

An Improved Version of the Integrated Herbst Appliance

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In 1997, we described the integration of a Herbst* appliance with conventional upper and lower fixed appliances.¹ A lower auxiliary archwire with the Herbst pistons attached was used to distribute the force from the Herbst appliance to the main mandibular archwire, thus reducing the possibility of bracket loosening and archwire breakage (Fig. 1A). In this version, the Herbst tubes are attached to headgear or auxiliary tubes on the maxillary first molar bands using various types of hooks (Fig. 1B).

We recently assessed the frequency of appliance problems during treatment with the integrated Herbst appliance in 87 patients, randomly selected from 174 consecutively treated patients in our clinic. Forty percent of these patients had no complications during their Herbst treatment. Of the 98 problems noted, 61% were related to the connection between the Herbst tubes and the maxillary first molars (predominantly fractures of the hooks and ballpins), and 39% to the lower auxiliary archwire with the attached Herbst pistons.

These findings are similar to those noted by Sanden and colleagues, who compared treatment with banded and cast-splint Herbst appliances.² In that study, 33% of the banded and 40% of the cast-split patients reported no complications; loosening was the most common issue with both types of appliances, and maxillary complications were twice as common as mandibular problems.

To avoid breakage of the upper part of the integrated appliance and simplify its insertion, we have modified the 1997 version by adding an auxiliary archwire made of .036-.040" round stainless steel in the maxillary arch, similar to the one designed for the mandibular arch¹ (Fig. 2). The auxiliary archwire transmits the horizontal force of the Herbst to the main archwire in the maxillary incisor region, rather than to the maxillary first molar headgear tubes, thus reducing the horizontal force vector on the first molars and the resultant risk of tube and band fractures (Fig. 3).

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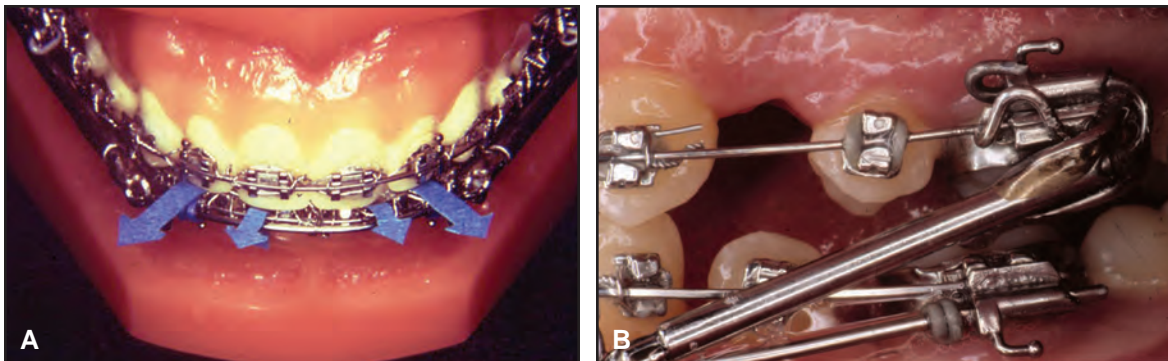


Fig. 1 Previous version of integrated Herbst* appliance with auxiliary wire in mandibular arch. A. Force of Herbst appliance distributed to main mandibular archwire by auxiliary archwire. B. Hook of .036-.040" round stainless steel wire used to attach Herbst tubes to maxillary first molar bands.

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Fig. 2 New version of integrated Herbst appliance, with auxiliary archwires in both arches.

Appliance Fabrication

We suggest that until ample experience is gained with installation of the integrated Herbst, the clinician prepare the various components of the appliance on dental casts. First, take impressions and a wax bite registration in a forward (jumped) position, and either mount the casts in an articulator or trim them in the forward position (Fig. 4). The auxiliary archwires are then formed and the length of the Herbst tubes adjusted on the casts as follows.

Lower auxiliary archwire. Adapt the .036-.040" round stainless steel auxiliary wire to the mandibular cast, following the archform. The lower auxiliary wire will later be attached to the arch in the posterior region via auxiliary tubes on the mandibular first molars; if the first molar bands have single tubes, the distal ends of the lower auxiliary archwire must be bent into "emergency hooks" mesial to the first molars (Fig. 5). Bend loops buccal to the mandibular canines on both sides to function as attach-



Fig. 3 Force distribution in maxillary arch from Herbst appliance, divided into horizontal and vertical vectors. Herbst tubes attached to loops of upper auxiliary archwire 3-4mm above headgear tubes to avoid interference with brackets and tubes in mandibular arch (see Fig. 14).



Fig. 4 Study casts before Herbst appliance installation, trimmed in forward (jumped) position.

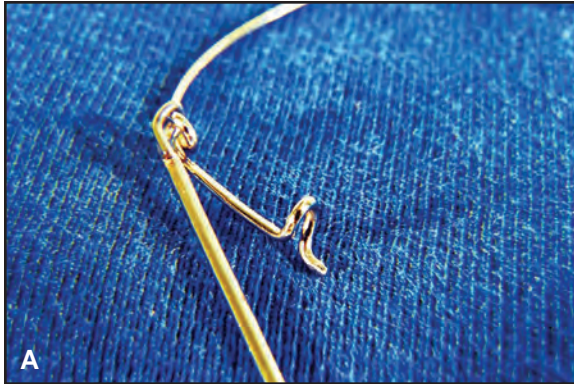


Fig. 5 A. Lower auxiliary archwire with piston engaged in loop and distal end bent into “emergency hook”. B. “Emergency hook” of lower auxiliary archwire locked in place mesial to mandibular first molar with elastomeric module.

ments for the pistons (Fig. 2). The median distance between the centers of the loops on the lower auxiliary archwire was 39mm in our sample.

Upper auxiliary archwire. Adapt the .036-.040" round stainless steel auxiliary wire to the maxillary cast as with the mandibular wire. In our sample, the median distance between the midline and the contact point between the second premolar and first molar was 43mm. Bend loops in the auxiliary archwire gingival to the first molar headgear tubes and buccal to the first molars. Prepare the ends to fit in the headgear tubes (Fig. 6).

Adjustment of Herbst tubes. Place the auxiliary archwire on the mandibular cast, and mark the anterior limits of the Herbst pistons with a lead pencil (Fig. 7). After occluding the upper and lower casts together, transfer these marks to the maxillary cast. Place the upper auxiliary archwire on the upper cast with the Herbst tubes connected, and mark the length of the tubes (Fig. 8). Cut the tubes accordingly, and polish the ends with a large round bur, paying particular attention to the inner edges of the tube ends (Fig. 9). The friction caused by raw edges can be irritating to patients and can result in grinding and appliance fracture.

Appliance Insertion

1. In the mouth, insert the end of the preformed upper auxiliary archwire into the headgear tube on one side, then adjust the auxiliary archwire to

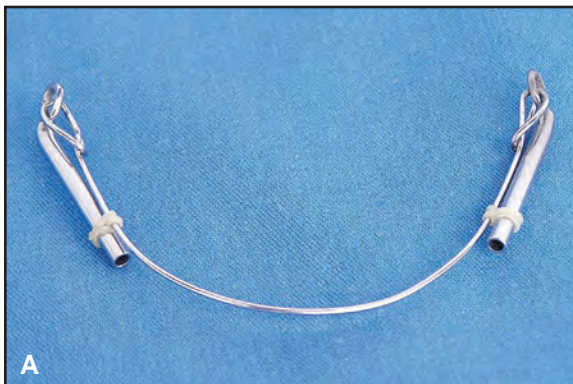


Fig. 6 A. Upper auxiliary archwire attached to Herbst tubes. B. Upper auxiliary archwire inserted into first molar headgear tubes.

follow the main archwire to the headgear tube on the opposite side without creating tension in the molar tubes.

2. If the Herbst tubes were removed for length adjustment, snap them into the loops in the maxillary molar regions of the auxiliary wire (Fig. 10). This should be easy because of the elasticity in the loops.

3. Insert the ends of the auxiliary archwire into the maxillary headgear tubes, and tie the auxiliary to the main archwire at the midline by wrapping the wires four to five times with stainless steel ligature wire (Fig. 11). If the hanging Herbst tubes cause discomfort, attach them temporarily to the upper main archwire with elastics (Fig. 12).

4. Insert the Herbst pistons, attached to the loops of the lower auxiliary archwire, into the upper Herbst tubes.

5. Insert the distal ends of the lower auxiliary



Fig. 9 Large round bur used to polish raw edges after adjustment of tube length.

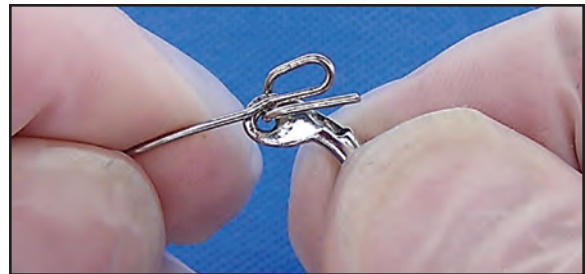


Fig. 10 Herbst tubes snapped into loops of upper auxiliary archwire.



Fig. 7 Anterior stop of Herbst piston marked on mandibular cast.



Fig. 11 Stainless steel ligature wire wrapped around upper auxiliary archwire at midline.



Fig. 8 Length of Herbst tube marked on maxillary cast.



Fig. 12 Herbst tubes temporarily attached to upper main archwire with elastics during installation to prevent patient discomfort.

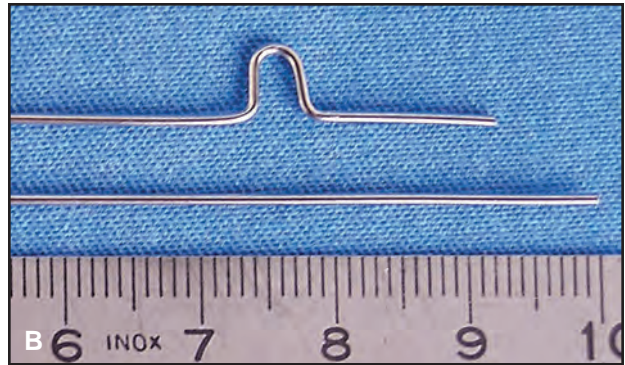


Fig. 13 A. Vertical loop made in maxillary first premolar region to adjust length of auxiliary archwire. B. Adjustment range for 6mm vertical loop is 6-7mm.



Fig. 14 Herbst tube interfering with mandibular first molar tube and second premolar bracket.



Fig. 15 Reduction in transverse dimension of loop attachment to upper auxiliary archwire.

archwire into the buccal tubes of the mandibular first molar bands. If the “emergency hooks” were used, attach each end of the lower auxiliary archwire to the main archwire mesial to the first molars, securing them with elastomeric ligatures (Fig. 5B). In the anterior, attach the lower auxiliary archwire to the main archwire using elastomeric ligatures attached to surgical ball hooks or to the hooks on a posted archwire (Fig. 2). This connection provides shock absorption for the appliance.

Discussion

This modification of the integrated Herbst appliance has two major advantages over the previous version. First, the installation is less complicated for the doctor and more comfortable for the patient. Second, the attachments for the Herbst tubes can be placed more gingivally (Fig. 13A), thus reducing interference with the mandibular first molar tubes and second premolar brackets (Fig. 14). This is critical when the bite is advanced in a patient with minor overbite, especially if the headgear tube is situated occlusally rather than gingivally to the main archwire tube.

To minimize sore spots in the maxillary molar regions, we have reduced the transverse dimension of the attachment of the Herbst tube to the upper auxiliary archwire by orienting the loop parallel to its long axis (Fig. 15). If the loop of the upper auxiliary archwire is placed too far distally,

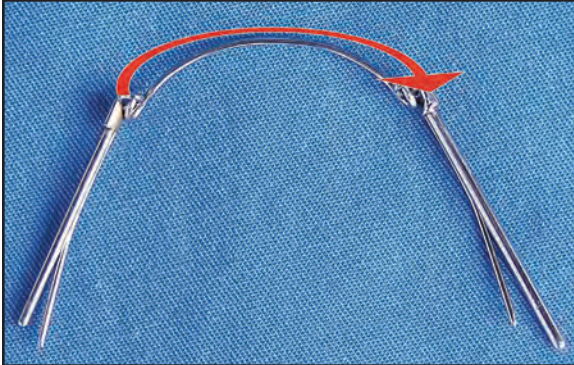


Fig. 16 Prefabricated lower auxiliary archwires provide various distances between loops in canine regions to accommodate different cases.

pressure from the masseter is more likely to cause soreness.

The addition of a vertical loop in the maxillary first premolar region provides 6-7mm of adjustment in the length of the auxiliary archwire (Fig. 13B). Based on the average length of well-aligned upper and lower arches in 30 nonextraction cases, we have prefabricated auxiliary archwires for both arches. Three versions of the lower auxiliary archwire provide different dimensions between the loops in the mandibular canine areas (Fig. 16).

To evaluate the treatment effects of the previous integrated Herbst appliance, we compared cephalometric changes in 30 male Class II patients, in stages of maturation from the onset of the pubertal growth spurt to peak growth, with those in untreated, age-matched male patients. Herbst treatment was associated with statistically significant and favorable cephalometric changes, whereas the control group showed only minor or no changes.³ The modification of the integrated Herbst in the upper arch is unlikely to influence treatment results. Thus far, our experience with the new version has been good, and breakage has been rare.

Although similar treatment effects have been

reported by others using Herbst appliances of various designs,^{4,7} there are some minor differences between our findings and the others. The reduction in SNA was somewhat greater in our sample³; furthermore, while most studies of Herbst treatment have reported small increases in mandibular plane angle,^{4,6,8,9} we noted significant decreases in ML/NSL.³ Du and colleagues reported a similar reduction in mandibular plane angle in teens treated with Herbst appliances and high-pull headgear.¹⁰ During adolescence, the mandible normally exhibits anterior growth rotation, as was noted in our untreated control group.³ These variations in results are most likely due to differences in the Herbst appliances used for treatment.

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