LONG-TERM FOLLOW-UP OF A YOUNG ADULT PATIENT WITH A CLASS II MALOCCLUSION TREATED WITH A HERBST APPLIANCE

A 13-year, 9-month-old girl presented with the chief complaint of crowding and protrusion of her anterior teeth. She was dolichofacial with a Class II Division 1 occlusion and had reached the final phase of her skeletal growth. Clinical symptoms and tomograms were indicative of a TMJ dysfunction. Because orthognathic surgery was not accepted by the patient and her parents, a Herbst appliance became the choice of treatment. An optimal occlusion and a good facial appearance were achieved after 24 months of treatment. TMJ tomograms at the end of treatment showed a more physiologic condylar position. Long-term follow-up 7 years after the end of treatment showed a very stable occlusion and an acceptable facial appearance. World J Orthod 2009;10:243–251.

Key words: Class II malocclusion, Herbst appliance, peak of growth

It has been demonstrated that appliances inducing mandibular protrusion can stimulate condylar growth and glenoid fossa remodeling in growing animals. Other studies have shown that condyle growth and glenoid fossa remodeling are also achievable in nongrowing animals. Moreover, using magnetic resonance imaging (MRI), Ruf and Pancherz documented that similar tissue responses can be obtained in humans.

However, in a systematic literature review, Popowich et al stated that MRI studies did not provide conclusive evidence of osseous remodeling or condyle position changes. They concluded that further research is needed to verify the effect of Herbst treatment on temporomandibular joint (TMJ) morphology.

In this report, a patient with a Class II Division 1 malocclusion was treated with a Herbst appliance as suggested by Ruf and Pancherz. A hand-wrist radiograph of this patient indicated that her skeletal growth was nearly complete.

PATIENT HISTORY

The patient was a 13-year, 9-month-old girl whose chief complaint was that her maxillary anterior teeth were crooked and sticking out. There was no relevant medical history. Oral hygiene and periodontal health were good, and no fillings were present. There was no history of dental trauma or oral habits. In both TMJs, a crepitus during mandibular movement was notable.
DIAGNOSIS AND ETIOLOGY

Extraorally, the patient had a mildly convex profile and appeared slightly asymmetric with a mandibular deviation to the left (Fig 1). Intraorally, she demonstrated a complete permanent dentition with a Class II Division 1 relationship, an increased overjet, a normal overbite, and bimaxillary anterior crowding (Fig 2). The mandibular midline was deviated to the left. The maxillary arch was constricted, which became obvious in a simulated Class I relationship.

A panoramic radiograph showed that all permanent teeth, with the exception of the mandibular third molars, were present (Fig 3). The lateral cephalogram and the cephalometric analysis revealed a Class II skeletal relationship (ANPg = 5 degrees) with a severe dolichocephalic pattern (SN/Go-Gn = 53 degrees, ANS-PNS/Go-Gn = 44 degrees) (Fig 4). The cephalogram further revealed that the concavity of the inferior borders of C2 and C3 had deepened, and the body of C3 was more high than wide. According to the cervical vertebral maturation method proposed by Baccetti et al,\textsuperscript{17} this indicates that the patient had reached her growth peak 2 years earlier.

A hand-wrist radiograph showed an advanced skeletal age in relation to the chronological age. The epiphysis of the radius was almost completely fused with its metaphysis (stage R-I); the epiphysis and metaphysis of the middle phalanx of the third finger (MP3) were completely fused (stage I) (Fig 5).\textsuperscript{18} A TMJ tomography made a condylar asymmetry with remodeling of the articular surfaces apparent (Fig 6). The right condyle was displaced superiorly and the left one posteriorly.
Fig 3  Pretreatment panoramic radiograph revealing the presence of all permanent teeth except mandibular third molars.

Fig 4  Cephalogram and cephalometric tracing before treatment revealing a skeletal Class II and a severe dolichofacial pattern.

Fig 5 (left)  Hand-wrist radiograph before treatment revealing almost complete fusion of epiphysis of the radius with its metaphysis (stage R-IJ); epiphysis and metaphysis of the middle phalanx of the third finger (MP3) showing complete fusion (stage I).

Fig 6 (below)  TMJ tomograms before treatment revealing condylar asymmetry with remodeling of the surfaces. Right condyle displaced superiorly, left posteriorly.
TREATMENT OBJECTIVES

Treatment objectives were as follows:

- Expand maxilla transversally
- Reposition the mandible ventrally, possibly encouraging its upward and forward rotation and controlling vertical dimension
- Relieve crowding of the anterior teeth in both arches

TREATMENT ALTERNATIVES

The first treatment plan proposed to the patient was leveling and aligning both arches with a subsequent referral to a maxillofacial surgeon for correction of the skeletal Class II and the structural asymmetry. The patient and her parents refused surgery, but they accepted a treatment plan including Herbst appliance therapy. Both parties were aware that a mild skeletal mandibular asymmetry would still be present at the completion of treatment.

TREATMENT PROGRESS

Treatment started with the insertion of an acrylic splint Herbst appliance (McNamara design) that was activated to an edge-to-edge position of the incisors. Further, a rapid maxillary expansion device was integrated into the maxillary splint. The appliance was activated once a day for 30 days. The maxillary splint also received two 0.45-inch tubes in the premolar area into which high-pull headgear could be inserted (Fig 7). The extraoral traction was to be worn only at night. After 9 months, the canines and molars were in a Class III relationship and the complex Herbst appliance was removed. A mild constriction of the maxillary arch was still present, causing a total open bite (Fig 8).

Next, the maxillary arch was bonded with a full preadjusted appliance (0.022 × 0.028-inch MBT prescription) in which a 0.016-inch Ni-Ti wire was inserted. After 3 months, a 0.019 × 0.025-inch heat-activated Ni-Ti wire was applied. The arch form selected was Orthoform III (3M Unitek) (Fig 9).

The transverse coordination of both arches induced a counterclockwise rotation of the mandible that resulted in closure of the open bite.
At this time, the mandibular arch was fully bonded and a 0.016-inch Ni-Ti wire was applied (Fig 10). This was followed by a 0.019 × 0.025-inch heat-activated Ni-Ti wire. Finally, 0.019 × 0.025-inch stainless steel wires were inserted in both dental arches. At this time, the patient wore light intermaxillary vertical elastics to improve the intercuspation (Fig 11).

After debonding, the patient was supplied with two Essix retainers that were to be worn 16 hours a day for 12 months. Total treatment time was 24 months.
TREATMENT RESULTS

After treatment, the patient had a Class I canine and molar relationship. The profile and front view were lightly influenced by the treatment (Fig 12). A slight mandibular asymmetry was still evident.

The panoramic radiograph at the completion of treatment revealed good root parallelism with moderate apical root resorption of the maxillary incisors (Fig 13). Root resorptions are a relatively common sequel of orthodontic treatment. Unfortunately, the factors that contribute to root resorption remain uncertain. Because no heavy orthodontic forces were used in this patient, it is possible that a hereditary component may have been involved.\(^{19}\) The lateral cephalogram and cephalometric analysis after treatment showed that the
SNPγ increased by 4 degrees (Table 1, Fig 14). The most significant changes occurred in the vertical skeletal parameters: SN/Go-Gn decreased from 53 degrees to 47 degrees and ANS-PNS/Go-Gn from 44 degrees to 40 degrees.

Because the patient had a fixed appliance, the maxillary incisor inclination decreased from 114 degrees to 102 degrees, whereas mandibular incisor inclination increased from 90 degrees to 94 degrees. Interincisal angle increased from 112 degrees to 123 degrees. Overjet and overbite were normalized, and the midline was centered.

TMJ tomograms at the completion of treatment confirmed a more physiologic condyle position (Fig 15). There were no significant signs or symptoms of a TMJ dysfunction; crepitus in both TMJs was significantly reduced.

Long-term follow-up (7 years after treatment) documented a very stable occlusion and a good facial appearance (Fig 16). Moreover, the gummy smile was reduced, probably due to residual growth of the lips. Lip incompetence at rest was still present, as was a mild facial asymmetry. The patient was completely satisfied with the result.

### Table 1 Pre- and posttreatment cephalometric measurements

<table>
<thead>
<tr>
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<th>Pretreatment</th>
<th>Posttreatment</th>
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<tr>
<td><strong>Sagittal skeletal relationship</strong></td>
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<tr>
<td>SNA (degrees)</td>
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<tr>
<td>SNPγ (degrees)</td>
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<td><strong>Vertical skeletal relationship</strong></td>
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<td>SN/Go-Gn (degrees)</td>
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<td>ANS-PNS/Go-Gn (degrees)</td>
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<td><strong>Dental relationship</strong></td>
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<td>Overbite (mm)</td>
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DISCUSSION

A Herbst appliance can correct a Class II occlusion even when a patient is behind her/his growth peak. The correction in this patient was accomplished by dental movements, as well as a mandibular repositioning and rotation. The correction of a Class II occlusion with a Herbst appliance in late growth phases allows more patients to avoid orthognathic surgery in skeletal borderline situations. Moreover, sagittal and vertical repositioning of the mandible by a Herbst appliance permits control or even resolution of TMJ dysfunctions. Finally, an acrylic splint Herbst appliance has a bite block effect and, combined with high-pull headgear, can control an unfavorable hyperdivergent facial pattern.

CONCLUSION

The Herbst appliance is useful in the correction of both skeletal and dentoalveolar distal occlusions. Moreover, it can provide an alternative to orthognathic surgery in adults with borderline skeletal Class II relationships.
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REFERENCES