Thirty-two-year follow-up study of Herbst therapy: A biometric dental cast analysis

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Introduction: The aim of this study was to analyze the very long-term effects of Herbst treatment on tooth position and occlusion. **Subjects:** Fourteen patients from a sample of 22 with Class II Division 1 malocclusions consecutively treated with the banded Herbst appliance were reexamined 32 years after therapy. **Methods:** Dental casts were analyzed from before (T1) and after (T2) treatment, and at 6 years (T3) and 32 years (T4) after treatment. **Results:** Minor changes in maxillary and mandibular dental arch perimeters and arch widths were seen during treatment (T1-T2) and posttreatment (T2-T4). Mandibular incisor irregularity remained, on average, unchanged from T1 to T2 but increased continuously during the 32-year follow-up period (T2-T4). Class II molar and canine relationships were normalized in most patients from T1 to T2. During the early posttreatment period (T2-T3), there was a minor relapse; during the late posttreatment period (T3-T4), molar and canine relationships remained, on average, unchanged. Overjet and overbite were reduced to normal values in all subjects during treatment (T1-T2). After treatment (T2-T4), overjet remained, on average, unchanged, but overbite increased insignificantly. **Conclusions:** Thirty-two years after Herbst therapy, overall, acceptable long-term results were seen. Stability was found in 64% of the patients for sagittal molar relationships, in 14% for sagittal canine relationships, in 86% for overjet, and in 86% for overbite. A Class II relapse seemed to be caused by an unstable interdigitation of the occluding teeth, a persisting oral habit, or an insufficient retention regimen after treatment. Most posttreatment changes occurred during the first 6 years after treatment. After the age of 20 years, only minor changes were noted. Long-term posttreatment changes in maxillary and mandibular dental arch perimeters and widths as well as in mandibular incisor irregularity seemed to be independent of treatment and a result of physiologic dentoskeletal changes throughout adulthood. (Am J Orthod Dentofacial Orthop 2014;145:15-27)

The great potential of the Herbst appliance in the clinical management of Class II malocclusions has been documented in several investigations and summarized in the textbook of Pancherz and Ruf.[1] Corrections of the Class II dental arch relationship and overjet are mainly accomplished by anterior advancement of the mandible (stimulation of condylar growth), distal movement of the maxillary lateral teeth, and proclination of the mandibular incisors.[2] Overbite reduction results from extrusion of the mandibular molars and intrusion of the mandibular incisors.[3] The Herbst appliance cannot relieve mandibular crowding. Thus, in crowded Class II malocclusion cases, extractions of teeth (mostly the 4 premolars) must often be performed; after that, the Class II problem has been solved with the Herbst appliance. In previous articles on changes after Herbst therapy, the follow-up periods varied between 1 and 10 years, and they usually end in late adolescence or early adulthood,[4-16] when growth-related dentoskeletal changes still can occur.[17,18]

To date, there has been no long-term follow-up study after Herbst therapy in adolescent patients in which the follow-up period ends in the patients' middle life, when growth-related changes in tooth position and occlusion must be considered to be at a minimum or at an end.

Therefore, the aim of this very long-term follow-up investigation after Herbst treatment was to reexamine previous adolescent patients (age, 12-14 years) at least 30 years after treatment. The study was planned to comprise 3 parts: (1) a biometric analysis of dental casts,

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(2) a cephalometric radiographic analysis of lateral head films, and (3) a functional analysis of the masticatory system with special reference to the temporomandibular joint.

MATERIAL AND METHODS

The patients in this study were derived from a well-defined sample of 22 consecutive patients with Class II Division 1 malocclusion treated with the Herbst appliance at the University of Malmö in Lund, Sweden, in 1977 and 1978. These subjects were presented in 2 articles in 1982.[2,3] However, in these articles, only cephalometric changes from before treatment to the end of active treatment were considered. Superimposed head-film tracings from every patient were shown.[2]

In 2011 and 2012, 30 to 33 years after Herbst therapy, these 22 subjects were recalled to the orthodontic department in Malmö for a follow-up investigation. At this time, they were 42 to 48 years of age. Two persons were deceased, and 6 did not come, for several reasons. Thus, the final follow-up sample comprised 14 subjects (12 men, 2 women) and is presented in detail in Table I. Before Herbst treatment, 12 subjects had a bilateral distal molar relationship greater than 0.75 cusp width, and 2 had a 0.5 cusp-width distal molar relationship. All 14 subjects had a bilateral distal canine relationship greater than 0.75 cusp width. Overjets ranged from 6.5 to 13 mm, and overbites from 3 to 7.5 mm.

Treatment of all subjects was performed by an author (H.P.) using a banded-type Herbst appliance with a simple anchorage system.[2] Because of major tooth irregularities after Herbst therapy in 2 patients (patients 1X and 8X), extractions of 4 premolars were performed, and maxillary and mandibular multibracket appliances were placed for about a year. Furthermore, for tooth alignment in a nonextraction patient (patient 12), a maxillary multibracket appliance treatment phase was instituted for 6 months after the Herbst phase. In these 3 patients, multibracket treatment after the Herbst phase did not aim to affect the occlusion but only to align the teeth, after the Class II dental arch and overjet corrections were achieved by the Herbst appliance.

Dental casts in centric occlusion secured by a wax bite were analyzed at 4 occasions: T1, before Herbst treatment; T2, after treatment, about 12 months after the Herbst appliance was removed and the occlusion had settled (for the 2 extraction patients [1X and 8X], T2 implied that the dental casts were analyzed after removal of the multibracket appliance); T3, 6 years after treatment at an average age of 20 years when the radius epiphysis/diaphysis plate was closed (hand-wrist stage R-J, according to Hägg and Taranger[19]); and T4, 32 years after treatment at an average age of 46 years.

The changes in tooth position and occlusion were analyzed during the following observation periods: T1-T2, treatment changes; T2-T3, early posttreatment changes; T3-T4, late posttreatment changes; and T2-T4, total posttreatment changes.

The dental casts from T1, T2, T3, and T4 were digitally photographed using a standard setup. The pictures were then evaluated with measurement analysis software (FACAD; Ilexis AB, Linköping, Sweden). A millimeter ruler was included in the photographic setup and used for calibrating the photographic illustrations of the casts.

The biometric analysis comprised the following variables.[20,21]

1. Arch perimeter: the maxillary and mandibular arch perimeters were measured sectionally with (a) the distance from the distal contact point of the second premolar (or deciduous second molar) to the mesial contact point of the first premolar (or deciduous first molar); (b) the distance from the mesial contact point of the first premolar (or deciduous first molar) to the distal contact point of the lateral incisor; and (c) the distance from the distal contact point of the lateral incisor to the midline point between the 2 central incisors. Arch perimeter was calculated as the sum of these 3 measurements.
2. Maxillary and mandibular arch widths: intermolar arch width is the distance between the mesiobuccal cusp tips of the first molars, and intercanine arch width is the distance between the cusp tips or estimated cusp tips in case of wear facets.
3. Mandibular incisor irregularity index: the linear displacement of the anatomic contact points of the mandibular incisors mesially to the canines according to the method of Little.[22]
4. Sagittal dental arch relationships: molar and canine relationships of the left and right sides were recorded with the precision of half a cusp. Normal, mesial, or distal relationships were assessed. The results from the left and right sides were pooled and averaged.
5. Overjet: the distance from the incisal edge of the most labial maxillary incisor to the opposing mandibular central incisor was recorded with a steel ruler with a precision of 0.5 mm.
6. Overbite: the vertical overlap of the maxillary and mandibular incisors was measured with a steel ruler with a precision of 0.5 mm.

Maxillary and mandibular arch perimeters, intermolar and intercanine widths, and the mandibular incisor