CASE REPORT

The Miniscrew-Anchored Herbst

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Non-compliance devices designed to distalize the upper molars[1-7] or advance the mandible[8-14] have become popular over the last two decades as a means of correcting Class II malocclusions without the variable of patient cooperation. The major drawback of both systems is that a complete reliance on dental anchorage inevitably leads to undesired tooth movements that, if uncontrolled, can compromise treatment results.[15-22]

Temporary anchorage devices (TADs) can be used in conjunction with maxillary distalizing appliances to prevent the loss of anterior anchorage.[23-26] The application of TADs with bite-jumping devices for mandibular advancement has been discussed,[27] but has not yet been incorporated into everyday clinical practice. This article describes the combination of a modified Herbst* appliance with TADs for efficient treatment of a skeletal Class II malocclusion.

Diagnosis and Treatment Plan

A 14-year-old female patient presented with a Class II, division 1 malocclusion, a retrusive chin, and a severe overjet (Fig. 1). The maxillary arch was asymmetrical, with a buccally displaced upper left canine and mild crowding. Cephalometric analysis indicated a Class II skeletal relationship due to a retrognathic mandible; the vertical jaw relationship was normal. The upper incisor inclination was within normal range, but the lower incisors were significantly proclined (Table 1).

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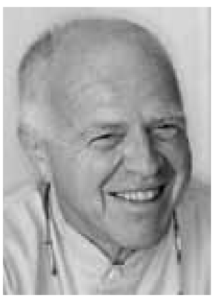
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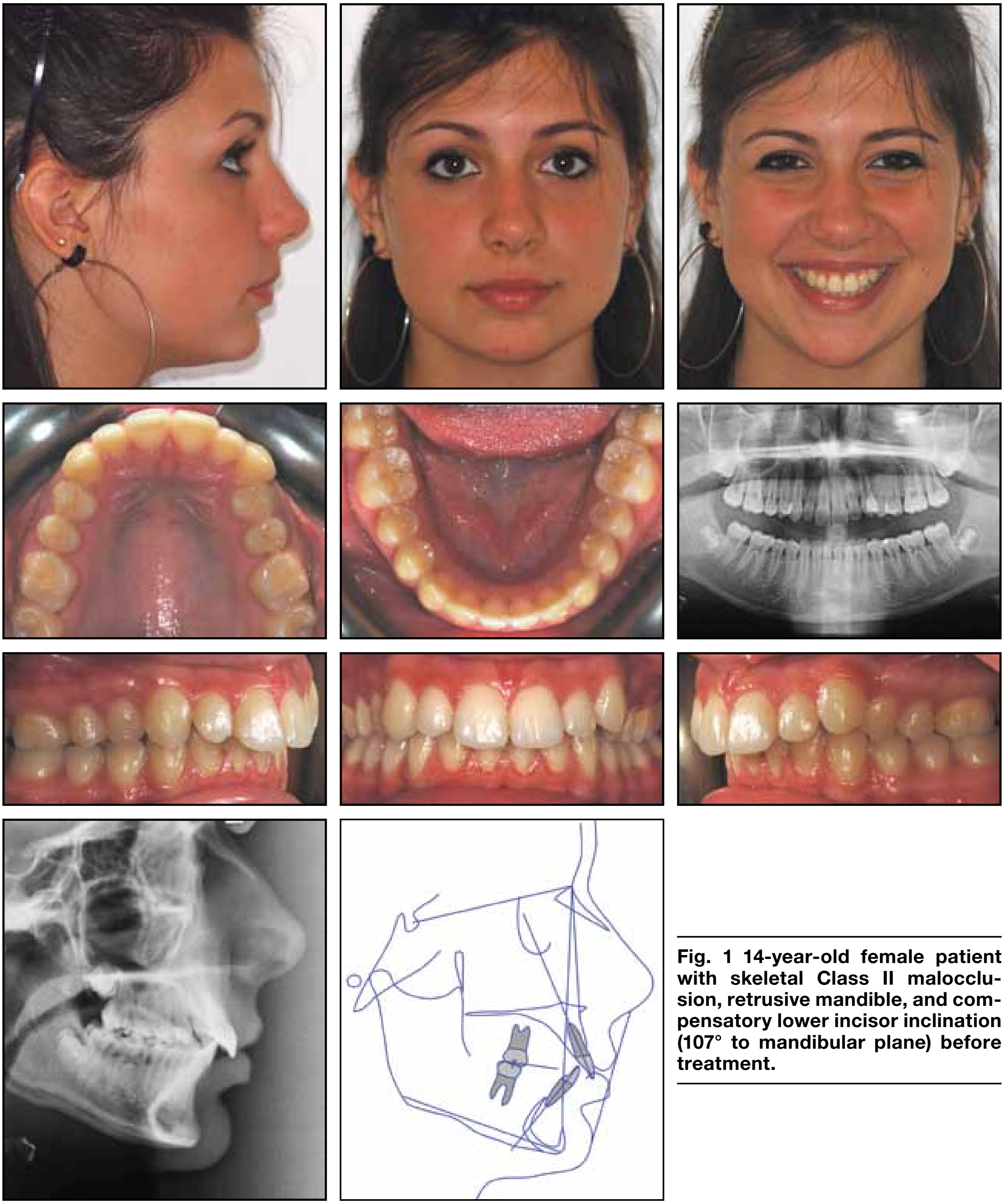


Fig. 1 14-year-old female patient with skeletal Class II malocclusion, retrusive mandible, and compensatory lower incisor inclination (107° to mandibular plane) before treatment.

The treatment plan involved the use of Miniscrew-Anchored Herbst (MAH) therapy for mandibular advancement, with full fixed appliances to finish. Total treatment time was estimated at 20-24 months.

Treatment Progress

Alginate impressions and a construction bite were sent to the dental laboratory, where a modified cast Herbst appliance was manufactured on preformed bands.** Hooks were added in the buccal regions of the mandibular cast framework on both sides (Fig. 2).

After placement of the Herbst appliance, Aarhus mini-implants*** (6mm long, 1.5mm in diameter) were inserted under local anesthesia in the lower buccal cortex between the roots of the first and second premolars on both sides (Fig. 3). Chlorhexidine rinse was prescribed for one week daily after toothbrushing. The TADs were tied tightly to the customized hooks on the Herbst appliance with .012" stainless steel ligatures (Fig. 4). This rigid connection provided indirect skeletal anchorage to the mandibular basal bone, with the aim of avoiding any dentoalveolar compensations in the lower dentition during the bite-jumping period.

Brackets were initially bond-

**Rollo Bands, trademark of American Orthodontics, Sheboygan, WI; www.americanortho.com.

***Trademark of ScanOrto, Charlottenlund, Denmark; www.aarhus-mini-implant.com. Distributed in North America by American Orthodontics, Sheboygan, WI; www.americanortho.com.

TABLE 1
CEPHALOMETRIC DATA

	Pretreatment	Post-Treatment
SNA	80°	79°
SNB	72°	74°
ANB	8°	5°
Wits appraisal	+5mm	+3mm
SN-MP	35°	36°
SN-ANS/PNS	12°	13°
ANS/PNS-MP	23°	23°
U1-ANS/PNS	113°	111°
IMPA	107°	108°
U1/L1	118°	116°
Upper lip to E line	–2mm	–2mm
Lower lip to E line	–1mm	0mm

Fig. 2 Modified cast Herbst appliance with soldered hooks for connection to mini-implants.

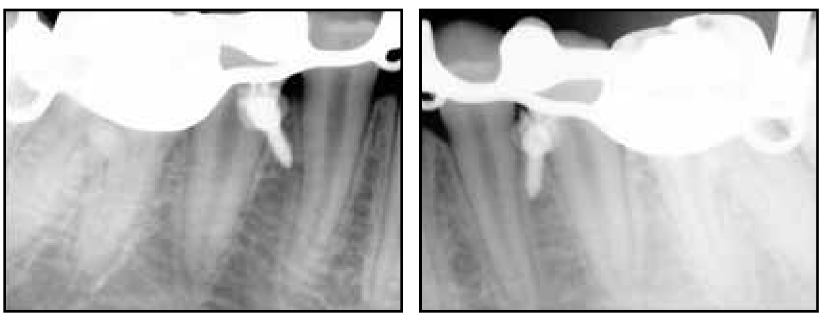


Fig. 3 Mini-implants inserted between lower first and second premolars on each side.

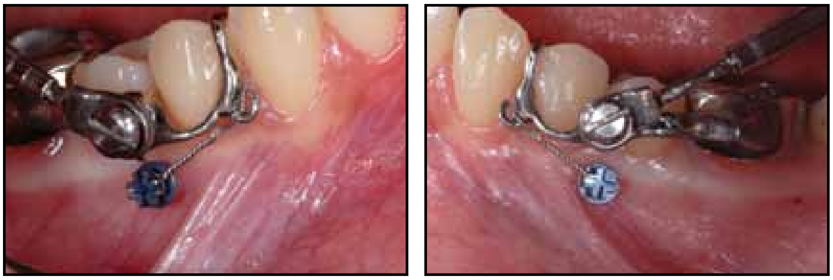


Fig. 4 Rigid connection made between Herbst appliance and mini-implants with tightly tied stainless steel ligatures.

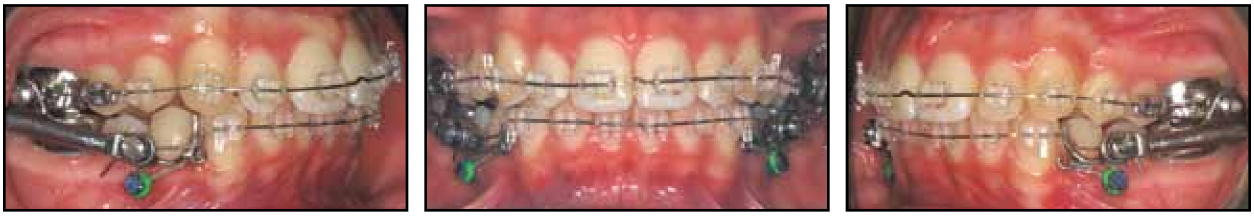


Fig. 5 Brackets bonded for leveling and alignment phase; archwires connected directly to molar bands of cast Herbst appliance.

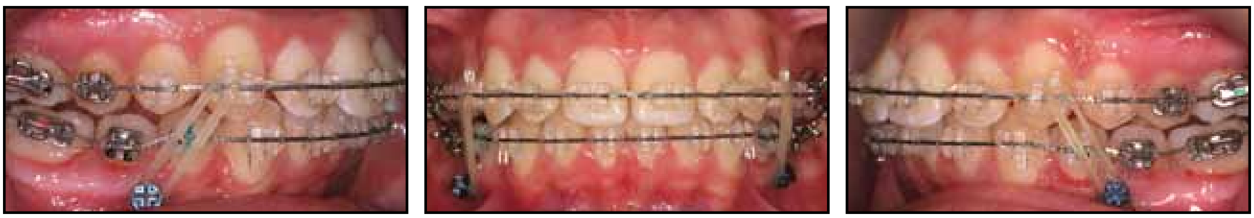


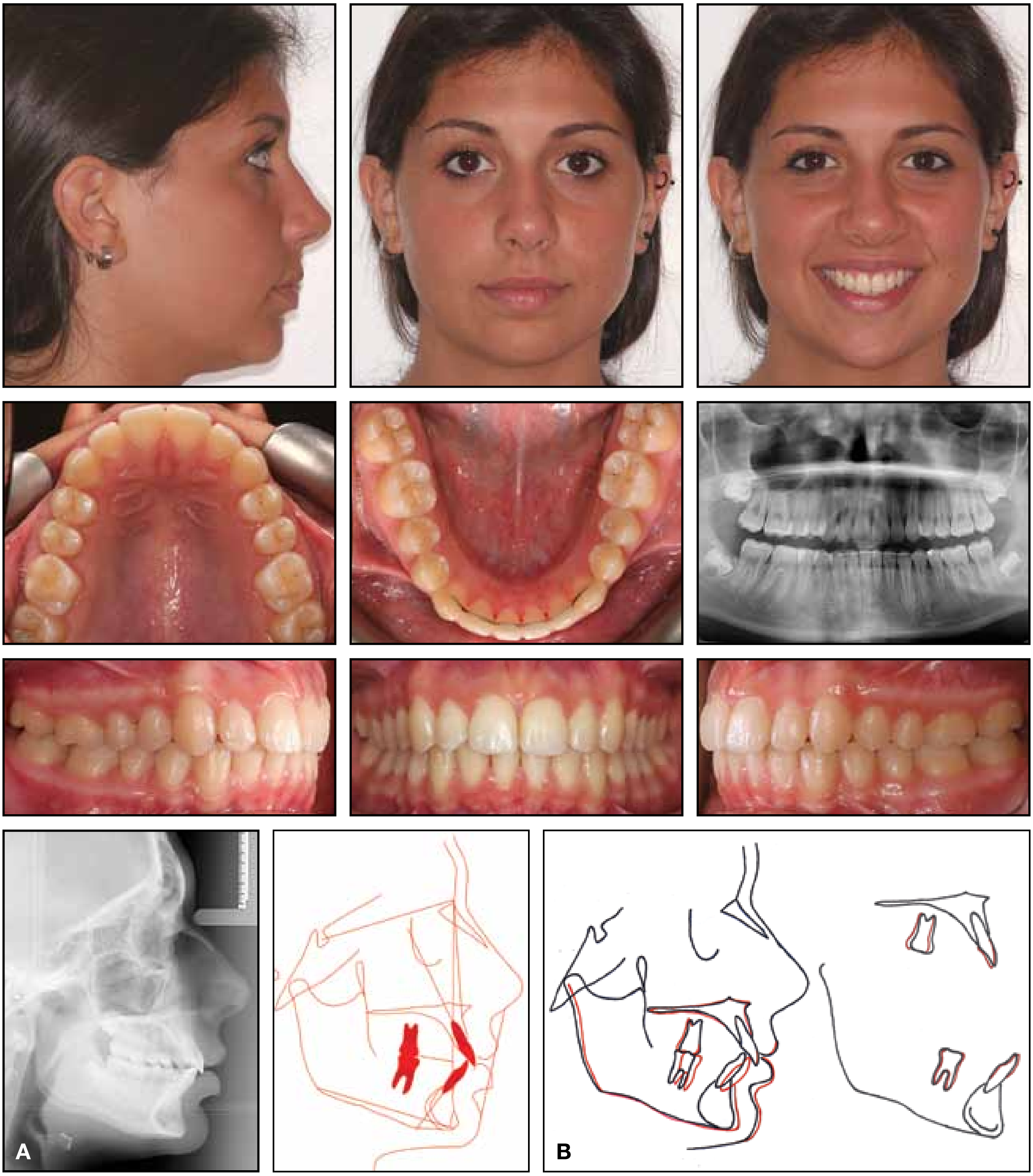
Fig. 6 Herbst appliance removed after nine months of treatment; intermaxillary elastics attached directly from mini-implant heads to upper canine brackets to enhance skeletal effect and prevent relapse following mandibular advancement.

ed in both arches, except for the molars and lower premolars, for leveling and alignment (Fig. 5). The patient was checked monthly so that the stainless steel ligatures between the mini-implants and Herbst appliance hooks could be tightened. After nine months of treatment, the Herbst appliance was removed and the remaining teeth were bonded. The TADs were left in place for attachment of intermaxillary elastics between the mini-implants and the upper canine brackets; these elastics were worn at night to prevent relapse of the mandibular advancement (Fig. 6).

After 15 months of treatment, finishing wires were placed in both arches, and vertical intermaxillary elastics were used to consolidate the intercuspation. Fixed appliances and mini-implants were removed after 20 months of active treatment. An upper removable retention plate was delivered for nighttime wear, and a lower fixed retainer was bonded.

Treatment Results

Post-treatment records showed Class I molar and canine relationships, along with a normal overjet and overbite (Fig. 7A). The panoramic radiograph confirmed proper root parallelism without signs of root or bone resorption. Superimposition of the pre- and post-treatment cephalometric radiographs demonstrated a significant improvement in the sagittal jaw relationship due to mandibular advancement, with no change in the vertical jaw relationship (Fig. 7B, Table 1). The increase in lower incisor inclination was within the range of measurement error (Fig. 7C).



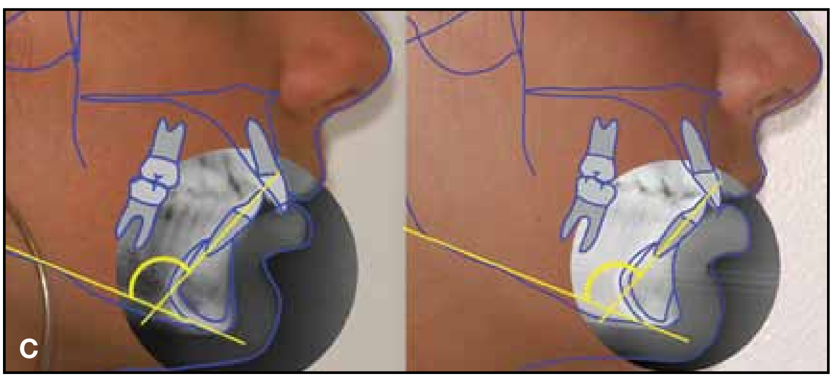


Fig. 7 A. Patient after 20 months of active treatment. B. Superimposition of pre- and post-treatment cephalometric tracings. C. Analysis of pre- and post-treatment cephalometric records shows mandibular anchorage control during treatment, with IMPA increasing by only 1°.

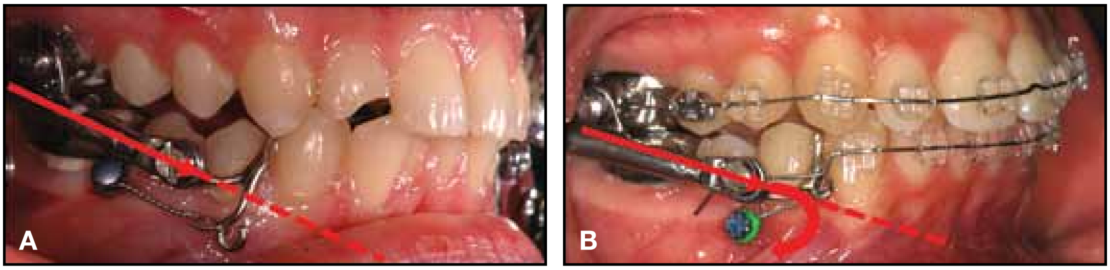


Fig. 8 A. Placing attachment hook at end of power arm makes anchorage ligature parallel to Herbst appliance's line of action, eliminating torsional moments that could allow incisor proclination. B. Placing hook at level of Herbst cast framework generates unwanted moment.

Discussion

More than 100 years after its introduction, the Herbst appliance is still the most widely used device for resolution of Class II malocclusions.[28-31] All fixed bite-jumping devices result in both skeletal and dental changes, however, with proclination of the lower incisors as a notable side effect.[32,33] Such proclination can partially reduce the overjet through dentoalveolar compensation, potentially diminishing the skeletal effect of the appliance by impeding forward movement of the mandible, to the extent that a full Class I dental relationship and stable intercuspation may not be achievable. Treatment methods such as cast mandibular devices, archwires with torquing bends, and brackets with selective torque cannot provide absolute anchorage.

Intra-arch mechanics using skeletal anchorage can easily be planned, but intermaxillary anchorage from mini-implants is more complicated. Although it is well known that mini-implants can withstand immediate orthodontic loading without increased risk of failure,[34,35] the lack of osseointegration dictates that the load should not exceed normal orthodontic range. Therefore, the orthopedic force from a Herbst appliance should not be transferred directly to miniscrews. When indirect force is applied by means of tight stainless steel ligatures, the bite-jumping device is connected directly to the lower dentition and indirectly to the lower basal bone, thus enhancing its skeletal effect.

The buccal cortex between the lower premolars, between the second premolar and first molar, or between the first and second molars offers optimal quality and quantity of bone.[36,37] Specific insertion sites should be based on the proximity of dental roots in each individual (Fig. 3). To maximize cortical contact while minimizing the risk of root contact, TADs should be inserted in the attached gingiva at an angle of 30-45°.[38] Bicortical miniscrews could be used for further stability.[39,40]

The biomechanics of the MAH system could be improved by placing the attachment hook at the end of a power arm to achieve parallelism between the anchorage ligature and the line of force acting on the lower dentition (Fig. 8A). This would prevent the creation of a torsional moment that could rotate the system as a hinge around the miniscrew, potentially allowing lower incisor proclination (Fig. 8B).

Following conventional Herbst treatment, patients are generally asked to wear intermaxillary Class II elastics at night to avoid relapse. In the case shown here, the mini-implants were left in place after removal of the Herbst appliance for attachment of elastics.

Conclusion

This new treatment protocol combines skeletal anchorage with the Herbst appliance for Class II cases in which lower-incisor proclination must be avoided. Reducing dentoalveolar side effects in the mandibular arch can optimize treatment efficiency and success by enhancing the skeletal response, thus improving the profile and final dental relationships and creating a solid, ideal intercuspation to reduce the likelihood of relapse. The combination of TADs with traditional Class II devices such as the Herbst and intermaxillary elastics should be further standardized for incorporation into common treatment protocols.

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