CASE REPORT

Herbst Appliance Supported by Four Miniscrews

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The Herbst* appliance is considered one of the most reliable fixed functional devices for treating Class II malocclusions without the need for patient compliance. It efficiently advances the mandible, achieving substantial and stable results in a high percentage of cases.[1-13] The Herbst is also well accepted by patients[14-16]: O'Brien and colleagues showed that patients are more likely to cooperate with Herbst treatment than with a Twin Block.**[11]

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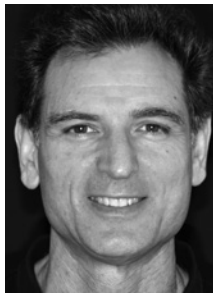
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Advantageous skeletal effects of Herbst treatment include enhancement of sagittal mandibular growth, anterior displacement of the mandibular arch, reduction of sagittal maxillary growth, posterior displacement of the maxillary arch, and TMJ remodeling.[13,17] On the other hand, the appliance's dental effects—proclination of the mandibular incisors and palatal inclination of the upper incisors—tend to limit the potential for mandibular advancement.[18,19]

To combat these side effects, several modifications of the original Herbst design have been proposed.[20,21] As far as we know, however, only the concomitant use of skeletal anchorage has effec-

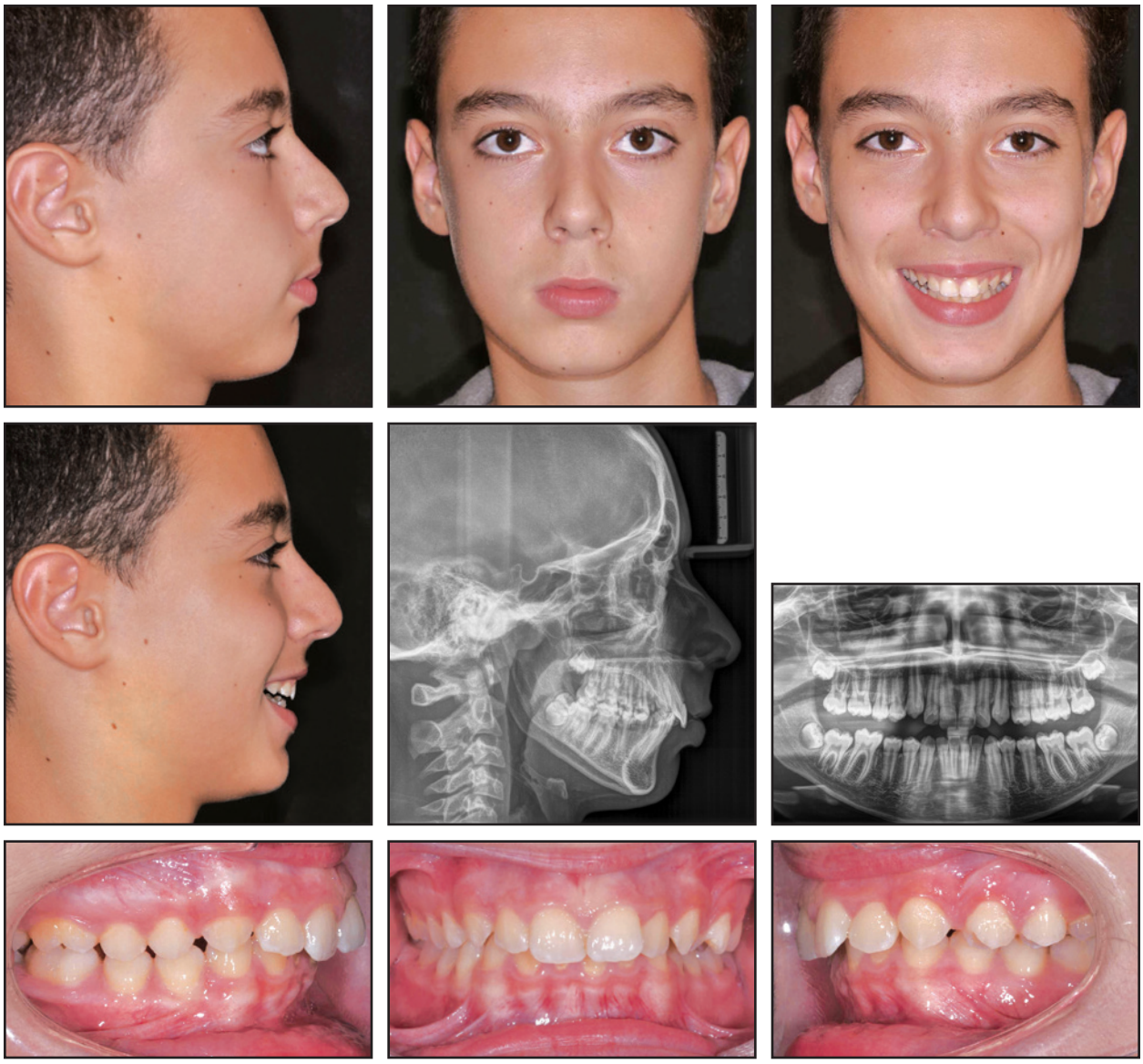

Fig. 1 12-year-old male patient with retrusive chin, incompetent lips, skeletal Class II malocclusion, and palatally inclined upper incisors before treatment.

tively controlled lower incisor flaring.[14-23] This case report demonstrates the use of four temporary anchorage devices (TADs) to mitigate the adverse dental effects of the Herbst appliance while correcting a Class II malocclusion.

Diagnosis and Treatment Plan

A 12-year-old male was referred by his dentist for orthodontic consultation. Clinical examination found a convex profile with a retrusive chin, excessive nasolabial angle, symmetrical mandible, and incompetent lips (Fig. 1). A half-unit molar and canine Class II relationship on the right side and a full first-molar and half-unit Class II canine relationship on the left had resulted in a scissor bite in the left premolar area. The panoramic radiograph showed the presence of all permanent teeth with normal interdental bone levels.

Cephalometric analysis indicated a skeletal Class II malocclusion with a long face, a short ramus, slightly palatally inclined maxillary incisors, and a protrusive inclination of the mandibular incisors relative to the mandibular symphysis (Table 1). The overjet and overbite were excessive.

Treatment goals were to improve facial esthetics, reduce the lower third of the face, and improve the mandibular projection and lip incompetence while converting the Class II dental relationship to a Class I. Because of the patient's convex profile, the treatment strategy would incorporate mechanics to enhance mandibular advancement.

One proven method for treating a Class II patient with a retrusive mandible involves Class II elastics attached to miniscrew implants and connected by elastic power chain to a full-size stainless steel archwire.[24,25] We rejected this option, however, because the patient could not guarantee adequate compliance with intermaxillary elastics. Another alternative was to expand the maxilla and align the dentition, with the expectation of surgery upon completion of growth, but the patient was not able to delay treatment. Based on the patient's facial features, the best choice seemed to be a bite-jumping appliance that would encourage mandibular

TABLE 1
CEPHALOMETRIC ANALYSIS

	Norm	Pretreatment (T0)	Post-Herbst (T1)	Post-Treatment (T2)
SNA	82.0° ± 3.5°	83.5°	84.9°	85.0°
SN-Pg	80.0° ± 2.0°	76.2°	79.0°	79.1°
AN-Pg	2.0° ± 2.5°	7.3°	5.9°	5.9°
SN/ANS-PNS	8.0° ± 3.0°	5.9°	6.5°	7.7°
SN/GoGn	33.0° ± 2.5°	36.1°	34.1°	33.2°
ANS-PNS/GoGn	25.0° ± 6.0°	30.2°	27.7°	25.5°
U1-ANS-PNS	110.0° ± 6.0°	108.7°	109.0°	110.0°
L1-GoGn	94.0° ± 7.0°	98.2°	96.0°	97.2°
L1-APg	2.0° ± 2.0°	0.8mm	2.6mm	3.6mm
Overjet	3.5mm ± 2.5mm	5.6mm	2.9mm	3.0mm
Overbite	2.0mm ± 2.5mm	5.7mm	0.7mm	2.3mm
Interincisal angle	132.0° ± 6.0°	124.2°	127.8°	123.3°

protraction while limiting the adverse effects traditionally associated with pushing force vectors.[18,19]

Treatment Progress

Preadjusted .022" × .028" brackets*** were placed in the upper arch, and an .014" nickel titanium archwire was used to correct the upper incisor inclination and the scissor bite (Fig. 2). After five months of treatment, a Herbst appliance with four 1.4mm × 6mm TADs† (H4T) was placed (Fig. 3). In the lower arch, one miniscrew was inserted between the right first permanent molar and second premolar and the other between the left first and second premolars. Auxiliary buttons were bonded to the buccal surfaces of the canines, and elastic chains were attached to the miniscrews to retrocline the lower incisors and promote mandibular protraction. In the upper arch, a miniscrew was inserted between the first and second premolars on each side, and elastic chains were attached between the miniscrews and an .018" × .022" stainless steel archwire for vertical control. Eleven days later, the miniscrew between the upper left first and second premolars failed, and a new one of the same size was placed between the canine and first premolar (Fig. 4).

After 10 months of treatment, the Herbst appliance was removed and new x-rays were taken (Fig. 5). The upper and lower arches exhibited an overcorrected Class I relationship. The upper first

Fig. 2 .022" × .028" brackets* placed in upper arch.**

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***Butterfly System, trademark of American Orthodontics, Sheboygan, WI; www.americanortho.com.
†Micerium Anchorage System, Micerium S.p.A., Avegno, Italy; www.micerium.it.

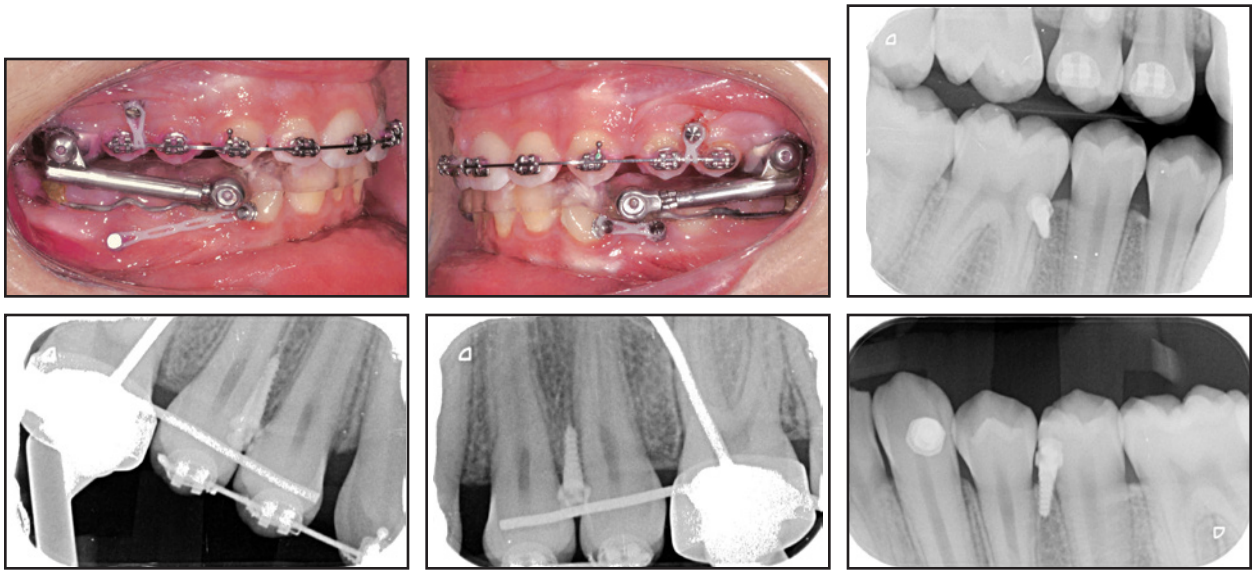

Fig. 3 After five months of treatment, Herbst* appliance placed with four 1.4mm × 6mm temporary anchorage devices† (TADs). Elastic chains attached between miniscrews and bonded buttons in lower arch and between miniscrews and archwire in upper arch.

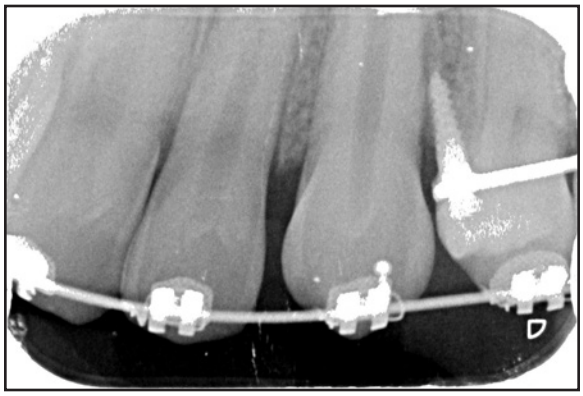

Fig. 4 Failed upper left TAD replaced after 11 days with TAD between canine and first premolar.

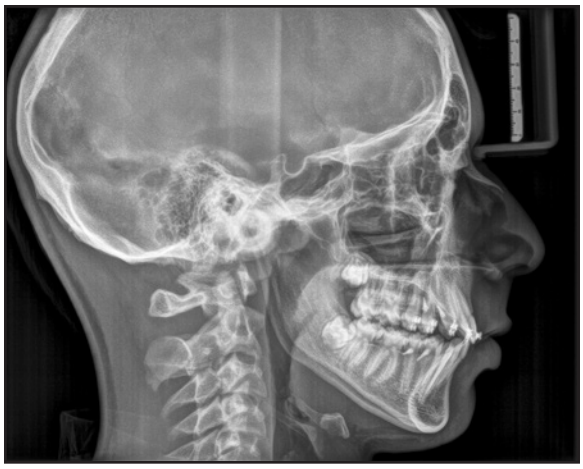

Fig. 5 Herbst appliance removed after 10 months of treatment.

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molars were bonded, and an .017" × .025" nickel titanium archwire was inserted (Fig. 6). Fixed multibracket appliances with .016" × .025" nickel titanium archwires were then placed in the lower arch, and the patient was given light Class II elastics to wear full time, starting at 30g per side and increasing over 11 months to 250g per side. To mesialize the upper posterior segments, elastic chains were connected from the first molars to the miniscrews. The lower archwires progressed to .017" × .025" nickel titanium, followed by final upper and lower .018" × .022" stainless steel wires.

Eleven months later, the fixed appliances were removed, and a positioner was delivered. After another six months, the positioner was replaced with two Essix‡ retainers.

Treatment Results

The active treatment time was 26 months (Fig. 7). The profile was improved substantially, resulting in harmony between the upper and lower lips, and bilateral Class I molar and canine relationships were achieved. A panoramic radiograph taken immediately after treatment showed acceptable root angulations, no evidence of root resorption, and stable bone levels. No muscle or joint problems had developed.

Because of mild upper incisor flaring, there was no worsening of the profile during the Herbst treatment (Table 1). The A point advanced between pretreatment (T0) and post-Herbst (T1) cephalograms and remained almost unchanged thereafter. The upper first molars were intruded and distalized, and vertical dentoalveolar growth was well controlled. The maxilla grew downward and forward, so that the posterior intrusion had only a

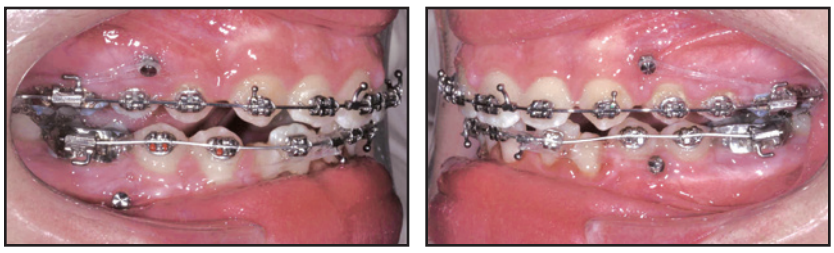

Fig. 6 Brackets bonded in lower arch, and full-time Class II elastic wear started; elastic chains attached between TADs and first molars to mesialize upper posterior segments.

dentoalveolar effect. By the end of treatment, the upper first molars had returned nearly to their pretreatment positions. Lower incisor inclination was well controlled between T0 and T1 and between T1 and the end of treatment (T2). Pogonion advanced 4.5mm, and substantial growth occurred at the ramus as the articular point moved upward and slightly forward.

The patient was satisfied with the overall esthetics and treatment outcome.

Discussion

The Herbst appliance is often utilized for treatment of a Class II malocclusion and a retrusive mandible because it works efficiently without relying on

Fig. 7 A. Patient after 26 months of treatment (continued on next page).

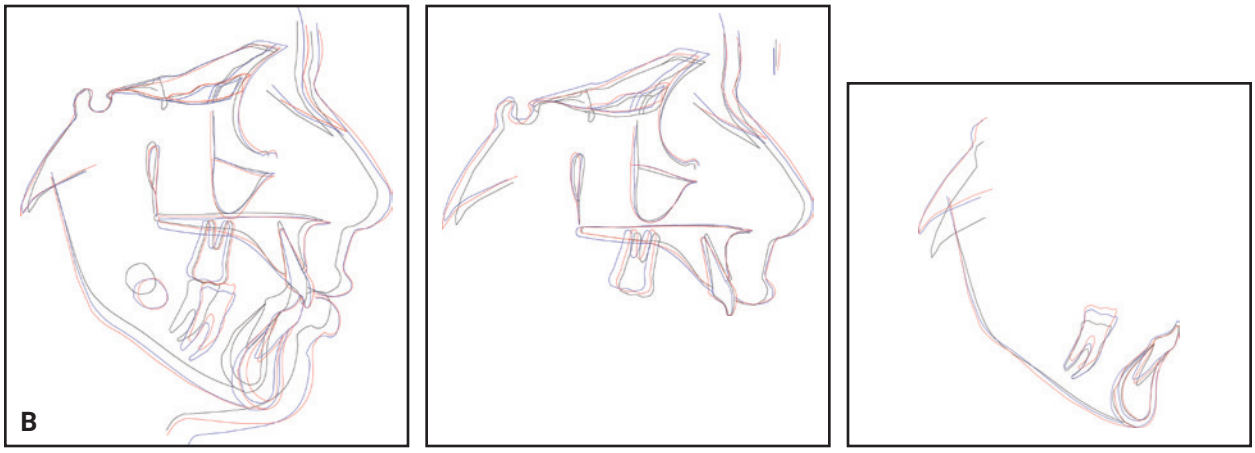

Fig. 7 (cont.) B. Superimposition of cephalometric tracings before treatment, after Herbst therapy, and after treatment.

patient cooperation. Despite such advantages, however, it causes some side effects that can hinder the desired mandibular advancement. Although these effects can be partly reduced by using miniscrew anchorage and elastic power chains,[14,23] there are still concerns about clockwise rotation of the maxillary arch and backward relapse of pogonion.[7,26]

The H4T method we have described, involving TADs in both arches, provided satisfactory control of our patient's vertical dimension (–2.9° change in SN/GoGn between T0 and T2). This induced a counterclockwise rotation of the mandible and contributed to a considerable mandibular advancement, as measured in a 4.5mm forward movement of pogonion on the cranial base superimposition (Fig. 7B). The decision to utilize TADs in the upper arch was based on clinical evaluation of the patient's excessive nasolabial angle. We believed the TADs could help prevent the usual palatal inclination of the upper incisors associated with the Herbst appliance. Buccal inclination of the lower incisors still occurred, but it resulted only in leveling of the lower arch. We employed Class II elastics to restrict the Herbst appliance's propulsory effect on the mandible.

The concept of using four TADs to control vertical development and promote mandibular advancement can also be applied to mandibular propulsive systems such as the PowerScope,†† Forsus,‡‡ and other fixed functional appliances.

†† Trademark of American Orthodontics, Sheboygan, WI; www.americanortho.com.
‡‡ Trademark of 3M, Monrovia, CA; www.3M.com.

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