A New Herbst Appliance

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Emil Herbst introduced the world to his unique appliance concept in 1910 with the publication of his *Atlas und Grundriss der Zahnärztlichen Orthopädie*[1,2] ("Atlas and Compendium of Dental Orthopedics"). Herbst needed only 10 pages to explain the rationale and use of his new device.

It is remarkable to observe how similar Herbst's 1910 design is to the appliance as we know it today (Fig. 1). To be sure, there have been significant contributions to modern-day Herbst treatment protocols and appliance design.[3-9] Still, in my own experience of about 10 years with Herbst treatment, I have seen room for improvement in three areas: patient comfort, ease of fabrication, and patient compliance.

I have found three problems that tend to reduce patient comfort. Foremost of these is ulceration of the mucosa covering the superior oblique ridge of the coronoid process. With single-rod/tube Herbst mechanisms, the rods have to be long enough so they will not disengage from the tubes upon extreme opening. In addition, the upper molar attachment assembly has traditionally been located on an extreme distobuccal angle to the upper first permanent molar to prevent disengagement. Unfortunately, this rod length and attachment location tend to encourage contact with the oblique ridge when the mandible is postured forward.

A related design problem: by locating the attachment on an extreme distobuccal angle, both visual and physical access are restricted during insertion of the rod/tube assembly into the maxillary component. The lip commissure must be so severely retracted that the patient squirms and suffers and the clinician becomes exasperated. Some may solve the dilemma by delivering the entire assembly with the tubes already attached, but others may want to accomplish some arch development prior to Herbst activation, or to ease the patient into the appliance and

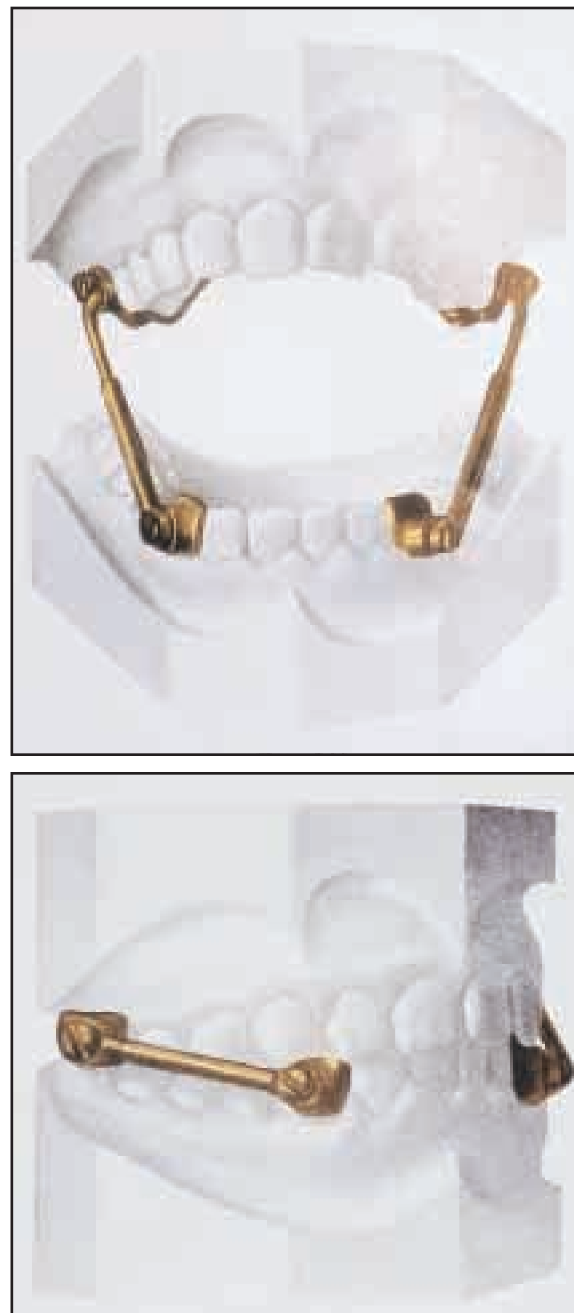

Fig. 1 Original design from Herbst's 1910 text.[1]

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attach the rods and tubes at a subsequent appointment.

The third factor affecting patient comfort is the limitation of range of motion in mandibular lateral excursions that occurs with axle-post-eye designs. Ideally, all forces on the rod/tube assemblies should be parallel to the rod/tube long axes because, metallurgically, rods and tubes are most susceptible to stress failure from perpendicular forces. These can occur when a rod or tube attachment binds before completion of a lateral excursion. There are three possible patient responses when such binding occurs. The patient may develop a subconscious memory of the limitation and henceforth avoid the excursion to maintain appliance integrity. The patient may continue to test the limitation, which could result in metal fatigue and potential bending or breakage. A third possibility is that the patient may become frustrated and aggressively stress the appliance, forcing immediate failure of either the rod/tube assembly or the soldered attachments.

Several appliances, such as the Herbst IV* and Flip-Lock Herbst,** have incorporated ball-and-socket designs to improve range of motion. This and the other problems listed above have now been addressed by a new Herbst appliance, which is introduced here.

Design Improvements

At least three improvements are provided by the Hanks' Telescoping Herbst Appliance (HTH)*** (Fig. 2):

1. Telescoping function
2. One-piece construction
3. Ball-and-socket joints

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***Herbsthelp.com, Inc., 2871 N. Tenaya Way, Las Vegas, NV 89128; distributed by American Orthodontics, 1714 Cambridge Ave., Sheboygan, WI 53082.

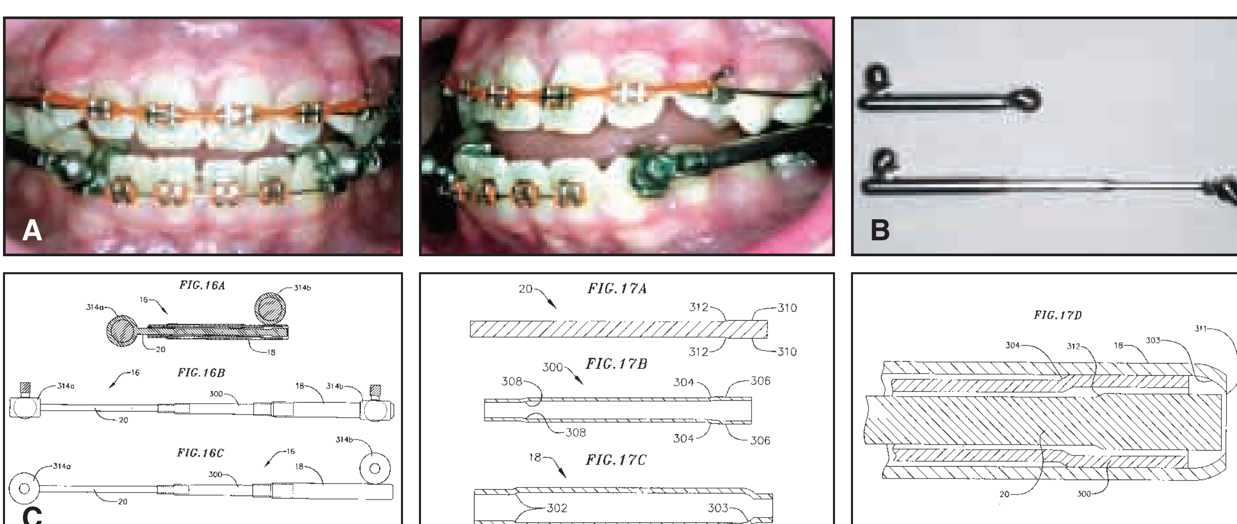

Fig. 2 A. Hanks' Telescoping Herbst Appliance. B. Telescope in closed and open positions, showing one-piece construction. C. Diagrams from patent.

The one-piece telescoping assembly consists of two tubes and a rod. The outer tube has inner stops that capture the middle tube, so that the middle tube can only protrude from the mesial end of the outer tube to a set limit. Similarly, the rod can extend mesially only to the extent that its distal expansion stop engages the compression stop on the mesial end of the middle tube. Obviously, the rod cannot move backward, to extend beyond the distal end of the outer tube, because the ball joint on the mesial end of the rod stops distal travel. The distal end of the outer tube is open for dissipation of the hydraulic pressures generated during appliance function, but is closed enough that the middle tube cannot

Fig. 3 Patient cannot open wide enough to fully extend telescope.

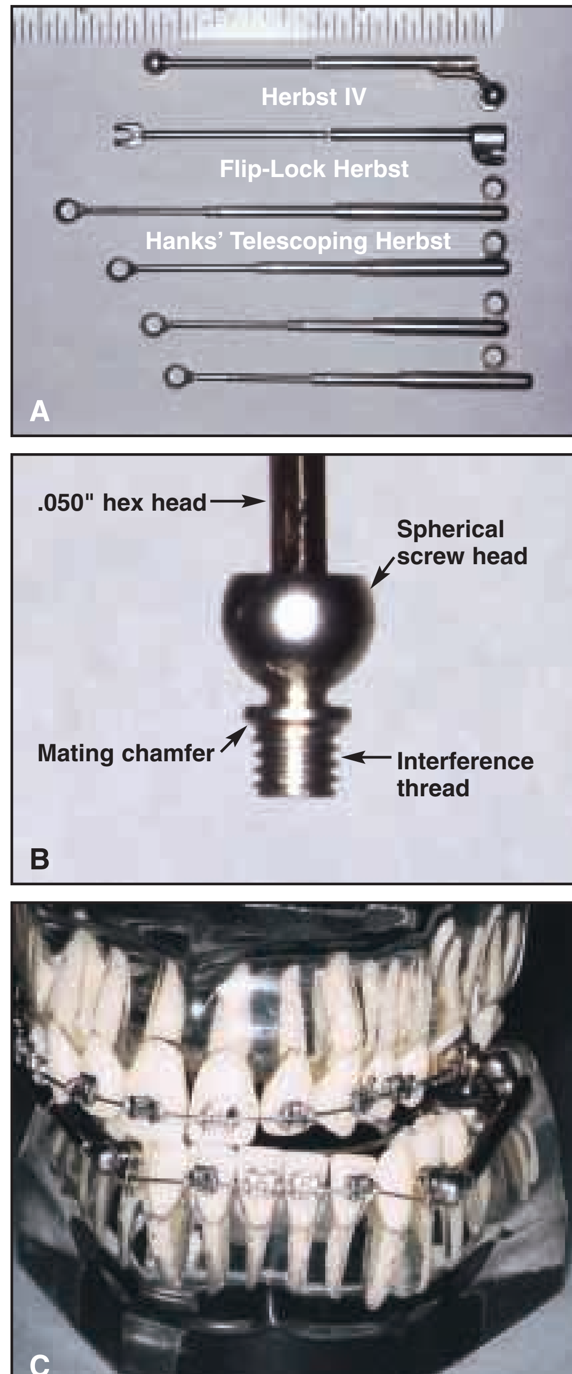

Fig. 4 A. Comparison of three types of ball-and-socket Herbst designs: Herbst IV, Flip-Lock, and HTH (four sizes). B. HTH ball-and-socket joint. C. Range of motion in lateral excursion with HTH.

extend beyond the distal end of the outer tube.

Contact with the oblique ridge is thus controlled by the distal location of the outer tube. Since the telescope extends farther than the patient can open, even when yawning widely (Fig. 3), the molar attachment can be placed more mesially, away from the forward-postured superior oblique ridge of the coronoid process. This completely eliminates the ulceration problem. Furthermore, since the telescoping assembly is a sealed unit and cannot come apart, it results in a Herbst appliance that is truly noncompliant.

Compared to other designs, the outstanding features of the HTH ball-and-socket joint are its miniaturization and its unrestricted latitude of at least 35° of rotation in every plane, which exceeds the human range of lateral motion (Fig. 4). The ball portion is actually a special screw with a spherical head that is captured within the socket. The threaded portion of the screw has an "interference" feature that makes it lock with the accompanying nut when the two are joined. This significantly reduces or even eliminates the need to use Ceka Bond,† which was formerly required to secure screw-type Herbst appliances.

Relative to shear forces, the weakest part of a screw is the last cut of the thread. If that cut is near the top interface between the screw and the nut, the screw is highly susceptible to failure from shear forces. On the other hand, if that last thread can be buried within the depth of the nut by the addition of harmonized mating chamfers, as with the HTH ball joint, then the strength of the screw is significantly enhanced.

One-piece construction eliminates the traditional need to adjust rod and tube length by trimming. The clinician or laboratory technician can choose the appropriate size of HTH from one of four basic lengths: 20mm, 24mm, 27mm, and 31mm. The length can then be adjusted more precisely by using a shim at the time of initial activation. Conventional Herbst shims are short tubes that are inserted by disengaging the rod from the tube and then sliding the shim over the end of the rod and securing it at the lower axle end. The split crimpable shims used with the HTH do not require rod/tube disassembly (Fig. 5). The split opening is slightly smaller than the diameter of the rod, so that the shim snaps onto the rod from the side. The shim is then compressed to fit snugly over the rod, making reactivation simple and quick.

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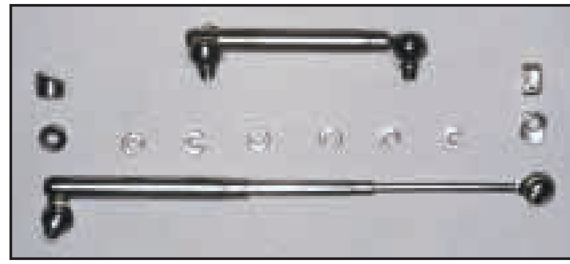

Fig. 5 HTH components, showing split crimpable shims used for reactivation.

Conclusion

The HTH appliance solves three problems common to traditional Herbst designs: coronoid process ulceration, disengagement of rods and tubes, and restricted visibility and access during delivery, activation, and removal. Additionally, the HTH design completely removes the issue of patient compliance.

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