Case Report

Nonsurgical and nonprosthetic camouflage treatment of skeletal Class II open bite with bilaterally missing lower first molars

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ABSTRACT

This report illustrates the successful nonsurgical and nonprosthetic camouflage treatment of a skeletal Class II open bite malocclusion combined with missing mandibular first molars bilaterally. In the mandible, the second and third molars were uprighted and protracted, substituting for the missing first molars. In the maxilla, anterior bodily retraction and full-arch intrusion were achieved following premolar and second molar extraction, which also induced autorotation of the mandible. The treatment outcome and prognosis were confirmed with three-dimensional superimposition techniques, along with long-term stability. (*Angle Orthod.* 2019;89:505–517.)

KEY WORDS: Molar protraction; Class II; Open bite; 3D superimposition

INTRODUCTION

For the treatment of skeletal Class II open bite with high mandibular plane angle, surgical correction can be combined with orthodontics as it improves the underlying skeletal discrepancies.[1] Camouflage treatment options, such as premolar or second molar extraction and/or additional vertical control through molar intrusion using temporary anchorage devices (TADs) reportedly provide satisfying results as well.[2–5]

Early loss of the mandibular first molar can result in overall changes in occlusion. Periodontally, the adjacent teeth can accumulate plaque inducing periodontal problems such as reduction in alveolar bone width and height.[6] In general, orthodontic space regaining and replacement of the missing tooth by dental implant, prosthetic bridge, or autotransplantation has been considered the standard of care for many years[7,8] since orthodontic space closure by second molar protraction in the mandible is biologically and biomechanically limited due to the insufficient amount of underlying alveolar bone and anchorage.[9,10] However, the application of TADs has effectively enlarged the range of root movement and efficiency of molar protraction, suggesting the possibilities of orthodontic space closure and the incorporation of the third molars into occlusion.[11]

This case illustrates the successful nonsurgical and nonprosthetic camouflage treatment of skeletal Class II open bite malocclusion combined with missing bilateral mandibular first molars. The treatment outcome was confirmed with three-dimensional superimposition techniques along with long-term stability.

History

A 21-year-old woman was referred by a general dentist to Dep. Orthodontics, Gangnam Severance Hospital, Yonsei University. The patient's concerns were mainly related to the treatment of missing mandibular molars, but she also wished for overall occlusal and esthetic improvement. The referring dentist offered an option for dental implants after regaining orthodontic space for the missing mandibular first molars. The patient noted "changes in biting with contact only on the back teeth" and reported that she was no longer able to find "the proper/stable bite."

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Accepted: July 2018. Submitted: March 2018.
Published Online: August 20, 2018

Figure 1. Pretreatment facial and intraoral photographs.

Diagnosis and Etiology

The initial extraoral evaluation indicated lip protrusion, retrusive chin with hyperdivergent profile, mentalis muscle strain. and excessive gingival display at full smile. The intraoral exam indicated Class II molar and canine relationships, large overjet (4.5 mm), and open bite with contact only between the second molars. Maxillary incisors (U1) were retroclined with moderate crowding. The mandibular left first molar was missing, while a small fractured tooth remnant of the mandibular right first molar was detected. The mandibular second molars were both tipped mesially, and minor spacing was present in the incisor region. The upper dental midline was slightly deviated to the right side compared with the facial midline (Figures 1 and 2).

The initial radiographic evaluation indicated flattening of both condyles with relatively short ramal height (36.7 mm). All four third molars were fully developed. The cephalometric analysis showed a skeletal Class II relationship with a retrognathic mandible (SNA 80.1°, SNB 70.4°, ANB 9.7°) and maxillary vertical excess (U1 to NF 34.4 mm) along with a high mandibular plane angle (SN-GoMe 54.5°, FMA 49.6°). The upper and lower lips were protruded 4.5 mm and 7.0 mm to the E-line, respectively, with an obtuse nasolabial angle.

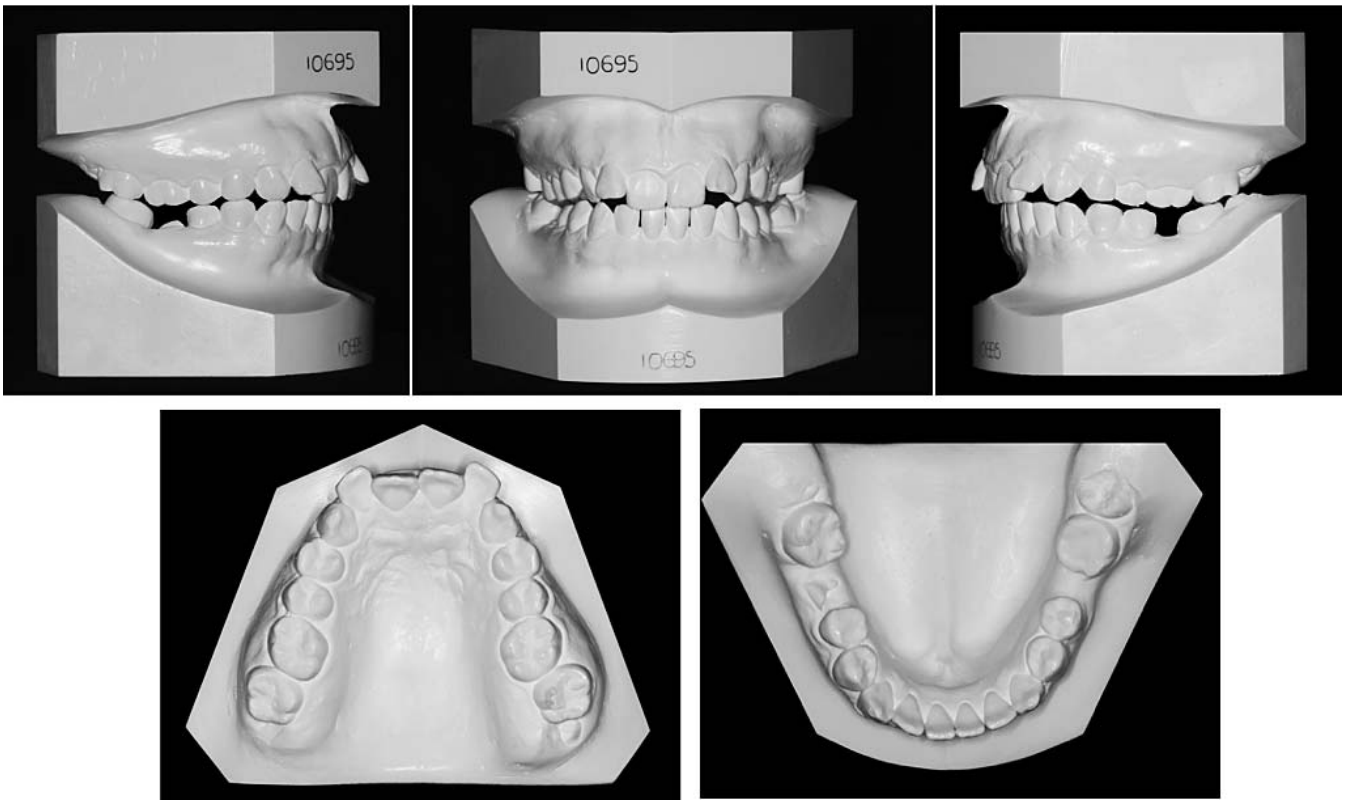

Figure 2. Pretreatment dental casts.

Both the maxillary and mandibular incisors were retroclined (U1 to SN, 91.5°, IMPA, 88.5°).

Upon these findings, the patient was diagnosed as skeletal Class II open bite malocclusion with bilaterally missing mandibular first molars (Figure 3).

Treatment Objectives

The treatment objectives were to

1. Establish ideal functional occlusion and manage the edentulous site.
2. Improve soft tissue esthetics.

Treatment Alternatives

Considering the severity of the skeletal Class II combined with vertical discrepancies, two-jaw orthognathic surgery was proposed as the first treatment option. To improve facial esthetics and allow stable surgical results, maxillary impaction with advancement of the mandible was proposed. To correct the crowding, protrusive upper lips with an obtuse nasolabial angle, maxillary premolar extraction followed by anterior retraction, and space closure were planned. The missing first molars were to be replaced with either dental implants or prosthetic bridges after regaining space. Extraction of the mandibular third molars was

Table 1. Cephalometric Summary[a]

Measurement	Norms	SD	Initial	Final
Skeletal				
SNA (°)	81.6	3.2	80.1	80.0
SNB (°)	79.1	3.0	70.4	70.4
ANB (°)	2.4	1.8	9.7	9.6
Wits (mm)	−2.7	2.4	1.5	0.5
SN to MP (°)	33.0	5.0	54.5	54.2
Bjork sum (°)	393.3	5.1	409.0	408.4
Gonial angle (°)	118.6	5.8	130.0	129.2
Mandibular body length (mm)	78.0	4.3	74.0	74.0
Anterior facial height (mm)	127.4	5.6	130.0	128.5
Posterior facial height (mm)	85.0	5.5	72.8	73.0
Post. height/Ant. facial height	66.8	4.2	56.0	56.8
Dental				
U1 to SN (°)	106.0	6.0	91.5	90.5
IMPA (°)	95.9	6.3	88.5	89.5
U1 to A-Pog (mm)	7.9	2.3	11.0	6.1
L1 to A-Pog (mm)	4.6	2.1	4.1	2.6
U1-NF (mm)	27.5	1.7	34.4	32.5
U1 to STMs (incisor show) (mm)	2.0	2.0	4.0	2.0
Soft tissue				
Upper lip to E-line (mm)	–0.8	2.1	4.5	1.5
Lower lip to E-line (mm)	0.5	2.3	7.0	2.7

[a] ANB indicates A point-nasion-B point; FH, facial height; L1, lower incisor; IMPA, lower incisor mandibular plane angle; MP, mandibular plane; NF, nasal floor; SN, sella-nasion; SNA, sella-nasion-A point; SNB, sella-nasion-B point; U1, upper incisor; STMs, stomion superius.

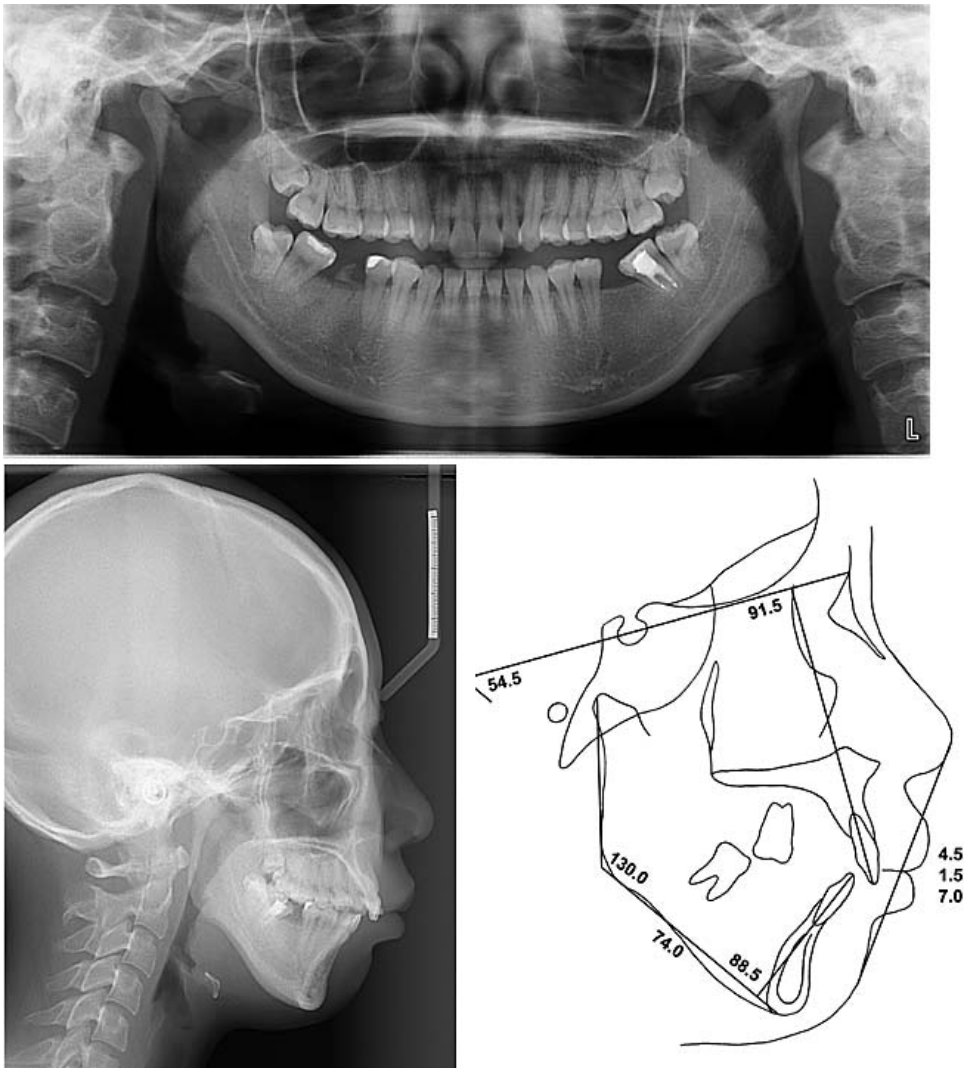

Figure 3. Pretreatment radiographs and cephalometric tracing.

necessary to allow sufficient space regaining for the first molars and for the surgical preparation for mandibular advancement. The final occlusion for this option would result in a Class II molar relationship with two dental implants/bridges replacing the mandibular first molars.

Although the merits of the first treatment option were well understood by the patient, the patient was reluctant to choose this option due to multiple surgical procedures and economic issues related to the high costs of orthognathic surgery and two dental implants in addition to the orthodontic treatment.

Thus, a second option involving camouflage treatment, which would be more economically affordable, was proposed. To achieve esthetic results without surgery, correction of both A-P and vertical discrepancies was required. In the maxillary arch, total intrusion along with anterior retraction was planned as it would improve the protrusion and open bite, induce autorotation of the mandible, and reduce the excessive incisor exposure at smile.[12,13] Conventionally, the third molars would be extracted for sufficient molar intrusion and vertical control. But in this case, the maxillary second molars were elongated and were the only teeth with occlusal contact. Since the maxillary third molars displayed comparable morphology to the second molar with a high chance of spontaneous eruption after second molar extraction,[14] the second molars were extracted instead of the third molars. This extraction regimen has advantages since it instantly eliminated the posterior occlusal stop, possibly inducing spontaneous counterclockwise rotation of the mandible,[15] and simplified the biomechanics required for facilitating molar intrusion.

In the mandible, the morphology, root length, and periodontal status of the second and third molars were also acceptable. Thus, the protraction of second and third molars to substitute for the missing first molars

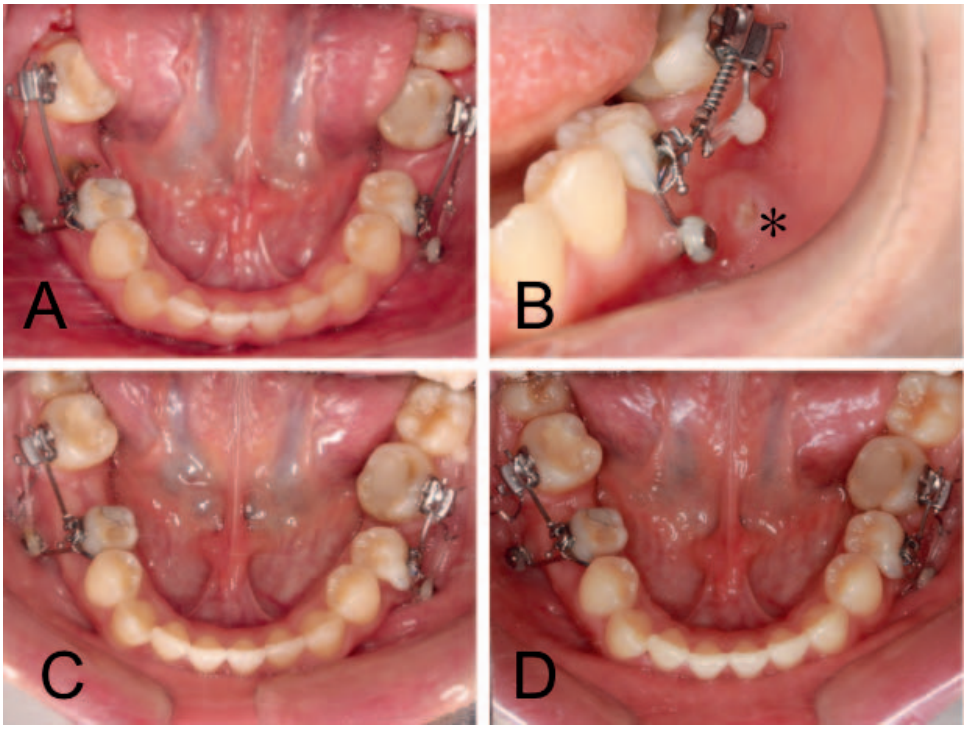

Figure 4. Molar protraction with temporary anchorage device and long lever arms in the mandible. (A) Initiation of molar protraction with temporary anchorage devices set for both direct and indirect anchored unit along with long lever arms; (B) after 3 months. Intraoral soft tissue irritation (*) caused by long lever arms. Shorter lever arms were set with the direction of force passing below the center of resistance (C) after 7 months and (D) after 10 months.

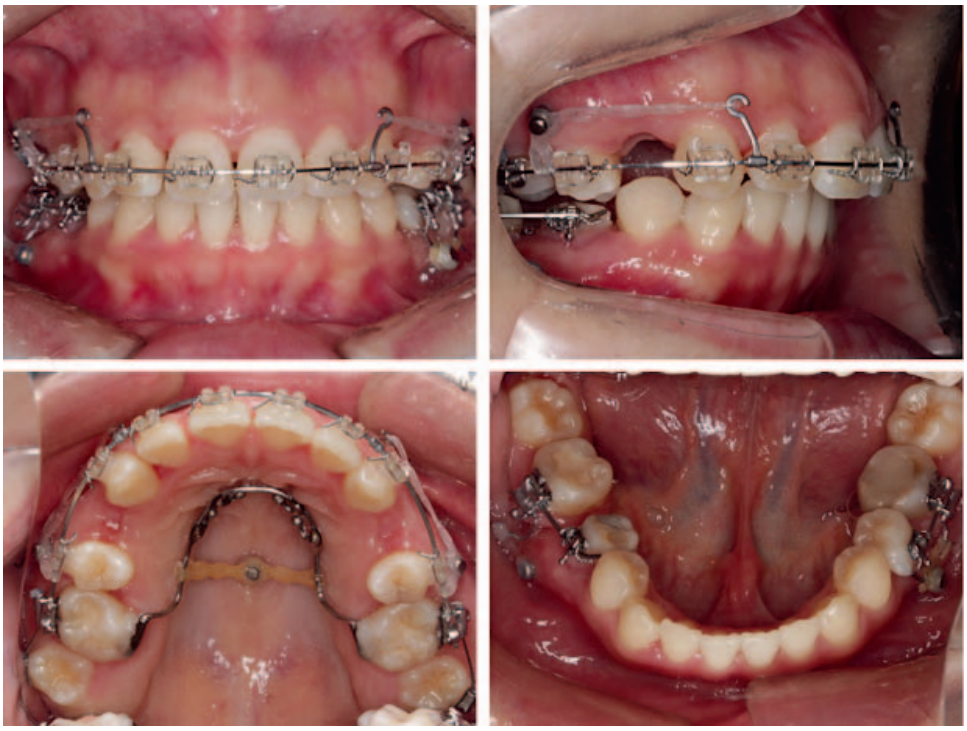

Figure 5. Intraoral photographs after 12 months.

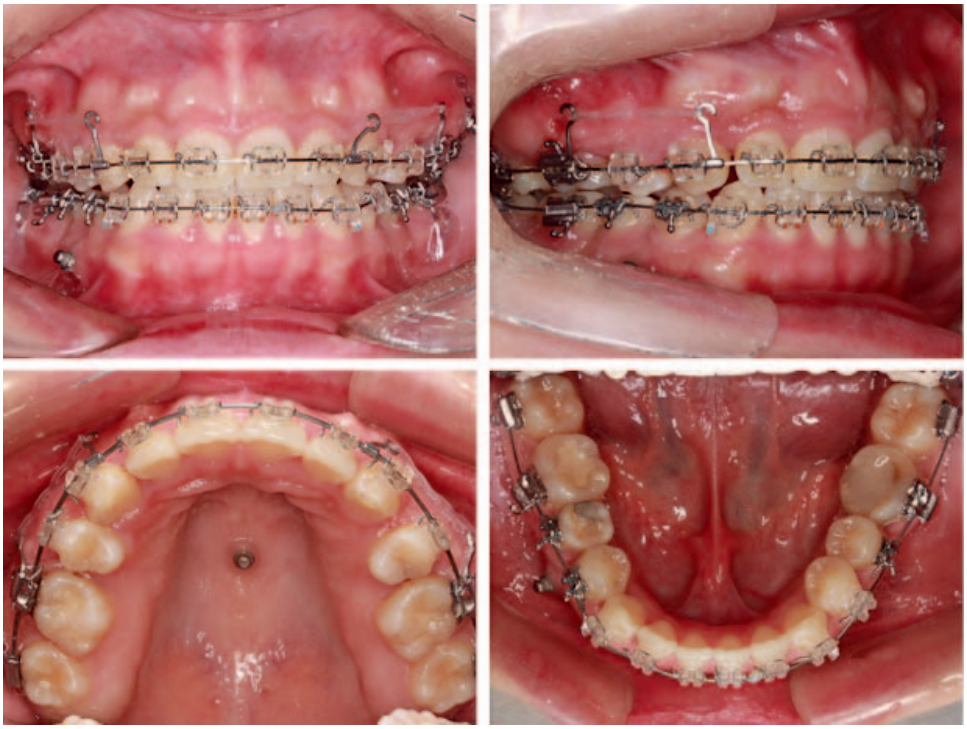

Figure 6. Final alignment and detailing after 29 months.

was planned instead of prosthetic replacement of the missing first molars. The final occlusion would also finish in a Class II relationship similar to the first option but without additional dental implants.

Treatment Process

In the mandible, miniscrews (7.0 mm length 1.8 mm diameter; ORLUS, Ortholution, Seoul, Korea) were inserted distal to the second premolar on the right and between the premolars on the left. The second premolar was rigidly connected with the adjacent miniscrew with 019" × 025" SS wire and bonding resin and served as an indirect anchorage unit. In addition, 018" slot Roth-prescription brackets (Tomy Inc, Tokyo, Japan) were bonded segmentally with 016" × 022" improved superelastic NiTi wire as the initial sectional archwire, and 017" × 025" SS long lever arms were placed in the auxiliary tubes of the second molars for bodily molar protraction. For the right side, the lever arm was set to produce a line of action near the furcation of the molar estimated as the center of resistance when protraction force was applied directly from the miniscrew with elastomeric chain.[11] For the left side, a longer lever arm was set to deliver force below the center of resistance to induce mesial root movement initially (Figure 4A). However, the lever arm on the left side irritated the buccal soft tissue (Figure 4B). To effectively produce molar uprighting and root movement on the left side with less irritation, a couple was applied: a light opencoil spring was placed on the archwire to tip the second molar crown at the bracket level, while the mesial side of the opencoil was fixed by crimpable hook and anchored to the slightly shorter lever arm with elastomeric chain, producing a line of action passing below the center of resistance of the second molar (Figure 4B). The left second molar was successfully uprighted, and protraction was then continued using the long lever arms (Figure 4C,D).

In the maxilla, the second molars were extracted, and 018-slot Roth prescription brackets were bonded on the molar segment. Miniscrews were inserted interdentally between the first and second premolars and in the midpalatal region, along with a bonded palatal arch on the first molar. Intrusive force was applied from the buccal and palatal TADs using elastomeric chains. Spontaneous eruption of the third molars was noted. After 7 months, the incisors were bonded, and the maxillary first premolars were immediately used as an indirect anchored unit with the buccal miniscrews to avoid unwanted extrusion during anterior alignment. After 10 months, the first premolars were extracted. Intrusion and retraction forces were directly applied using elastomeric chains to the 017" × 025" SS archwire and to the palatal arch as well as long crimpable power arms between the lateral incisors and canines.

Spontaneous eruption and mesial drift of the mandibular third molars were also noted. Indirect

Figure 7. Posttreatment facial and intraoral photographs.

anchoring wire was detached with failure of the miniscrew on the right side at around 10–12 months. During the course of these events, mild lingual tipping of the right second premolar was observed. However, relocation of a miniscrew to an adjacent site provided sufficient anchorage overall (Figure 5).

To control maxillary anterior torque, additional buccal crown torque of 7° was added to the maxillary anterior region of the archwire during retraction.[16] Maxillary buccal TADs were removed at 24 months, but long lever arms were engaged in the auxiliary tubes of the first molars to maintain the vertical level of the retraction force.

The mandibular space was closed after 20 months. To avoid unwanted reactions to the relatively well-aligned mandibular incisors during molar protraction, bonding of the mandibular incisors and the third molars was delayed until the final finishing period at 29 months followed by final detailing (Figure 6).

After 36 months, the appliances were removed. Fixed lingual retainers were bonded to the lingual surfaces of both arches. In the maxilla, bony exostosis was noted bilaterally adjacent to the apical region of the lateral incisors. Alveoloplasty was recommended for esthetic issues, along with crown restoration for the endodontically treated mandibular left second molar.

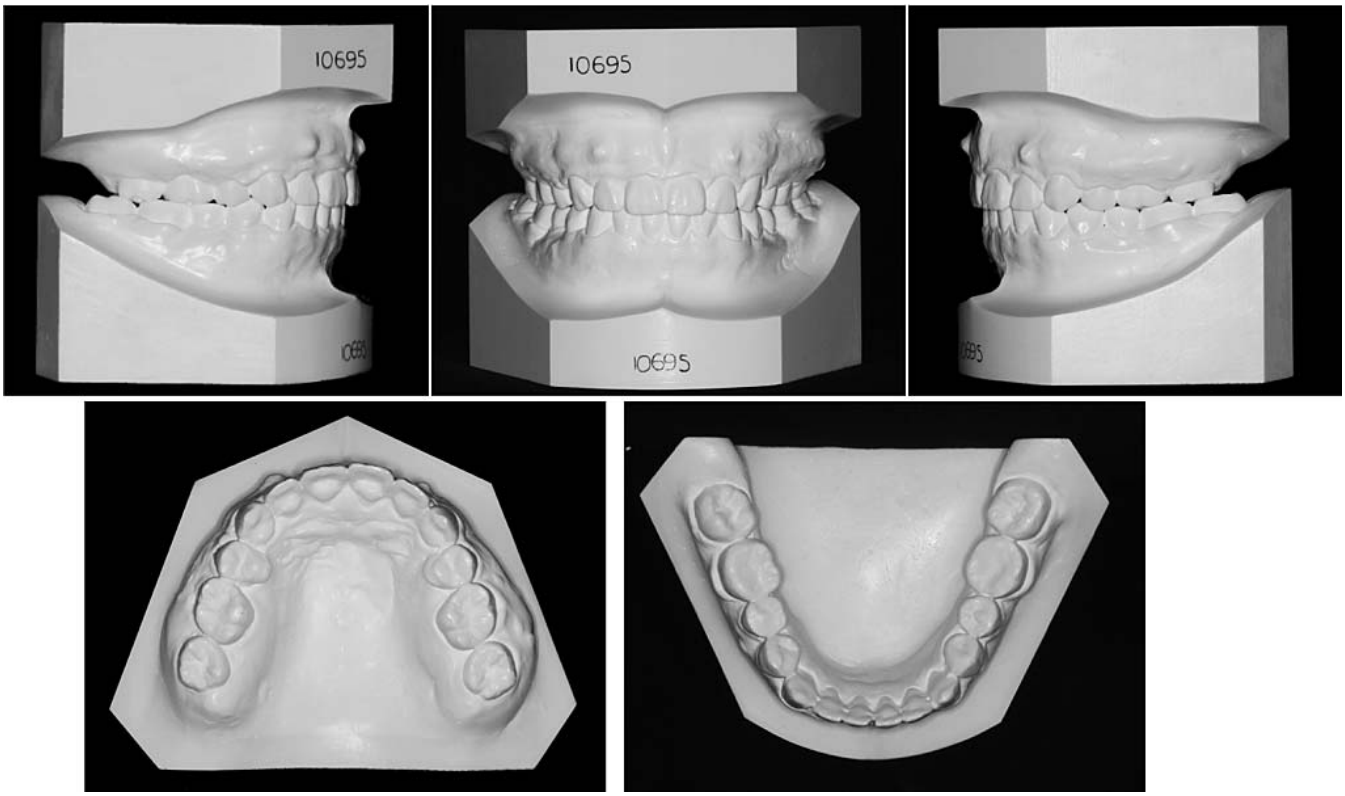

Figure 8. Posttreatment dental casts.

Circumferential retainers were delivered for full-time usage for the first 6 months and for nighttime use for an additional 6 months.

Treatment Results

Facial esthetics and occlusion improved. The occlusion was finished in ideal Class I canine and Class II molar relationship with mandibular second and third molars substituting for the first and second molars and maxillary third molars replacing the second molars. Lip protrusion was corrected, and the patient was fully satisfied with the esthetic outcome (Figures 7 and 8).

The posttreatment panoramic radiograph indicated well-aligned roots, but mild to moderate root resorption was noted. Cephalometric evaluation indicated a decrease in A-P discrepancy and lip protrusion and reduction of overjet without changes in maxillary anterior torque. Full arch intrusion was induced in the maxilla with slight counterclockwise rotation of the mandible resulting in the reduction of anterior facial height. The mandibular second and third molars were fully protracted (Figure 9, Table 1).

To evaluate the alveolar bone response of the previously edentulous region along with surgical planning to correct exostosis, a posttreatment cone beam computed tomography was taken. To confirm treatment outcome, pretreatment and posttreatment cone beam computed tomographic images were superimposed on the anterior cranial base.[17] Overall, counterclockwise rotation of the mandible and a mild decrease in the anterior facial height were noted. The maxillary incisor tip and apex were retracted an average of 4.6 mm, indicating bodily retraction, while molar anchorage was maintained. Mild to moderate root resorption ($<$3 mm) was observed in the incisors. Vertically, the maxillary arch showed a total impaction-like effect with 1.5–2.0 mm and 2.0–2.5 mm of intrusion for both the incisors and molars, respectively (Figure 10).

Unexpectedly, positional changes of the condyles were also noted following treatment. The condyles were repositioned slightly upward and posteriorly (Figure 11A–C). No specific temporomandibular joint–related symptoms were noted. Due to the changes in condyle position and the complex three-dimensional movement of the mandible, mandibular regional superimposition was applied.[18,19] The right second molar showed bodily protraction, while the left second molar showed greater root movement. The vertical levels of the molars were well maintained. The incisors were slightly uprighted and elongated (Figure 11D–F).

Retention and Stability

The occlusion and facial esthetics were stably maintained throughout the follow-up period of 16

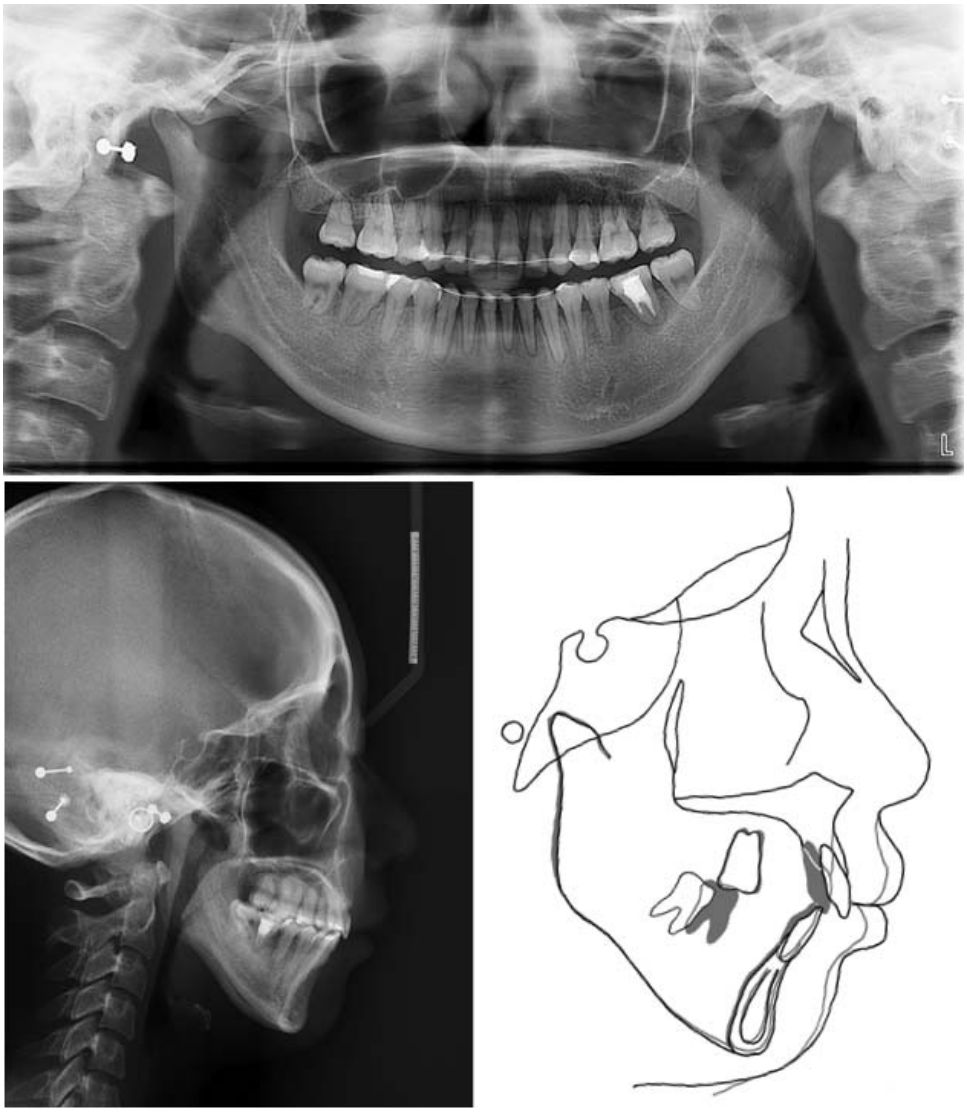

Figure 9. Posttreatment radiographs and cephalometric superimposition. Black, initial; gray, final.

months. Alveoloplasty improved the esthetic appearance of the maxillary anterior periodontium (Figure 12).

DISCUSSION

Successful camouflage treatment of skeletal Class II open bite malocclusion relies on precise control of both the A-P and vertical problems. The treatment scheme increases in complexity when additional dental limitations, such as premature loss of first molars and/or esthetic issues are combined with the skeletal problem. The illustrated case successfully overcame these limitations with selective tooth extraction and application of simple biomechanics using TADs for molar protraction, total intrusion, and anterior torque control.

Although orthodontic protraction of a mesially tipped second molar presents biomechanical and biological limitations in general, the patient was a young adult, had relatively thick alveolar bone in the edentulous region without periodontal involvement, and the morphology of the second and third molars were compatible, indicating a favorable prognosis for protraction.[11] Since protraction using a full-arch system may induce an unfavorable response for the mandibular incisors, a sectional arch technique with second premolars indirectly anchored to the miniscrew was used. To provide root or bodily movement, long lever arms were inserted into the auxiliary tubes and a protraction force of $<$150g was delivered directly from the same miniscrew.[11] The line of action was modified as needed by adjusting the height of the lever arm intraorally.

In the maxilla, the second molars were selectively extracted instead of the third molars to improve biomechanical efficiency. The maxillary second molars were the only teeth that were in contact with the tipped

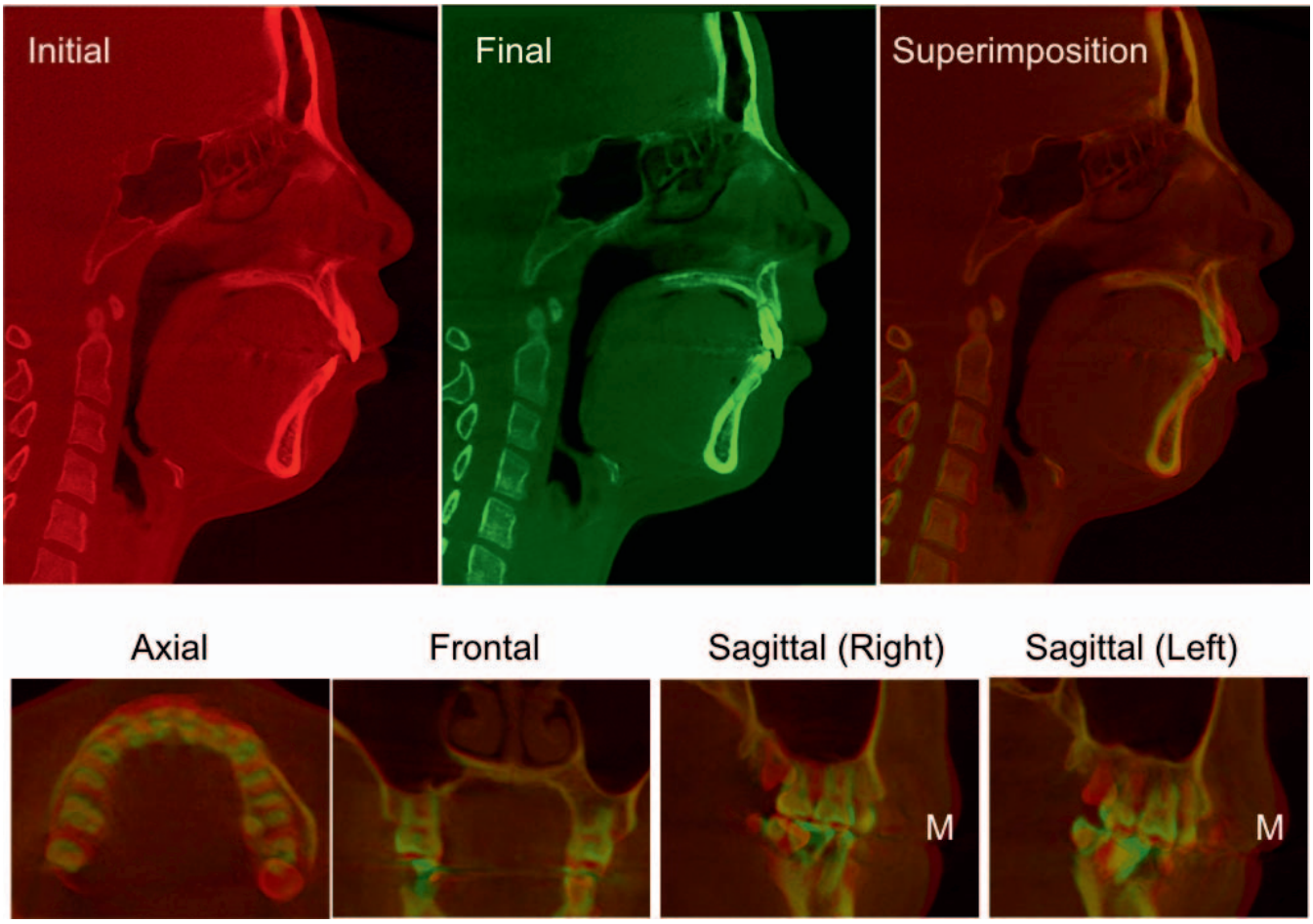

Figure 10. Three-dimensional cone beam computed tomography superimposition on the anterior cranial base. Upper panel: midsagittal slices showing the long axis of the maxillary left central incisors. Lower panel: axial slices at the maxillary dentition midroot level, frontal slices at first molars, and sagittal slice passing through the buccal roots of the maxillary right first and left molar. Red, initial; green, final; yellow, superimposed; M indicates mesial.

mandibular teeth. The initial extraction of the maxillary second molars eliminated the occlusal interference and possibly induced spontaneous counterclockwise rotation of the mandible,[15] simplifying the total arch intrusion. It also allowed vertical freedom to avoid expected occlusal trauma during the uprighting process of the mandibular second molars, which may cause periodontal breakdown.[20] Spontaneous eruption of the third molars was also noted, but, unlike the mandibular third molars, where the leveling was delayed until the final stage to allow spontaneous mesial drift, the erupting molars were engaged for leveling and alignment in the early phase to benefit from additional intrusive reactions that might be delivered to the adjacent teeth during leveling.

Total intrusion of the maxillary arch induced counterclockwise rotation of the mandible and decreased facial height as expected.[2,12,13] However, due to the unexpected changes in the condylar position, which resulted in a slight posterior movement of the mandible, protrusive change of the chin was not evident. The patient initially reported occlusal instability due to the premature contact of the posterior teeth, and given that no temporomandiular joint–related symptoms were present throughout the treatment, the reestablishment of the occlusion may have contributed to the repositioning of the condyles.

Due to the complex movements of the condyles in this case, analysis of the overall changes in three-dimensional superimposition based on cranial base registration offered many advantages over two-dimensional cephalometry. Mainly, the images were not magnified, and head positioning errors could be corrected after image acquisition, providing more accurate superimpositions, while registration errors were reduced because greater data volume was used rather than points or lines.[17] In addition, left and right anatomic landmarks were readily identifiable with

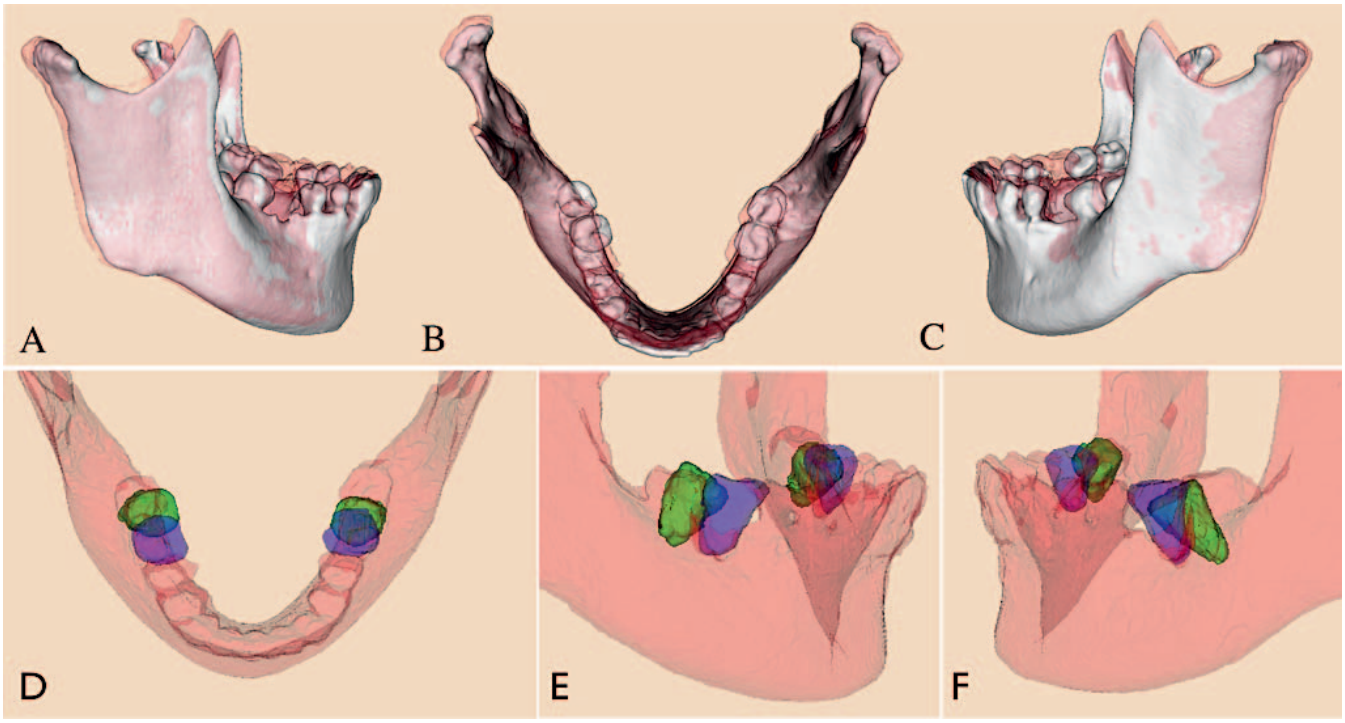

Figure 11. Three-dimensional cone beam computed tomography cranial base and three-dimensional mandibular regional superimposition. The right condyle (A) showed more posterior displacement compared with the left (C). White, initial; semitransparent red, final. Mandibular second molars in green for initial and purple for final (D, E, F).

detailed information on condylar position and remodeling as well as the evaluation of individual tooth movement in all planes of space using regional superimpositions.[18,19] Precise evaluation of treatment outcome confirmed the effective three-dimensional movement of both the maxillary and mandibular arches with stable and satisfactory results without surgical or prosthetic intervention.

CONCLUSIONS

- Nonsurgical and nonprosthetic camouflage treatment of a skeletal Class II open bite malocclusion, combined with missing mandibular first molars bilaterally, was successfully treated by second molar protraction and maxillary full-arch intrusion with bodily retraction.

ACKNOWLEDGMENTS

Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT & Future Planning (NRF-2013R1A1A3011648), supported this research.

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Figure 12. Postretention facial and intraoral photographs

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