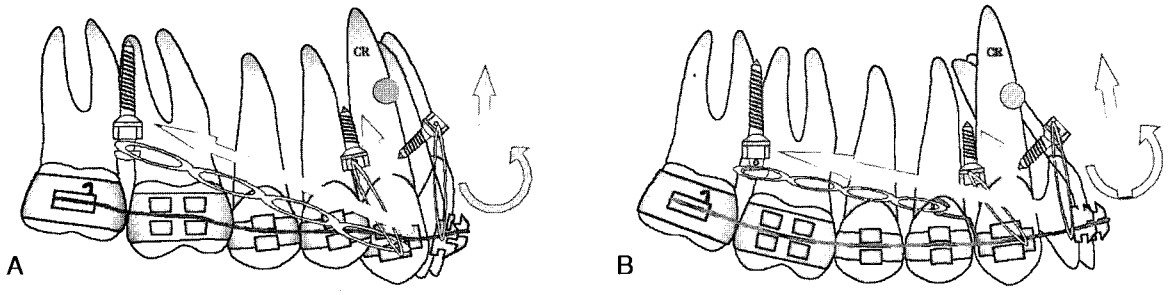

Fig 1. Schematic illustration of mechanics for treatment of Class II division 2 with microimplant anchorage. **A,** Intrusion of anterior teeth and, distalization of canines and posterior teeth; **B,** en masse retraction of 4 anterior teeth.

of the upper incisors by continuous traction with an elastic thread which was tied from the head of the screw to the archwire.

Microimplant anchorage (MIA) has been widely used in recent times in the treatment of various malocclusions due to its efficacy and potency.[6,7] However, there is as yet no report about Class II division 2 treatment with MIA. Therefore, this case report illustrates the possibility of microimplants as anchorage to intrude, distalize and retract the maxillary dentition simultaneously in the nonextraction treatment of Class II division 2 malocclusion.

BIOMECHANICS OF CLASS II DIVISION 2 TREATMENT WITH MICROIMPLANTS AND ANTERIOR BITE PLANE

Maxillary anterior microimplants (MIs) inserted between the maxillary lateral incisors and canines can provide anchorage for intrusion and lingual root torque of the upper incisors. Two other anterior MIs placed between the maxillary canines and 1st premolars can provide anchorage for intrusion of the maxillary canines when they are unusually supraerupted (Fig 1, *A*). Maxillary posterior MIs can provide anchorage for distalization of the maxillary canines and posterior teeth and retracton of incisors, and counteract the proclination of incisors during intrusion (Fig 1). Anterior bite plane can be used for intrusion of the mandibular anterior teeth and extrusion of posterior teeth and allow the mandible to move forward by unlocking the closed bite. Therefore, the use of MIs and bite plane can eliminate the need for extraction or use of headgear to correct Class II relationship.

DIAGNOSIS

A 22-year old male presented with a chief complaint of having gummy smile and lingually tipped upper incisors. Dentally, he had Angle Class II canine and molar relationships. The left 1st and 2nd premolars were in buccal crossbite and the mandibular arch was constricted in the premolar area. He had a peg-shaped anomaly of both upper lateral incisors. He displayed an exaggerated impinging overbite (100%) due to overeruption of the maxillary and mandibular anterior teeth. The arch length discrepancies in the maxillary and mandibular arches were 2 mm and 3 mm, respectively. The curve of Spee was excessive (3 mm), especially on the left side (Fig 2). The pretreatment panoramic radiograph revealed the abscence of disease and the presence of the maxillary and mandibular third molars (Fig 3). The pretreatment cephalogram demonstrated a skeletal and dental Class II pattern, while still showing a normal soft tissue profile, except for a deep labiomental sulcus (Fig 3). A FMA of 24.5°, an IMPA of 92.0°, a FMIA of 63.5°, an ANB angle of 4.5°, a FHI of 0.83°, a FH/U1 of 81.5°, and a Z-angle of 64.0° indicated the uprighting of the anterior teeth and hypodivergent skeletal tendency (Table). Facial

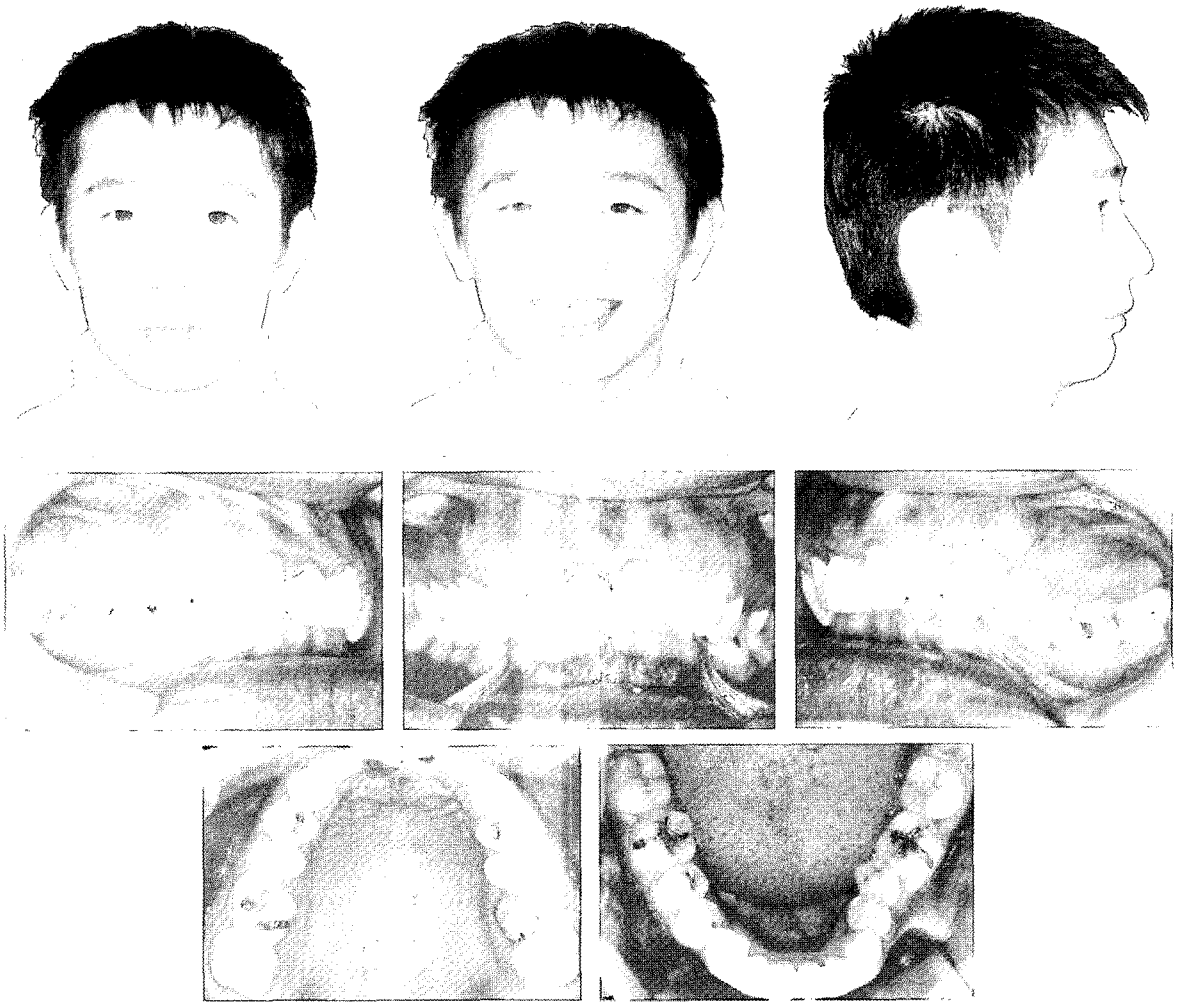

Fig 2. Pretreatment extraoral and intraoral photographs.

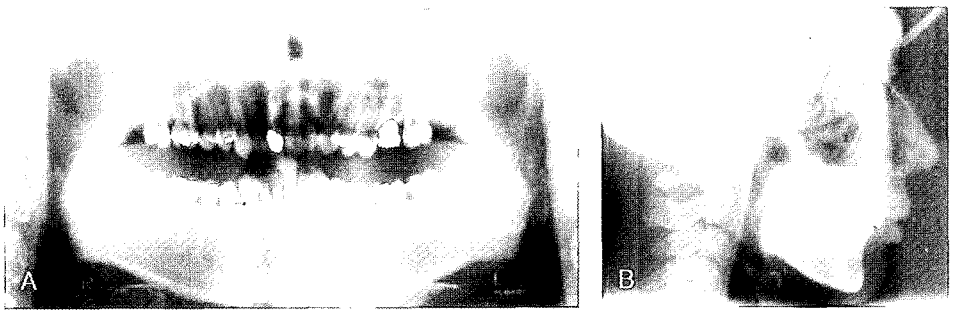

Fig 3. Pretreatment panoramic and lateral cephalometric radiographs.

photographs of the patient illustrated an acceptable facial profile, but a marked gingival display due to the retroclined and extruded upper incisors and hyperactive upper lip elevator muscles on smiling (Fig 2). The patient was in good general health with no signs or symptoms of temporomandibular dysfunction.

Table. Cephalometric measurements

	Pretreatment	*Posttreatment*
FMIA (°)	63.5	57.0
FMA (°)	24.5	23.5
IMPA (°)	92.0	99.5
SNA (°)	74.0	72.5
SNB (°)	69.5	70.5
ANB (°)	4.5	2.0
AO-BO (mm)	5.0	1.5
Occlusal plane angle (°)	9.5	10.5
Y-Axis (°)	69.5	69.0
FH to U1 (°)	81.5	102.0
Interincisal angle (°)	162.0	135.0
Z angle (°)	64.0	68.5
FHI (PFH/AFH) (%)	0.83 (62.5/75.0)	0.85 (63.5/75.0)

TREATMENT PLAN

The first alternative was conventional orthodontic treatment. To correct the axial inclination and supraeruption of the maxillary and mandibular anterior teeth, their proclination and intrusion would be needed. Bite plane and maxillary and mandibular intrusion arches could be used to intrude and procline the anterior teeth and extrude the posterior teeth. But, in this option, the possibility of extracting maxillary premolars to correct Class II relationships would be increased. This would cause a round tripping effect on the maxillary anterior teeth and lengthening the total treatment time. Also, this could not achieve pure intrusion of the maxillary anterior teeth. So, another treatment plan was chosen.

The second alternative was nonextraction, the use of an anterior bite plane, intrusion arch and MIs for anchorage control. In my opinion, MIs would intrude the upper anterior teeth and distalize the upper canines and posterior teeth simultaneously. This would minimize any detrimental effects on the maxillary anterior teeth and reduce the total treatment time by decreasing the possibility of premolar extraction to correct Class II relationships. So, non-extraction treatment was planned, particularly for his straight facial profile with minor crowding. Also the patient and I discussed the need for esthetic surgery or an alternative method with botulinum toxin to the reduce gummy smile due to hyperactive upper lip elevators.

TREATMENT PROGRESS

Bite plane and fixed preadjusted appliances (.022 × .028-in slot) and a .014-in nickel titanium (Ni-Ti) archwire were placed in the maxillary arch (Fig 4).

Maxillary anterior MIs (1.2 mm in diameter, 4.0 mm in length; Absoanchor AN12-004, Dentos Co, Daegu, South Korea) were placed bilaterally in the labial alveolar bone between the maxillary lateral incisors and canines, and between the maxillary canines and first premolars. Maxillary posterior MIs (1.2 mm in diameter, 8.0 mm in length; Absoanchor AX12-108, Dentos Co, Daegu, South Korea) were placed bilaterally in the buccal interradicular bone between the maxillary first and second molars (Figs 4-6).

The anterior and posterior MIs were immediately loaded after placement with an elastomeric force of 50 g and 200 g, respectively. To apply an intruding force to the supraerupted maxillary incisors and canines, elastic threads were tied from the anterior MIs to the archwire. Additionally, to distalize the maxillary

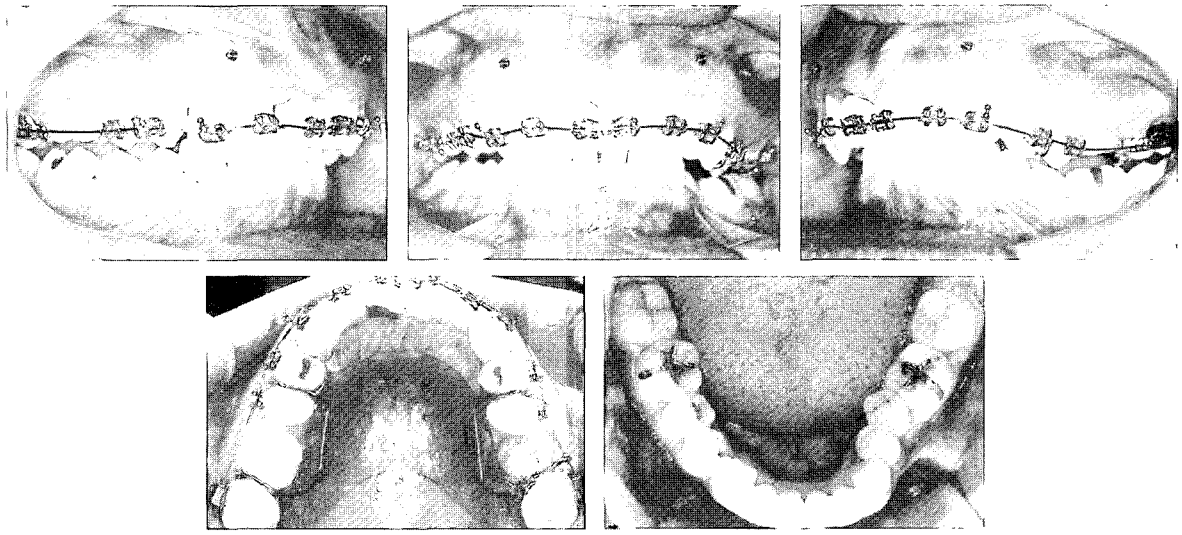

Fig 4. Maxillary anterior MIs and bite plane were placed for intrusion of maxillary and mandibular anterior teeth.

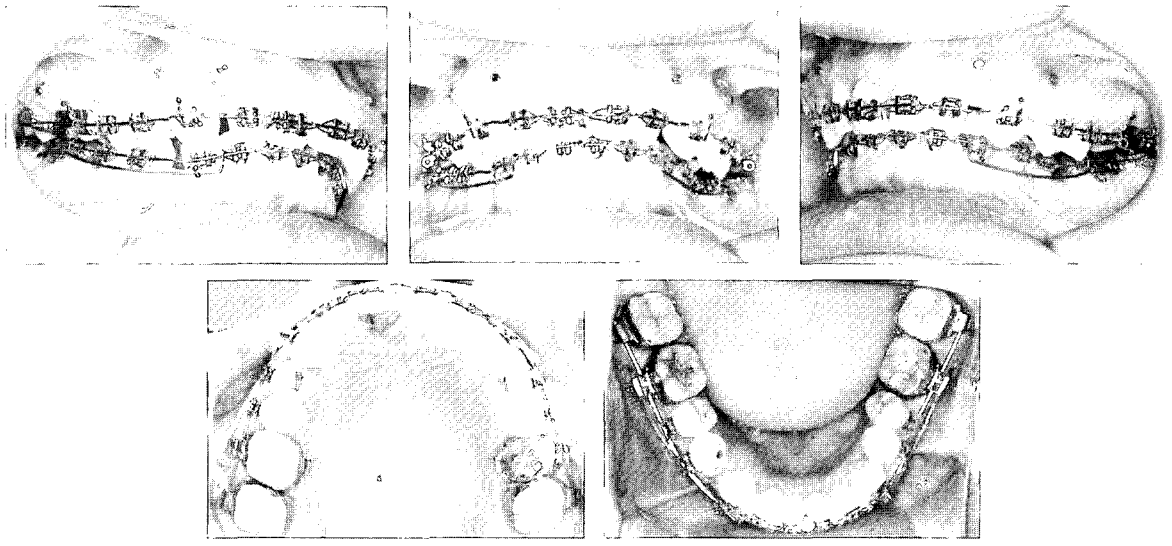

Fig 5. Additional maxillary anterior MIs were placed for intrusion of the maxillary canines, the maxillary posterior MIs were placed for distalization of the maxillary canines and posterior teeth, and intrusion arches were placed for intrusion of mandibular anterior teeth and extrusion of the mandibular posterior teeth.

canines and posterior teeth, the elastomeric chain force was applied from the posterior MIs to the canine brackets on both sides (Figs 4-6).

After 9 months of treatment, fixed preadjusted appliances (.022 × .028-in slot) and a .014-in nickel titanium (Ni-Ti) archwire with intrusion arch (.017 × .025-in TMA) were placed in the mandibular arch. After creating space by distalizing the maxillary canines and posterior teeth, .017 × .025-in stainless steel archwire with soldered hooks between the maxillary canines and 1st premolars was placed to retract the upper incisors (Figs 5 and 6). After space closure, treatment was completed with ideal arch wires and cusp seating elastics. The total treatment time was 29 months.

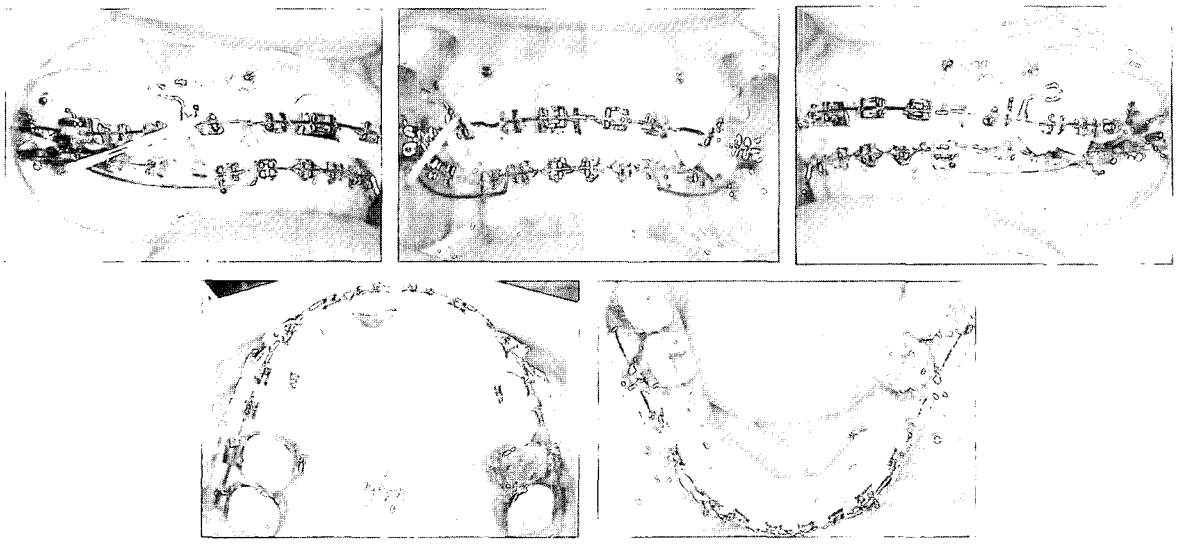

Fig 6. Maxillary anterior teeth were retracted with elastomeric chains connected from the maxillary posterior MIs to the hooks and Class II elastics were applied on the right side for Class II key correction.

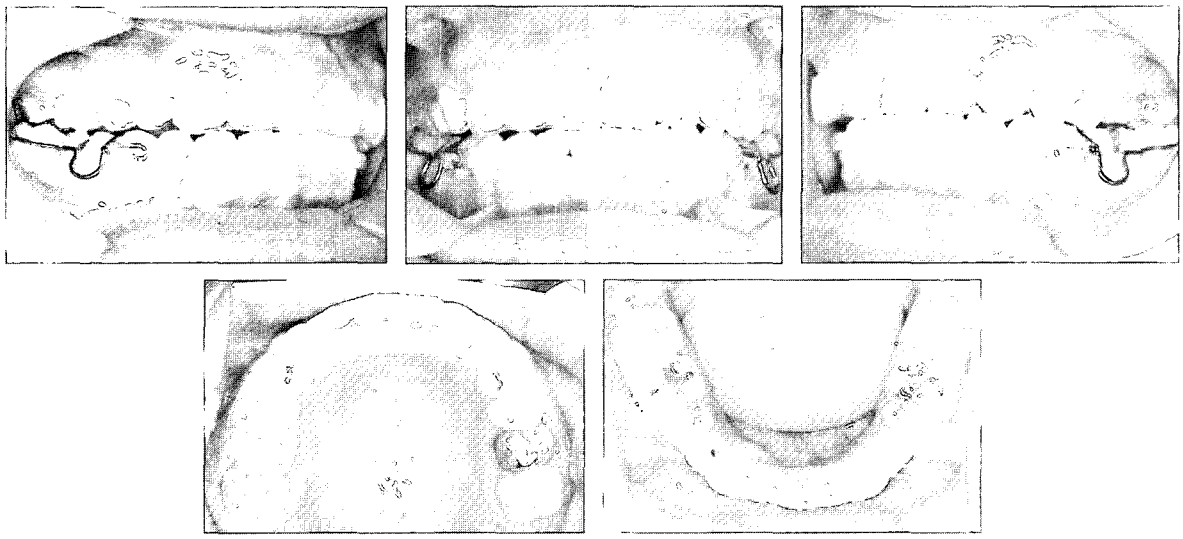

Fig 7. Modified Essix type invisible retainer with bite plane in the maxillary arch and circumferential clear retainer and lingual fixed retainer in the mandibular arch were applied.

The patient was instructed to wear a modified Essix type invisible retainer with a bite plane in the daytime and a maxillary circumferential clear retainer at nighttime. The mandibular retainer consisted of a circumferential clear retainer and a twisted, three-stranded .032" wire bonded onto the lingual side of the incisors and canines (Fig 7). Esthetic treatment of the maxillary anterior segment involving peg-shaped upper lateral incisors was planned after an appropriate period of retention.

TREATMENT RESULTS

At the end of treatment, a well-aligned dentition with Class I molar and canine relationships was

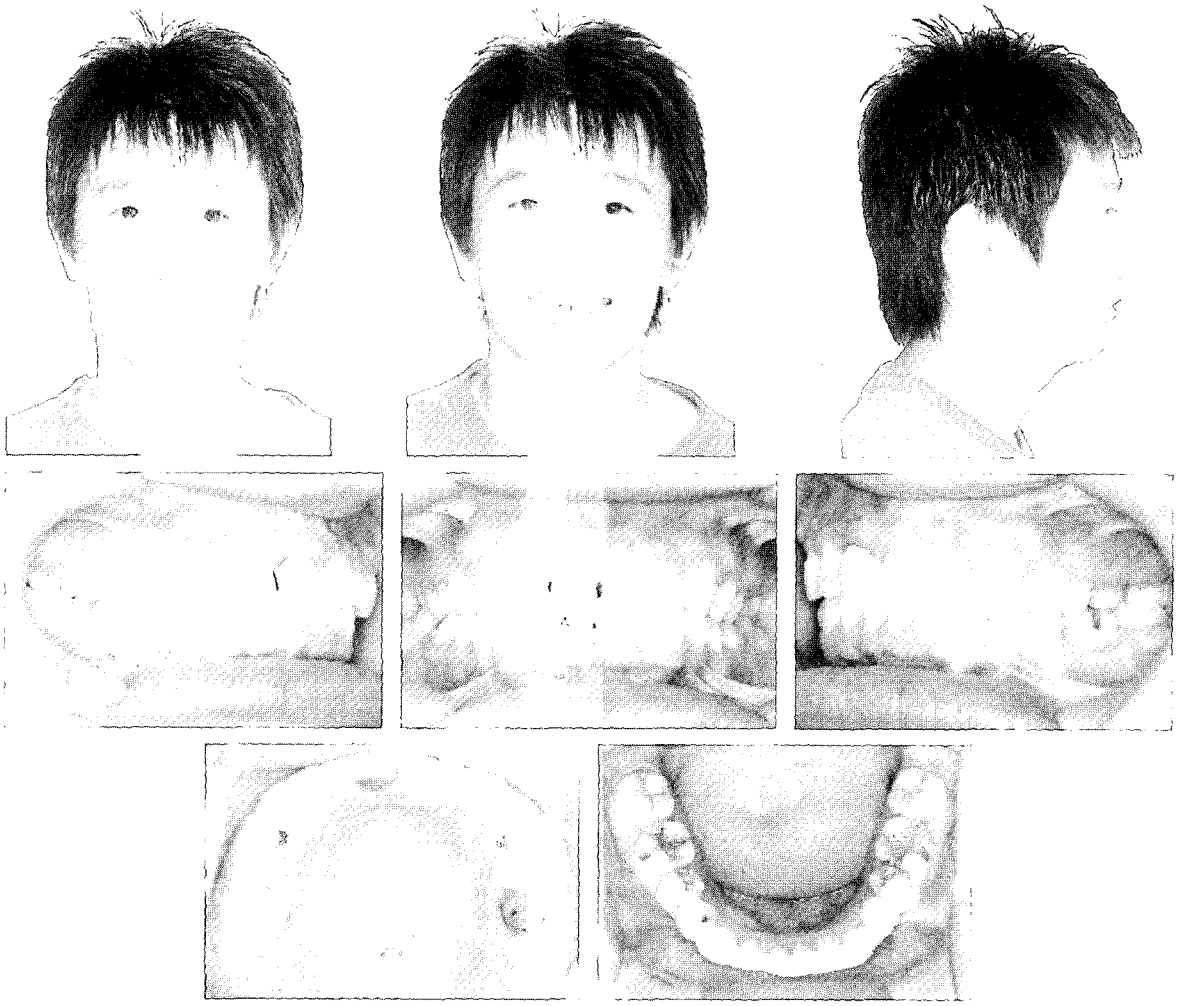

Fig 8. Posttreatment extraoral and intraoral photographs.

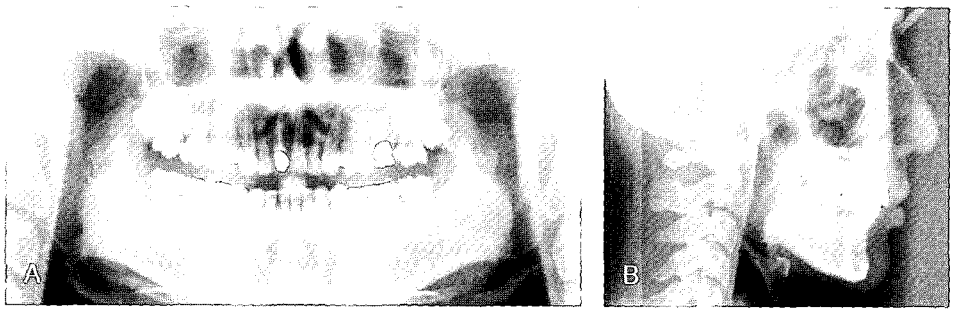

Fig 9. Posttreatment panoramic and lateral cephalometric radiographs.

obtained. A nicely balanced and harmonious face was achieved by reducing mandibular lip eversion. The intrusive forces that were used on the maxillary anterior segment successfully reduced the excessive gingival display when smiling (Fig 8).

Superimposition of pretreatment and posttreatment cephalometric tracings demonstrated good control of tooth movement such as prominent axial inclination

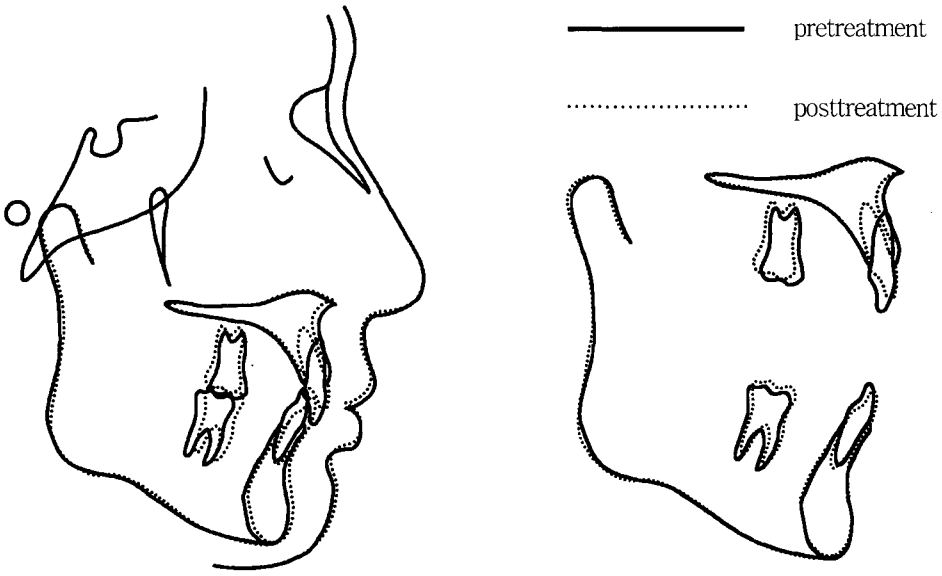

Fig 10. Lateral cephalometric superimposition.

change and intrusion of upper incisors, labially controlled tipping and intrusion of the mandibular anterior teeth, extrusion of the mandibular posterior teeth, and distalization and intrusion of the maxillary canines and posterior teeth. The intrusion of the maxillary anterior teeth resulted in esthetic improvement of the deep labiomental fold by raising upper and lower lips. The mandible moved forward after the lingually tipped maxillary anterior teeth and deep bite were corrected. Additionally, retraction of A point helped to correct the dental and skeletal Class II problem while the occlusal plane angle was slightly increased by 1. The ANB angle was reduced by 2.5°, which was induced by a 1.5° decrease of the SNA angle and a 1.0° increase of the SNB angle. The FMA angle was decreased by 1.0° and the Z angle was improved from 64.0° to 68.5°. The FH/U1 and IMPA was increased by 20.5° and 7.5°, respectively, which was induced by applying intrusive forces on anterior teeth for the correction of deep bite (Figs 9 and 10, Table).

DISCUSSION

According to the definition published by Angle[8] in 1899, Class II division 2 malocclusion is characterized by posterior displacement of the mandibular dental arch, deep overbite and lingually tipped upper incisors. The characteristics of Class II division 2 malocclusion have been widely discussed by many authors since Angle defined this malocclusion for the first time.

Class II division 2 malocclusions have many characteristics such as autosomal dominant type, low prevalence rate, uprighting and supraeruption of upper and lower incisors, large interincisal angle, deep curve of Spee, large collum angle (bending tendency), generalized tooth-size reduction, closely related to congenital anomalies, decreased mandibular intercanine width, pronounced chin point, abundant mandibular basal growth, hypodivergent facial pattern, lack of vertical growth, mandibular displacement, high gingival margin and high lip line, hyperactive lower lip or mentalis muscles, increased masticatory bite forces, and deep mentolabial sulcus. Most of them are accepted as a general rule, but some of them are still controversial.[9-11]

A nonextraction approach[3,4] was indicated in the treatment of this Class II division 2 malocclusion because of the acceptable facial profile, hypodivergent facial pattern and minor arch length discrepancy, while the patient had Class II canine and molar relationship. Traditionally, treatment of a Class II division 2 patient with a moderate or severe skeletal discrepancy has involved proclining the upper labial segment, thereby,

converting the incisal relationship to Class II division 1 malocclusion and then treated as division 1 from that point on. This kind of round-tripping tooth movement can cause undesirable results such as root resorption of maxillary anterior teeth, delayed treatment time and the need for more anchorage reinforcement of the maxillary posterior teeth during retraction of the maxillary anterior teeth.

Correction of a deep overbite[12-14] can be achieved by incisor intrusion and proclination, molar extrusion and increasing lower facial height. Since growth tends to increase the vertical distance between the maxilla and the mandible, it is probably useful to treat these cases during a period of mandibular growth. However, increasing the lower facial height by molar extrusion is not stable in adults because it is counteracted by posterior occlusion. Therefore, in this adult patient, intrusion of the anterior teeth was the treatment of choice for correcting deep overbite.

The effectiveness and clinical application of the MIs have been discussed previously.[6,7] Creekmore and Eklund[5] implanted a surgical vitallium screw in the area of the anterior nasal spine. Surgical incision and suture might be necessary due to the movable tissue such as the labial frenum to insert MIs into the ANS area. Furthermore, the head of the orthodontic screw could not be used directly due to being covered with movable soft tissue. Therefore, I decided to insert anterior MIs into the area which had favorable attached gingiva. The maxillary anterior MIs[6] were used for intrusion and lingual root movement of the upper incisors without proclination to reduce deep overbite and gummy smile. Unlike common Class II division 2 malocclusions, this patient had extremely supraerupted canines. So, additional anterior MIs were inevitable to intrude the maxillary canines. Simultaneously, posterior MIs were used for distalizing the maxillary canines and posterior teeth to correct Class II canine and molar relationships as an absolute anchorage. As a result, this simultaneous intrusion and retraction abolished round tripping of the maxillary anterior teeth and provided genuine intrusion, not pseudointrusion.[12] In the mandibular arch, intrusion and proclination of the anterior teeth and extrusion of the posterior teeth were achieved by the use of bite plane, intrusion arch and Class II elastics.

It is a common belief that the mandible is displaced posteriorly during closure from rest position into intercuspal position in Angle Class II division 2 malocclusions. For this patient, cephalometric superimposition showed forward movement of the mandible which also helped to correct the dental and skeletal Class II relationships. But the concept of a posterior mandibular displacement in Class II division 2 malocclusion is still controversial[15] and further studies are necessary.

The reasons for a gummy smile might be as follows: short or hyperactive upper lip, altered passive eruption, dentoalveolar extrusion, vertical maxillary excess, and multiple etiologies. For this patient, hyperactive upper lip and overeruption of upper incisors were the causes of gummy smile. Proper intrusion of the upper incisors to the esthetic level of the lips at rest was achieved. But, in spite of sufficient intrusion of the upper incisors, the patient showed only a somewhat reduced gummy smile during social and unposed smile when compared with pretreatment, due to the hyperactivity of the upper lip elevator muscles. Dental treatment has limitations in treating this symptom. Accordingly, facial plastic surgery or alternative treatment may be necessary. To reduce the excessive smile curtain (amount of mobility and elevation of upper nale lip when smiling), a surgical approach can be taken to immobilize smile with spacers made of cartilage or silicone and to lower the height of the gingivolabial sulcus.[16] An alternative method, chemodenervation with botulinum toxin type A[17,18] may be used to weaken the zygomaticus major muscle. However, it has been noted to be unpredictable.

Orthodontic correction of Class II division 2 malocclusions is known to be difficult and prone to relapse. The contributing factors for retention and stability might be these: interincisal angle, amount of initial overbite, growth pattern, muscular balance and pressure, position of incisors, or palatal root torque.[19,20] Engel et al[21] suggested that a relapse of 1 mm was to be expected for an average intrusion of 3 mm. For retention, in addition to a routine retainer such as

circumferential clear retainer and fixed lingual retainer, a modified Essix type invisible retainer with anterior bite plane[22] was placed in the maxillary arch to provide intrusive force to the mandibular anterior teeth, intrusive and proclining forces to the maxillary anterior teeth, and extrusive force to the mandibular posterior teeth.

CONCLUSIONS

Non-extraction treatment of Class II division 2 which is characterized with Class II canine and molar relationships and deep bite was corrected by combination of MIA and a conventional method. MIA provided an absolute anchorage for the intrusion and lingual root torque of upper incisors, and distalization and intrusion of the maxillary canines and posterior teeth, simultaneously, to correct the deep bite and Class II relationships.

Consequently, by this simultaneous movement of the maxillary dentition with MIA, the treatment results were achieved more efficiently.

- 국문초록 -

Microimplant Anchorage (MIA)를 이용한 II급 2류 성인 환자의 비발치 치험례

채 종 문

상악 측절치와 견치의 치근 사이에 식립한 microimplant를 이용하여 상악 전치의 함입과 설측으로의 치근 이동을 얻을 수가 있었으며, 상악 견치와 제1소구치의 치근 사이에 식립한 microimplant를 이용하여 과맹출된 상악 견치를 함입시켰다. 또한 상악 제1, 2대구치의 치근 사이에 식립한 microimplant를 이용하여 상악 견치 및 구치의 후방 이동 및 상악 전치의 후방 견인을 시행하였다. Anterior bite plane과 intrusion arch, 그리고 II급 고무 등과 같은 전통적인 방법을 사용하여 하악 전치의 함입 및 구치부의 정출을 얻을 수가 있었으며, 과개 교합 및 상악 전치의 설측 경사가 해소 되면서 하악골이 전방으로 약간 이동하였다. 이와 같이, MIA는 II급 2류 부정교합 환자에 있어서 II급 견치 및 구치 관계 그리고 과개 교합을 동시에 해소 하는데 절대적인 고정원을 제공하였다.

(**주요 단어**: II급 2류 부정교합, 미세임플란트고정원, 치아함입, 설측 치근토크)

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