Skeletal, dentoalveolar and TMJ's effects of the Herbst appliance on class II division 1 malocclusion: A review of literature

Peer review status:
No

Corresponding Author:
Dr. Valentina Caridi,
Odontoiatra, Scienze odontostomatologiche e Maxillo-Facciali Roma - Italy

Submitting Author:
Dr. Valentina Caridi,
Odontoiatra, Scienze odontostomatologiche e Maxillo-Facciali Roma - Italy

Other Authors:
Dr. Gabriella Galluccio,
Direttore della Scuola di Specializzazione in Ortognatodonzia , Scienze Odontostomatologiche e Maxillo-Facciali,
Roma "La Sapienza" - Italy

Article ID: WMC004465
Article Type: Systematic Review
Submitted on: 16-Dec-2013, 04:05:14 PM GMT Published on: 17-Dec-2013, 05:17:34 AM GMT
Article URL: http://www.webmedcentral.com/article_view/4465
Subject Categories: ORTHODONTICS
Keywords: Herbst appliance; Class II malocclusion; Molar distalization

How to cite the article: Caridi V, Galluccio G. Skeletal, dentoalveolar and TMJ's effects of the Herbst appliance on class II division 1 malocclusion: A review of literature. WebmedCentral ORTHODONTICS 2013;4(12):WMC004465

Copyright: This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC-BY), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Source(s) of Funding:
None

Competing Interests:
None
Skeletal, dentoalveolar and TMJ's effects of the Herbst appliance on class II division 1 malocclusion: A review of literature

Author(s): Caridi V, Galluccio G

Abstract

Introduction: No-compliance orthodontic treatment has recently become very popular. Unlike removable appliances requiring patient compliance, the Herbst appliance is a widely used fixed functional bite-jumping device generating predictable results in the treatment of skeletal class II malocclusions.

Objectives: They were chosen from "PubMed" several publications about Class II malocclusion treated with the Herbst appliance. This review was carried out to evaluate the skeletal and dentoalveolar effects of the crown Herbst appliance used to treat II skeletal class and the morphological changes in the temporomandibular joint (TMJ) condyles, during the treatment.

Discussion: The main problem associated with tooth-borne bite-jumping appliances is the generation of unavoidable dental movements, especially proclination of lower incisors, in addition to the skeletal effects; the dento-alveolar compensations can, when uncontrolled, compromise treatment results. We refer the Aidar et al.'s study in which were evaluated the morphological changes in the temporomandibular joint (TMJ) condyles and calculated the Helkimo clinical dysfunction index (CDI) in adolescents with Class II Division 1 malocclusion and mandibular retrognathism treated, at the first, with the Herbst appliance and then with fixed orthodontic appliances. Also we reported a results about three possible adaptive TMJ growth processes contributing to the increase in mandibular prognathism accomplished by Herbst appliance therapy: (1) condylar remodelling; (2) glenoid fossa remodelling; and (3) condyle-fossa relationship changes. People were treated with the Herbst appliance and condylar remodelling, glenoid fossa remodelling, and condyle-fossa relationship changes were analyzed by means of magnetic resonance imaging (MRI). We conducted the study by Franchi et al., showed that two thirds of the achieved occlusal correction was due to skeletal effects and only one third to dentoalveolar adaptations. Both skeletal and dentoalveolar effects were due mainly to changes in mandibular structures. A significant amount of relapse in molar relationship occurred during the post treatment period, and this change could be ascribed to the mesial movement of the upper molars. Class II malocclusion associated with mandibular retrognathism may be treated using orthopedic functional appliances in the first phase of treatment to advance the mandible and to improve its anteroposterior adjustment during growth. In the...
second phase of treatment, fixed orthodontic appliances are used to refine occlusion. The Herbst appliance is an orthopedic fixed device for treatment of Class II malocclusion mainly directed to mandibular growth stimulation in growing patients. Several papers have described its effects during the Class II correction, showing its dental and skeletal action occurring in the same proportion. Part of the dental movement is upper molar distalization. This search had the objective of assessing the kind and amount of first upper molar movement using the Herbst appliance. A study conducted by Chintakanon et al, about a comparison between control and Clark Twin-block groups, suggested that reduction of the condylar axial angle represents a feature of untreated Class II growth patterns, where as axial angle stability with Clark Twin-block therapy may suggest alteration of condylar growth direction. The responses of the temporomandibular joints (TMJs) treated using this method are controversial, which has led to the conduction of studies using the three-dimensional finite element method as well as analyses in groups of experimental animals or humans beings.

Methods

This study consists of review of articles published in the literature about these devices. We were chosen from “PubMed” several publications about systematic review of Class II malocclusion treated with the Herbst appliance and it’s skeletal, dentoalveolar and TMJ’s effects. The main inclusion criteria of research are: Use of crown or banded Herbst appliance to correct Class II division 1 malocclusions, Nonsyndromic or medically compromised patients, no surgical intervention, the characteristics of Herbst.

The term functional appliance refers to both removable and fixed appliances designed to alter the sagittal or vertical position of the maxilla or mandible. Currently, there is little doubt that measurable dental changes such as reduced overjet or molar correction occur in a favorable manner with the continuous use of functional appliances. However, the degree of skeletal versus dentoalveolar change that underlies these treatment effects is a source of debate.

A number of studies have reported very high success rates in Class II correction by the Herbst appliance, usually followed by fixed appliance therapy. High manufacturing expenses and high band breakage rate have been reported as disadvantages of the Herbst appliance. To overcome these drawbacks, in 1980, Langford introduced the stainless steel crown Herbst (cHerbst) modification. The two Panzer articles involved the same groups of subjects, but each article reported different measurements. The subjects used were a consecutively treated prospective sample. The treatment group consisted of 21 subjects, while the untreated control group consisted of 20 subjects. The control group was followed on a parallel basis. One of the articles stated that the mean age of the treatment group was 12 years 1 month, while the control group had a mean age of 11 years 2 months. The time between lateral cephalograms was 6 months for both groups. Post treatment radiographs were taken upon appliance removal.

Review

Pancherz et al’s study analyze quantitatively the sagittal skeletal and dental changes contributing to Class II correction in patients treated with the Herbst appliance after the pubertal growth peak. They claim that as a result of the Herbst therapy, all patients attained a Class I or overcorrected Class I occlusal relationship. Class II molar correction averaging 6.1 mm was due to 37% skeletal and 63% dental changes. Overjet correction averaging 8.4 mm was due to 27% skeletal and 73% dental changes. Differences between the late and the early treated patients were only found for the dental changes. The upper anterior teeth were retroclined and the lower anterior teeth were proclined more in the late cases. Part of the dental movement is upper molar distalization. This search had the objective of assessing the kind and amount of first upper molar movement using the Herbst appliance. In the scientific literature there are information about significant distal movement of the molar crown and root while the occlusal surface was intruded in comparing to palatal plane. In consequence the occlusal plane rotated in relation to Frankfurt. Class II patients treated with the Herbst appliance demonstrated anterior displacement of the condyles and glenoid fossae along with maxillary restraint when compared with the treated Class II controls; this might result in more anterior mandibular projection. Also it is evaluated whether the association of a modified Herbst appliance and TADs (temporary anchorage devices ) can enhance the correction of skeletal class II malocclusion, avoiding the undesirable proclination of the lower anterior teeth. Two miniscrews in two different patients of the EG (experimental group) lost stability during treatment. One was immediately substituted with a new one inserted in an adjacent site, while the second one was tightened deeper until stability was achieved again. In
these cases, the association of TADs with the Herbst appliance can be applied in order to reduce undesirable proclination of lower incisors and enhance the skeletal response\(^7\). Regarding cranial base changes, no selected study reported significant changes except with regard to the cranial base angle \((1^\circ)\), and this change is not likely clinically significant. No changes in the facial growth axis were reported, but a decrease in the facial profile was found \((3^\circ)\). Significant changes in the vertical dimensions were reported for the posterior \((1.4 \text{ to } 2.5 \text{ mm})\) and lower anterior facial heights \((1.2 \text{ to } 3 \text{ mm})\) \(^5\). A significant increase in the mandibular protrusion was found \((1.2 \text{ to } 2.9^\circ)\). No significant changes for the mandibular plane inclination, gonial angle, or condylar position were reported. Mandibular dimensions were shown to be significantly increased \((0.7 \text{ to } 2.7 \text{ mm})\). In general, mandibular incisors were protruded \((1.5 \text{ to } 4 \text{ mm})\), proclined \((3.2 \text{ to } 4.5^\circ)\), and extruded \((5.3^\circ)\) after treatment. The mandibular molars were also protruded \((0.8 \text{ to } 3.6 \text{ mm})\) but not proclined or clinically significantly extruded\(^6\).

**Discussion**

Hans Pancherz et al examined forty-two Class II Division 1 malocclusion cases. Twenty-two of these were treated with the Herbst appliance for 6 months. The other twenty cases served as a control group. The results of the investigation revealed the following: (1) Bite jumping with the Herbst appliance resulted in Class I occlusal relationships in all treated cases. (2) The improvement in occlusal relationships was about equally a result of skeletal and dental changes. (3) Class II molar correction averaging 6.7 mm. was mainly a result of a 2.2 mm. increase in mandibular length, a 2.8 mm. distal movement of the maxillary molars, and a 1.0 mm. mesial movement of the mandibular molars. (4) Overjet correction averaging 5.2 mm. was mainly a result of a 2.2 mm. increase in mandibular length and a 1.8 mm. mesial movement of the mandibular incisors. (5) Anterior condylar displacement \((0.3 \text{ mm})\), redirection of maxillary growth \((0.4 \text{ mm})\), and distal movement of the maxillary incisors \((0.5 \text{ mm})\) were of minor importance in the improvement in molar and incisor relationships seen. (6) A direct relationship existed between the amount of bite jumping at the start of treatment and the treatment effects on the occlusion and on mandibular growth\(^8\). The studies selected showed that use of Herbst appliance resulted in increased anteroposterior length of the mandible, increased vertical height of the ramus, increase in lower facial height, mandibular incisor proclination, mesial movement of lower molars, and distal movement of upper molars\(^9\). However, about TMJ’s effects it should be pointed out that MRI changes such as those seen in the Herbst patients have never been observed in MRIs of orthodontically-untreated subjects\(^4\). The clinical significance of the size of joint space remains controversial, as the importance of a decreased or increased joint space is unknown. Prior to treatment, the condyles of the Herbst patients were, on average, found to be anteriorly positioned, which is a deviation from ideal concentricity that has been described for Class II division 1 patients (Pullinger et al., 1987). Post-treatment, the average condylar position was insignificantly more anterior than pre-treatment-an observation that has also been made by evaluating lateral head films of Herbst patients (Pancherz and Stickel, 1989)\(^4\). A direct comparisons between studies were difficult on several levels: different landmarks/measurements reported, different group age ranges, and different treatment durations\(^5\). Minimal effects were demonstrated on the maxilla, whereas several significant (and nonsignificant) increases were seen in mandibular length as compared to the untreated controls. It appears that the magnitude of the mandibular change lies in the 2- to 3-mm range, depending on which measurement is considered. While the mandibular effects could be anticipated, the lack of a headgear effect on the maxilla is noteworthy. Previous studies involving various types of functional appliances have found both the presence and absence of this effect on the maxilla\(^6\). Generally, maxillary incisors were retroclined; mandibular incisors showed a definite proclination, which is not surprising given the force vectors involved with Herbst treatment. Maxillary first molar position showed small but statistically significant amounts of intrusion. The clinical significance of this level of intrusion is questionable. It also was moved distally within the maxillary alveolus. This distal movement could account for the retroclination of the maxillary central incisors via transseptal fibers. Mandibular first molars showed an extrusive and anterior direction of movement. This could be accounted for by the relative intrusion of the opposing maxillary first molar, allowing for this small but significant amount of eruption\(^8\).

**Conclusion(s)**

This systematic review showed that use of the Herbst appliance in treating adolescents with Class II division I malocclusion resulted in increased anteroposterior length of the mandible, increased vertical height of the
ramus, increase in lower facial height, mandibular incisor proclination, mesial movement of lower molars, and distal movement of upper molars. Also about the increase in mandibular prognathism accomplished by Herbst therapy seems in particular to be a result of condylar and glenoid fossa remodelling, while condyle-fossa relationship changes are of less importance. 

References

5. “Immediate Skeletal and Dentoalveolar Effects of the Crown- or Banded Type Herbst Appliance on Class II division 1 Malocclusion” Gregory A. Barnett, Duncan W. Higgins, Paul W. Major, and Carlos Flores-Mir; The Angle Orthodontist Volume 78, Issue 2 (March 2008)