CASE REPORT

Non-Surgical Correction of Skeletal Open Bite: A Goal-Oriented Approach Evaluated by CBCT

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Skeletal open bite is one of the most challenging malocclusions to treat and maintain.[1-4] Although a combination of orthodontic treatment and orthognathic surgery may be the ideal approach in most cases,[5-7] the complications, risks, and costs of surgery have stimulated considerable interest in alternative treatment methods beyond the use of traditional mechanics with orthognathic-like effects.

Adult patients can be treated without the need for special compliance using the Skeletal Anchorage System (SAS), in which titanium anchor plates and monocortical screws are temporarily placed in the maxilla, the mandible, or both.[8,9] The SAS has been used in combination with multibracketed appliances to move molars individually or to move the entire dentition in three dimensions.[8,10] Its mechanics for molar intrusion and distalization have been shown to be highly predictable.[11,12]

This article describes a goal-oriented strategy for non-surgical correction of skeletal Class II open bite in an adult patient using the SAS, with the results evaluated by cone-beam computed tomography (CBCT).


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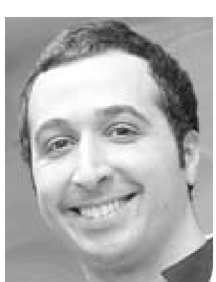
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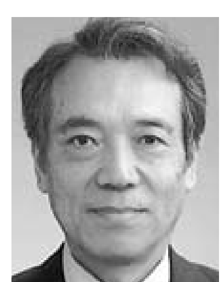
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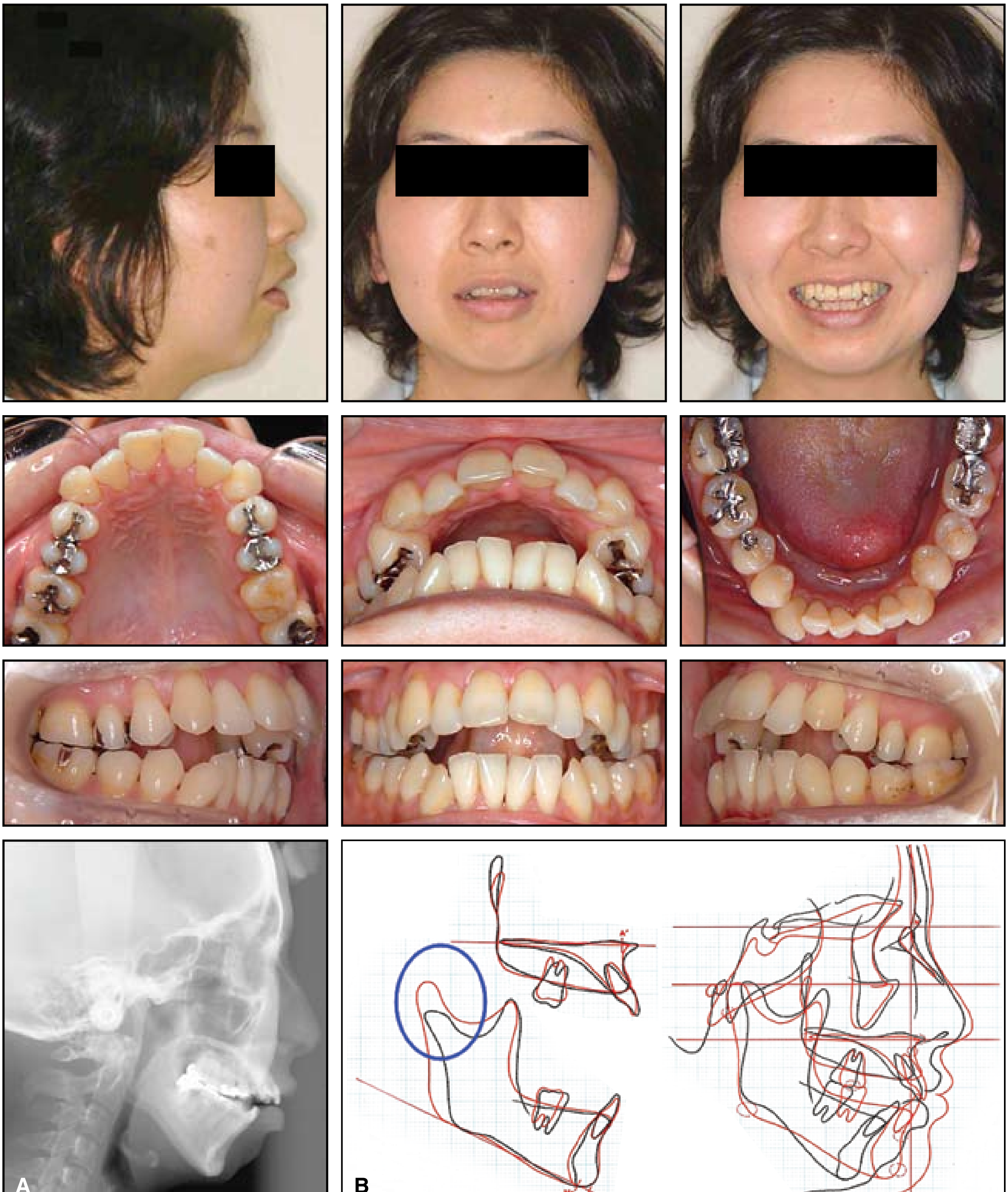

Fig. 1 A. 39-year-old female patient with retrusive mandible, skeletal Class II relationship, severe overjet, and open bite before treatment. B. Craniofacial morphology of patient (black) compared with norms for adult Japanese females (red); note short ramus and small condyle (blue circle).

Fig. 2 Panoramic radiograph and cone-beam computed tomography (CBCT) images reveal significantly shortened and deformed condyles (yellow circles), with right condyle smaller than left.

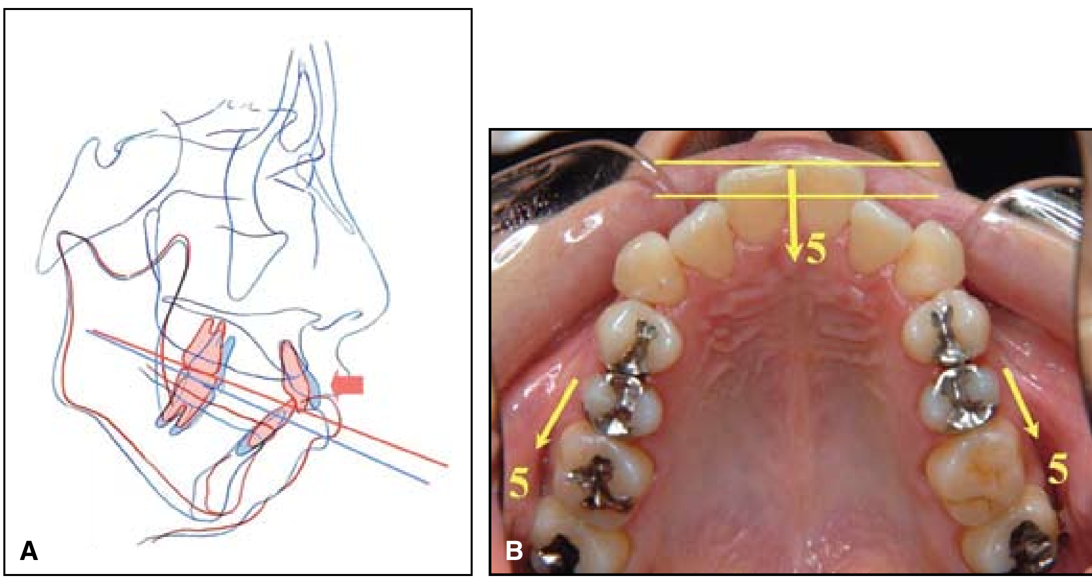

Fig. 3 A. Superimposition of pretreatment cephalometric tracing (blue) and predicted treatment results (red). B. Treatment goals shown in occlusal view.

Diagnosis and Treatment Plan

A 39-year-old female presented at SAS Orthodontic Centre, complaining of an anterior open bite and difficulty in biting with her front teeth (Fig. 1). She had a Class II profile, a mild long-face tendency, an extremely wide interlabial gap, and a strained chin musculature on lip closure. Intraorally, she showed a severe anterior open bite with double occlusal planes, Class II denture bases, attritional occlusion of the molars, upper and lower incisor crowding, a narrow upper arch, and a large overjet.

Radiographs indicated that the third molars had been previously extracted. The condylar processes were unusually short, and the condyles were deformed bilaterally. Cephalometric analysis revealed a high-angle skeletal Class II pattern due to a retrusive mandible, a short ramus, and excessive maxillary molar height. A CBCT scan was ordered to clarify the condition of the condyles and the dentition; it showed that the right condyle was significantly smaller than the left (Fig. 2), suggesting a degenerative TMJ, although the patient had no symptoms of TMD.

Because of the condylar condition, we considered options for nonsurgical orthodontic treatment. We believed the SAS would produce predictable intrusion and distalization of the maxillary and mandibular molars, which in turn would close the bite, enabling us to resolve the patient's complex dental issues and adequately camouflage her skeletal problems.

Based on cephalometric, photographic, and setup model predictions (Figs. 3,4), we devel-

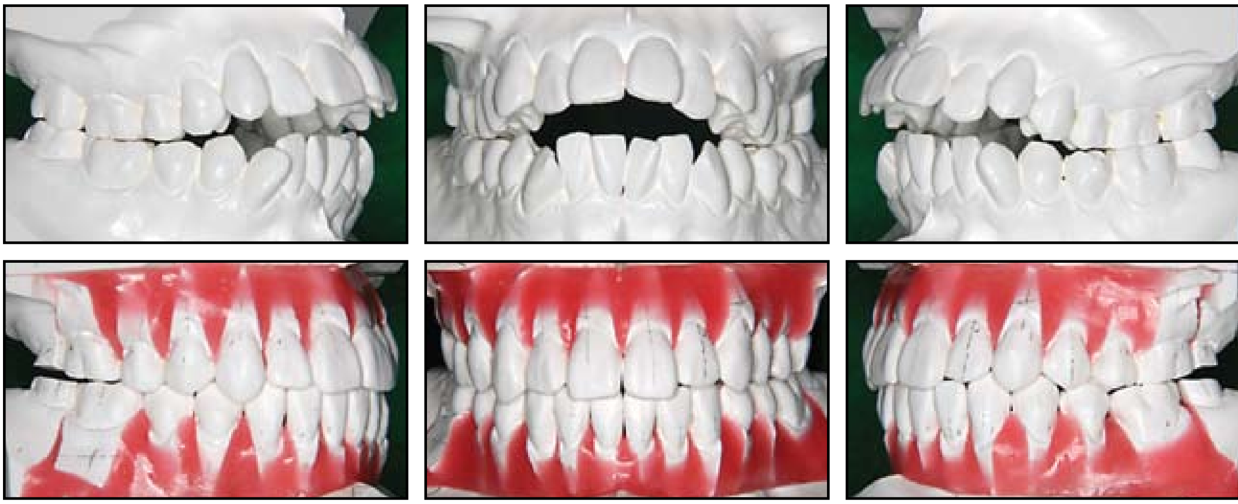

Fig. 4 Setup models indicate successful treatment without premolar extractions.

oped the goals of intruding the upper molars 3mm and distalizing the upper and lower molars 5mm and 2mm, respectively, while maintaining the lower molars at the same level. This movement would be followed by an automatic counterclockwise rotation of the mandible, with simultaneous correction of the patient's lower facial height, interlabial gap, and anterior open bite. The CBCT images revealed sufficient space for distalization of the maxillary molars and uprighting of the mandibular molars, eliminating the need for premolar extractions.

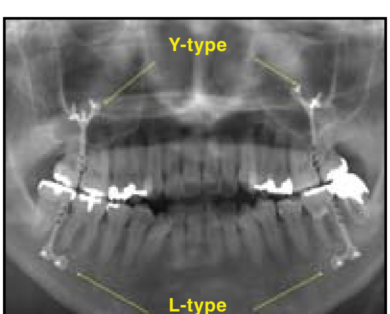

Fig. 5 Implantation of Skeletal Anchorage System (SAS) miniplates in zygomatic buttresses (Y-type) and mandibular body (L-type).

Treatment Progress

Orthodontic miniplates (Orthoanchor*) were implanted in both jaws (Fig. 5): Y-type miniplates at the zygomatic buttresses, with the first hooks set at the cervical level of the molars, and L-type miniplates in the left and right mandibular bodies, between the first and second molars. Orthodontic treatment started 11 days later, immediately after the sutures had been removed.

Because of the anterior crowding, brackets were initially bonded only to the upper and lower premolars and molars. A continuous .014" nickel titanium archwire was placed in the maxilla, and a segmental nickel titanium wire in the mandible (Fig. 6A). Simultaneously, molar intrusion and distalization were initiated with a force of 100g per side. Two months later, an .016" × .016" stainless steel wire was placed in the maxilla, and both intrusion and distalization of the upper buccal segments were generated from elastic chains exerting a force of 400g per side. In the mandible, a segmental .019" × .026" Copper Ni-Ti** (40°C) wire was engaged, and chain elastics applying a force of 200g per side were attached to the SAS to upright the molars (Fig. 6B). After three months, the elastic chains were replaced by elastic threads (Fig. 6C).

Five months after the initiation of treatment, lingual crown torque was added to the rectangular archwires (Fig. 6D). A month later, with the upper molars significantly intruded and only the premolars in occlusion, an auxiliary CNA*** intrusion arch was ligated to the main archwire at the central incisors to intrude the upper premolars. In the lower arch, brackets were bonded to the anterior teeth (Fig. 6E). Intrusion and distalization were continued for three more months to correct the Class II canine and molar relationships while controlling

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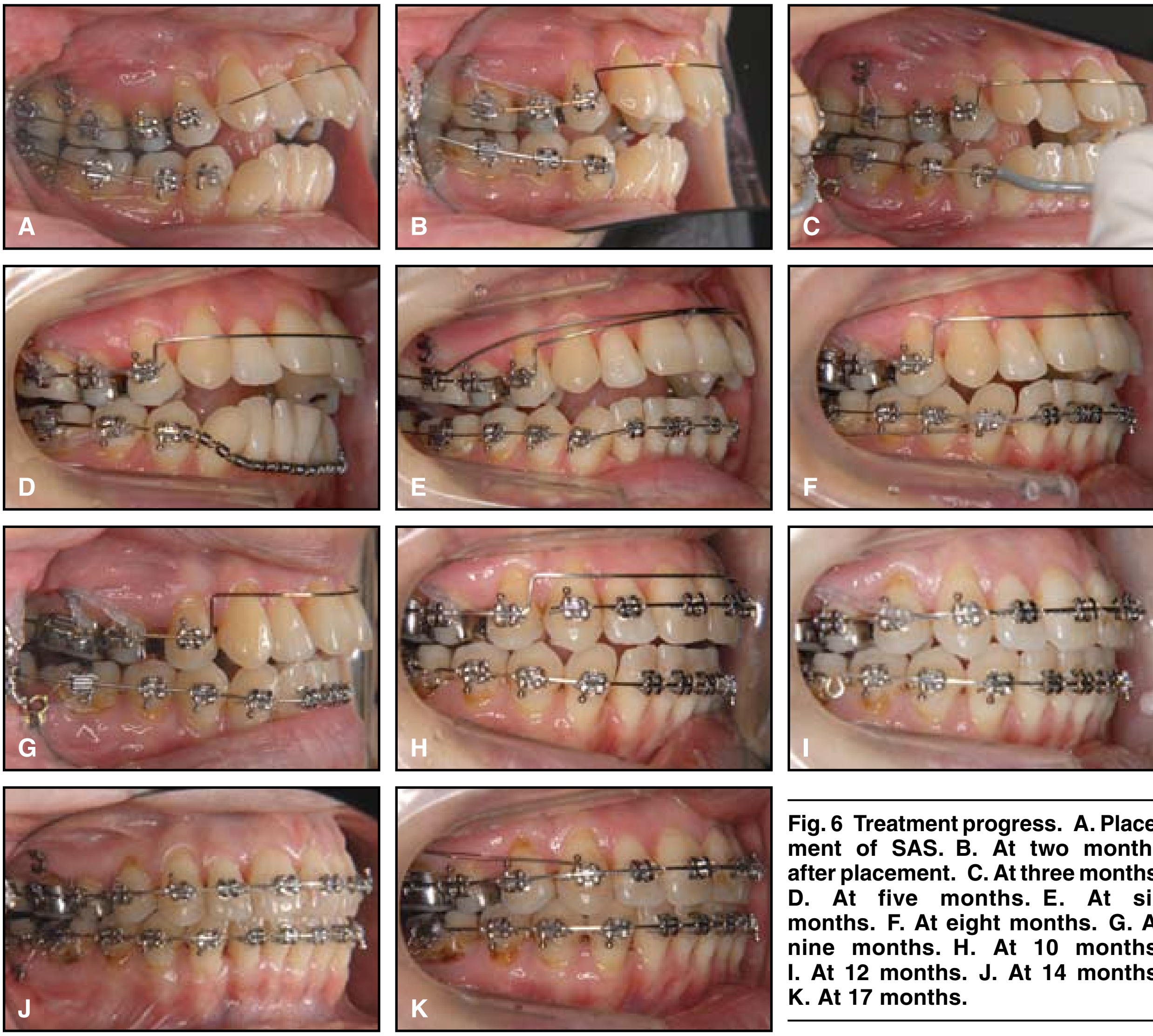

Fig. 6 Treatment progress. A. Placement of SAS. B. At two months after placement. C. At three months. D. At five months. E. At six months. F. At eight months. G. At nine months. H. At 10 months. I. At 12 months. J. At 14 months. K. At 17 months.

buccal flaring of the posterior teeth (Figs. 6F,G).

After 10 months of treatment, brackets were bonded to the upper incisors and canines, and leveling and alignment were initiated with a segmental wire. In the lower arch, space closure was begun with elastic chains (Fig. 6H). Two months later, a continuous archwire was placed in the upper arch for final leveling and alignment while the lower arch was stabilized (Fig. 6I). Another two months later, distalization of the entire dentition was started (Fig. 6J). With four skeletal anchorage units in the molar regions, correction of the dental midline was not difficult.

As treatment approached the finishing stages, we stripped the upper and lower anterior teeth to reduce "black triangles". After 17 months of treatment, the dental midlines coincided with the facial midline, and an esthetic and functional occlusion had been established with good posterior occlusion, proper anterior guidance, and no CO-CR discrepancy (Fig. 6K).

After a total treatment time of 18 months, all brackets were debonded, and the SAS miniplates were removed under local anesthesia. A wraparound retainer with tongue spurs was placed in the maxillary arch, and a lingual retainer was bonded in the lower anterior segment.

Treatment Results

Post-treatment facial photo-

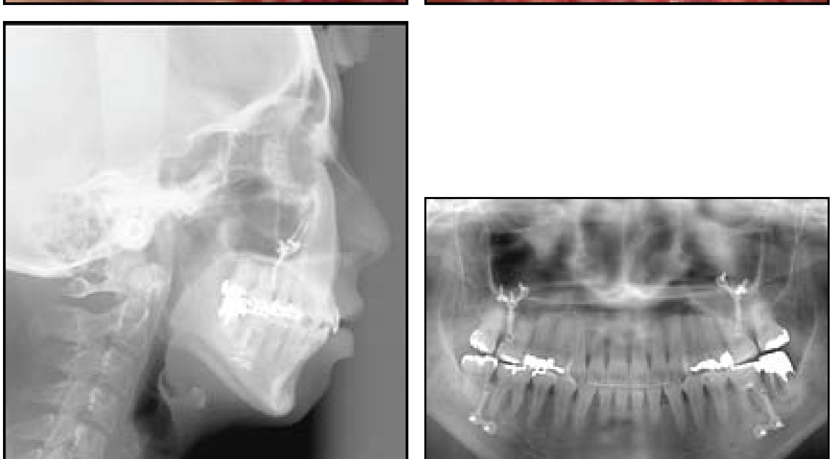

Fig. 7 After 18 months of treatment, showing improved facial profile and occlusion.

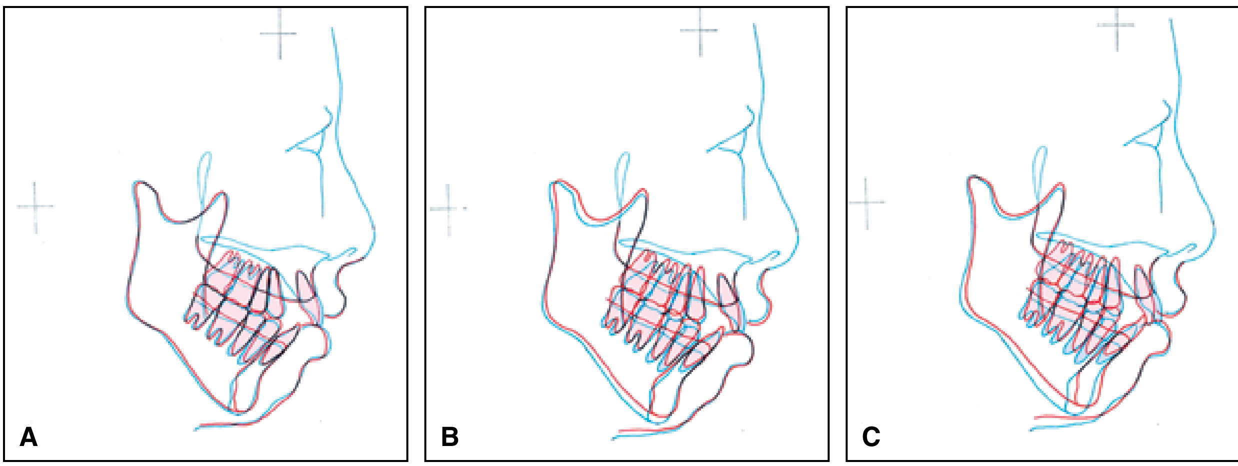

Fig. 8 Superimpositions of cephalometric tracings at baseline (blue) and during treatment (red). A. At six months. B. At 12 months. C. After debonding. Mandible rotated counterclockwise after intrusion and distalization of maxillary molars, improving vertical facial proportions and interlabial gap.

graphs showed a remarkable change in the patient's profile (Fig. 7), especially considering that she had undergone neither surgery nor tooth extractions. The Class II profile, retrusive chin, and interlabial gap were significantly improved, and the strain in the circumoral musculature during lip closure had disappeared. Class I canine and molar relationships had been achieved, with normal overbite and overjet. The patient displayed a firm posterior occlusion and adequate anterior guidance on jaw excursions.

Cephalometric analysis confirmed that the entire upper dentition was slightly distalized and the lower posterior teeth were uprighted during the first six months of SAS treatment; the mandible showed a slight closing rotation after intrusion of the upper molars (Fig. 8A). After 12 months of SAS treatment, the maxillary posterior teeth had been significantly intruded, and the occlusal plane had shifted upward. As a result, the mandible showed significant counterclockwise rotation, while the maxillary dentition was distalized (Fig. 8B). A dramatic correction of the open bite and malocclusion resulted from the radical intrusion and distalization of the posterior teeth. The vertical facial proportion and interlabial gap also improved because of the counterclockwise rotation of the mandible (Fig. 8C).

Post-treatment CBCT images clearly showed both superior and distal movement of the upper molars (Fig. 9). The upper first and second molars had penetrated into the sinus after intrusion, and the mucous membranes had thickened significantly. We noted slight root resorption of the first and second molars, but did not consider it clinically significant. The buccodistal roots of the maxillary left and right second molars were distalized 5mm and 4.5mm, respectively (Fig. 10). No TMJ symptoms were observed after treatment; condylar imaging revealed no further pathological degeneration.

Discussion

When an adult presents with a skeletal Class II open bite, a severe overjet, and crowded dental arches, innovative orthodontic mechanics are required to avoid orthognathic surgery or premolar extractions.[13-15] Traditional molar-intrusion methods do not produce predictable tooth movements. Miniscrew anchorage has been successfully used to intrude molars in patients with skeletal open bites, but this technique often requires multiple buccal and palatal screw insertions and complex mechanics to move a single tooth,[16-19] especially when molar distalization is attempted. Conventional intraoral distalizing appliances tend to extrude the

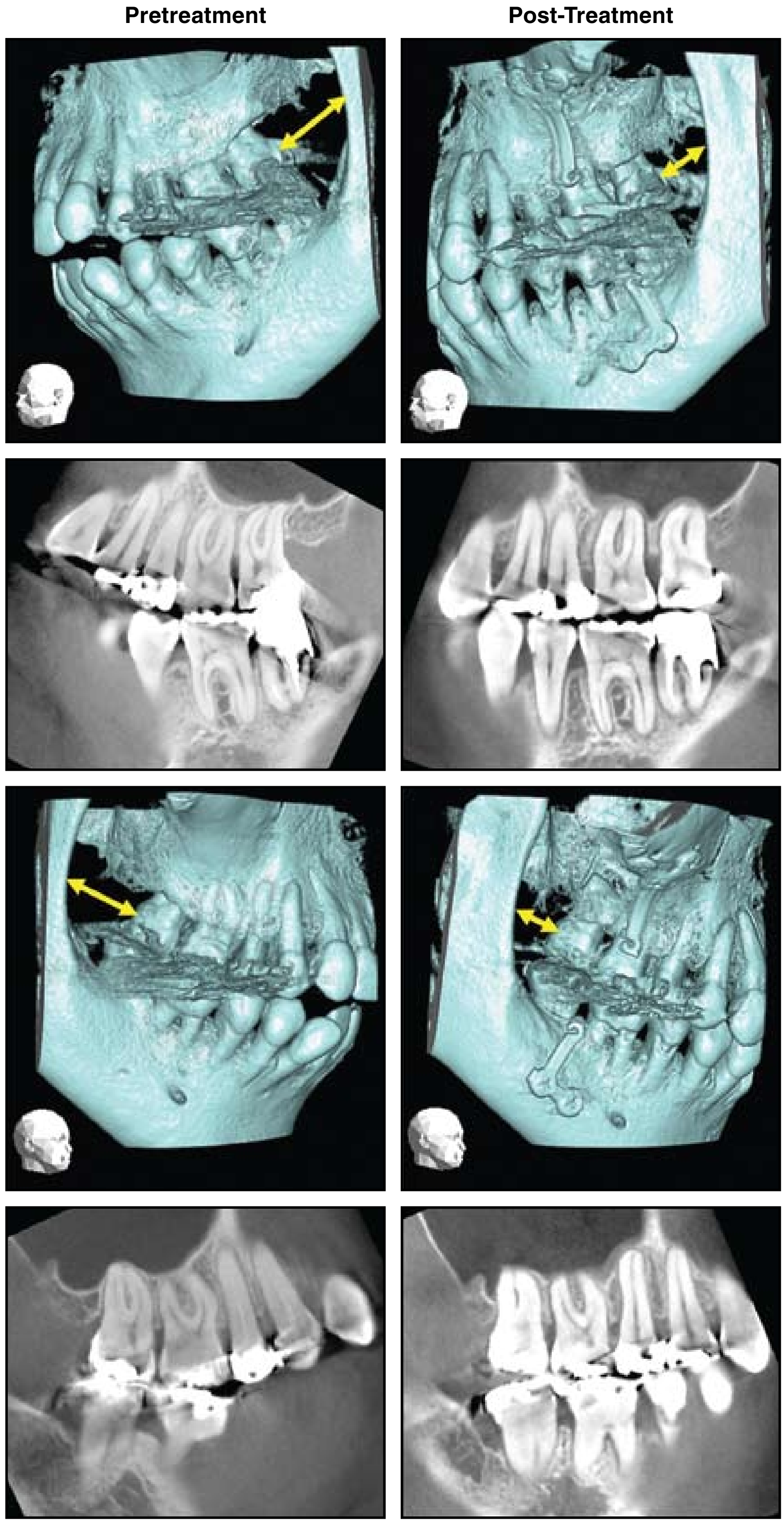

Fig. 9 Pre- and post-treatment CBCT images show maxillary molar intrusion and distalization after treatment with SAS.

molars and thus exacerbate the original problem.

The SAS provides simultaneous three-dimensional control of the maxillary and mandibular molars for both distalization and intrusion.[8-10,20,21] Although distalization mechanics are used primarily in Class II cases, other indications for distal movement with the SAS include maxillary crowding, flared incisors, or both.

Our research group has previously evaluated the effects of maxillary molar intrusion using SAS on the nasal floor and dental roots in dogs.[22] After four months, the root apices of the intruded molars penetrated into the nasal cavity, the nasal floor membrane and a thin layer of newly formed bone (which lifted intranasally) covered the intruded molar roots, and root resorption reached partly into the dentin without the formation of reparative cementum. In the patient presented here, the mucosal membrane of the sinus thickened significantly over the molars during treatment, although new bone formation was not yet observed at debonding. Another six months might be required for complete bone formation.

Molar intrusion progressed linearly in this patient, with 1mm of intrusion observed every six months (Fig. 11). In addition, the buccodistal roots of the maxillary left and right second molars were distalized 5mm and 4.5mm, respectively, over the 18 months of treatment (Fig. 12). Distal movement of 1.5mm in six months is considered significant.[12]

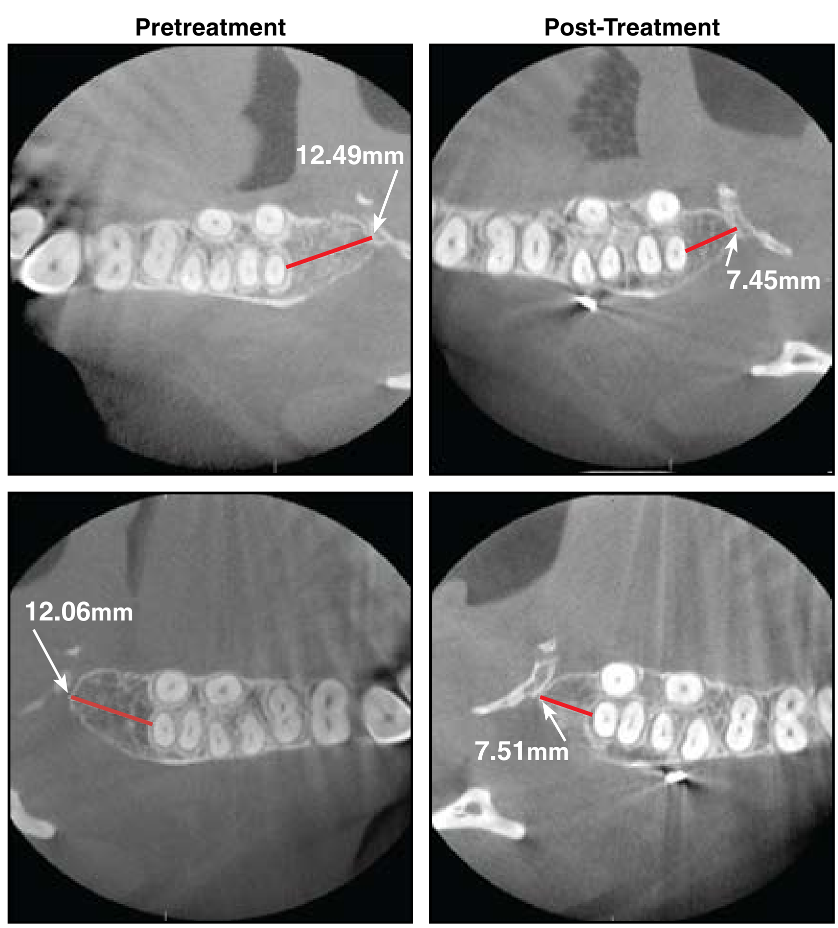

Fig. 10 Pre- and post-treatment coronal-section CBCT images, showing distalization of maxillary second molar roots.

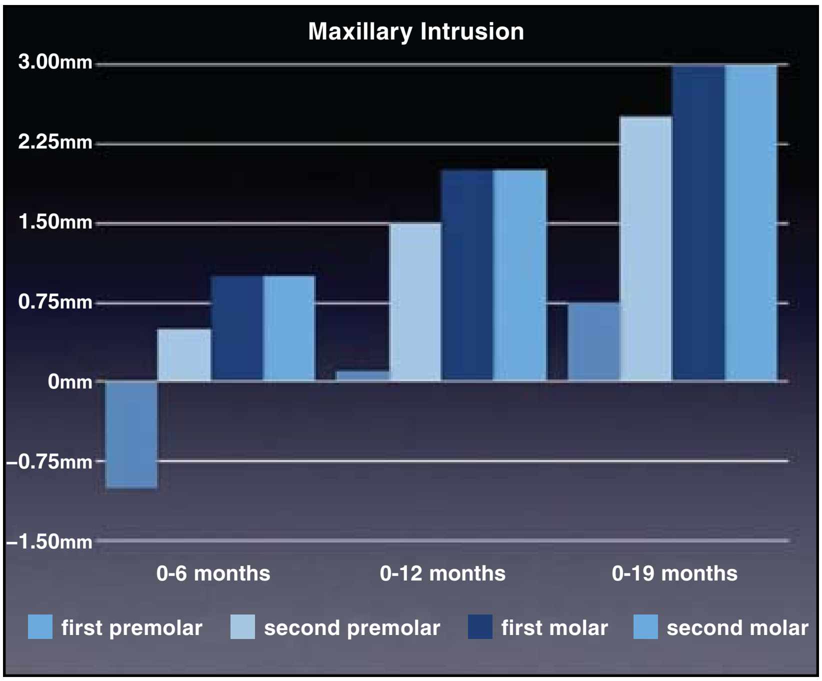

Fig. 11 Intrusion of upper premolars and molars during treatment, showing about 1mm of intrusion every six months.

Although goal-oriented strategies are essential in contemporary orthodontics,[23] there are no published treatment goals for the correction of skeletal open bite through intrusion and distalization of the maxillary molars. The individualized goals for molar and incisor positioning and soft-tissue profile development in the present case were established with cephalometric and occlusogram predictions before treatment. SAS treatment was initiated only after confirmation of the 3D treatment goals with setup models and CBCT. The predicted distalization of the maxillary first molars, about 5mm, was close to the actual results, and maxillary molar intrusion was similarly reliable. It is not a matter of simply trying to distalize or intrude the molars as much as possible; the degree to which specific treatment goals are achieved should also be evaluated.[12]

Conclusion

The Skeletal Anchorage System appears to be a viable and predictable alternative to traditional orthodontic mechanics and surgical correction for treatment of skeletal open bites requiring molar intrusion and distalization. These rigid anchorage units allow the clinician to perform not only single-tooth movements, but 3D en-masse movement of the buccal segments, thus reducing the need for premolar extractions.

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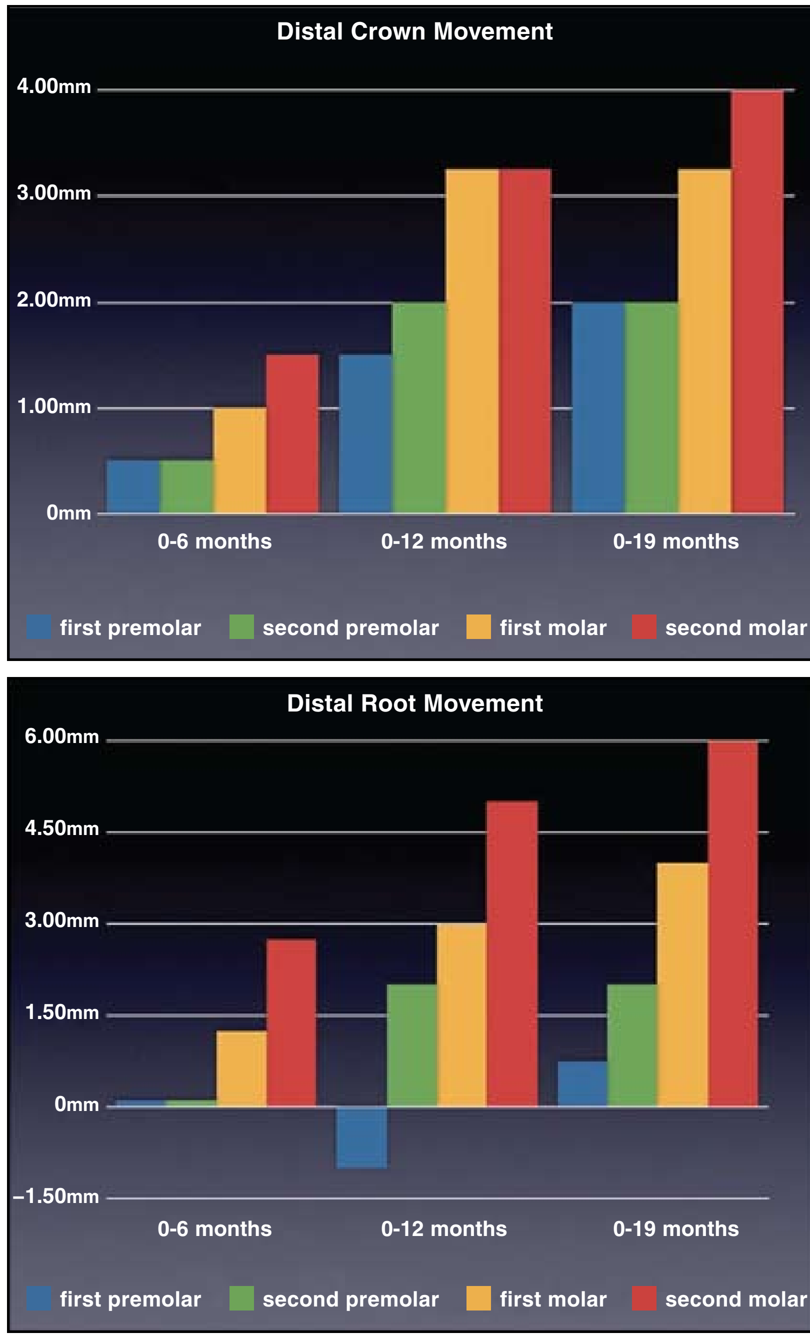

Fig. 12 Distal movement of crowns (top) and roots (bottom) of upper premolars and molars during treatment, showing crowns distalized 1.5mm and roots distalized 2.5mm on average every six months.