

CLINICIANS' CORNER

Clinical management of the acrylic splint Herbst appliance

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This article describes one variation in Herbst appliance design—the acrylic splint Herbst. Topics discussed include early fixed appliance treatment before Herbst therapy, impression taking, bite registration, and evaluation of appliance fabrication. The specifics of appliance delivery, including bonding of the maxillary appliance when indicated, are also discussed as are the techniques of appliance advancement and removal. (AM J ORTHOD DENTOFAC ORTHOP 1988;94:142-9.)

The Herbst appliance was introduced by E. Herbst in the early 1900s. After achieving some initial popularity,¹ this appliance remained infrequently used until it was reintroduced into the orthodontic literature in 1979 by Hans Pancherz.²⁻⁸

The Herbst bite-jumping mechanism is used in the correction of Class II malocclusion (Fig. 1). It extends from the region of the upper first molar to the region of the lower premolar teeth and works by prompting the lower jaw forward. The parts of the Herbst bite-jumping mechanism include the maxillary tube (sleeve), the mandibular plunger, and the axles (pivots) around which the tube and plunger rotate (Fig. 1). Screws attach the tube and plunger to the axles.

During the last few years, the original banded design of Pancherz has been modified in various ways. For example, stainless steel crowns have been substituted for orthodontic bands on the abutment teeth.⁹⁻¹⁰ More recently acrylic splints have been used to carry the bite-jumping mechanisms on both the maxillary and mandibular dental arches¹¹⁻¹⁴ (Figs. 2 and 3).

In an effort to minimize the risk of decalcification and decay that was present with bonded splints, this description will emphasize the use of removable splints. In some instances the maxillary acrylic splint can be bonded in place, particularly if a rapid palatal expansion appliance or buccal tubes are used in conjunction with it. The mandibular splint is removable, almost never bonded. If poor compliance or neuromuscular problems such as cerebral palsy or polio are present, a cemented

design with reinforced bands or stainless steel crowns may be indicated.

The clinical management of the acrylic splint Herbst appliance involves a series of steps that may include early fixed appliance treatment, impressions, construction, bite registration, delivery, patient instructions, advancement, and post-Herbst fixed appliance treatment.

Early fixed appliance treatment

Before placement of a Herbst appliance, many patients require repositioning of malposed teeth. The purpose of this first phase of orthodontic treatment is to decompensate the dental arches. This process is similar to the presurgical phase of orthodontic treatment that facilitates proper repositioning of the skeletal elements during surgery. During this first phase of treatment, retruded or overly erupted incisors may be flared or intruded. Also it is important to anticipate and establish a proper transverse relationship posteriorly before the lower jaw is brought into a forward position.

Pre-Herbst dental repositioning can be accomplished with an initial phase of fixed appliance therapy. For example, a utility arch¹⁵⁻¹⁶ may connect the four incisors to the first permanent molar to correct vertical and horizontal discrepancies in the position of the anterior teeth. If transverse expansion is required, it may be accomplished before Herbst treatment through the use of an orthopedic maxillary expansion appliance.

Occasionally it is possible to combine the initial fixed appliance phase with Herbst treatment, particularly if the dental repositioning is limited to the maxillary arch. A rapid palatal expansion screw (Fig. 4) or buccal tubes (Fig. 5) can be incorporated into the maxillary splint. This allows simultaneous flaring of maxillary incisors, orthopedic midfacial expansion, and for-

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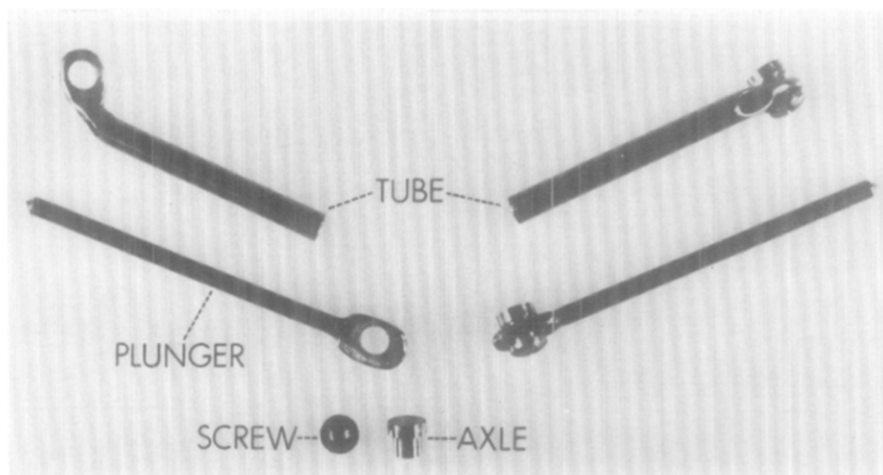


Fig. 1. The components of the Herbst bite-jumping mechanism.

ward positioning of the mandible with the Herbst mechanism. If this is done, the maxillary splint may be bonded in place until the expansion or incisor repositioning has been completed. Then the upper splint may be left bonded to the maxillary teeth or may be debonded and worn as a removable splint.

Impression taking

Except for bonded brackets that may be left on the upper four anterior teeth, all initial phase appliances are removed. If pre-Herbst dental repositioning has taken place, a transitional retainer such as an invisible retainer¹⁷⁻¹⁸ is used to stabilize the dentition during appliance fabrication. If a transitional retainer is not worn during the interval needed for appliance fabrication, unwanted tooth movement may occur that may prevent proper seating of the appliance.

After the teeth are cleaned, accurate, bubble-free maxillary and mandibular alginate impressions are taken of the dentition and the associated soft tissue.

Bite registration

To ensure an accurate wax bite registration, the patient is instructed to practice repositioning the mandible forward before the wax is placed in the mouth. This allows the clinician to inspect the molar relationships and to use the incisor overjet as an index of the amount of forward repositioning necessary. Care must be taken to align the skeletal midlines, using the dental midlines as reference points. The mandible is advanced 2 to 4 mm anteriorly and 3 mm vertically in the incisor region to allow space for fabrication of the plastic splints. In many cases subsequent stepwise anterior activations will be needed to complete mandibular repositioning treatment.

Once the patient has practiced aligning the skeletal midlines and posturing the mandible forward, the wax bite registration can be taken. Wax coverage of the anterior teeth is avoided so that the overjet and midline relationship can be observed (Fig. 6).

After the wax bite has been taken, it is placed on the original study models. This will allow the clinician to determine visually the amount of bite advancement by comparing the relationship of the backs of the dental casts that previously have been trimmed flush when the bite of the patient is recorded in habitual occlusion. Of course, this procedure is not possible if initial fixed appliance therapy has been performed. In this instance an additional wax bite taken in habitual occlusion is helpful to determine the amount of bite advancement by providing an initial reference position for the work models.

If bonding of the maxillary splint is to take place at the next visit, an antisialogogue can be given to the patient at this time with instructions to take it 1 hour before the appliance placement appointment.

Appliance construction

The impressions are poured and any bubbles or imperfections are removed. Then the models are inserted into the wax bite registration and the backs of the models are trimmed flush. Once this is done, the models and the wax bite are sent to an orthodontic laboratory with the prescription for the fabrication of the maxillary and mandibular acrylic splints. It is suggested that all canines be covered on all removable maxillary appliances. Any added auxiliaries such as an expansion screw, buccal tubes, headgear tubes, or a tongue crib are requested as needed. Details of appliance construction are described elsewhere by McNamara.¹⁹

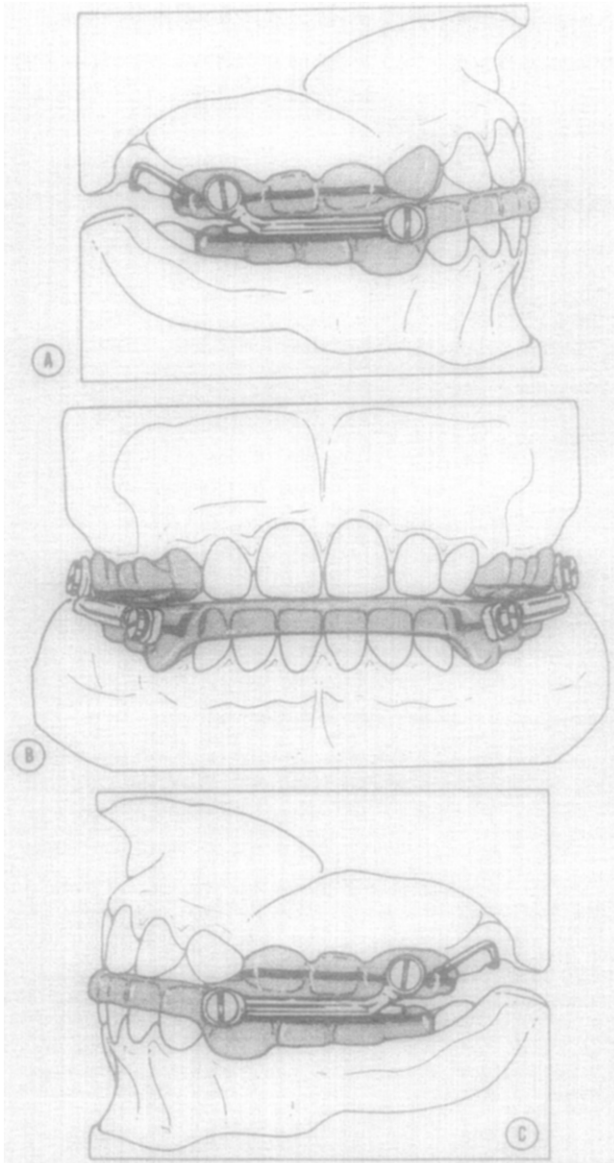


Fig. 2. The acrylic splint Herbst appliance. **A**, Right sagittal view. This drawing demonstrates full coverage of the maxillary canine, the design recommended when the maxillary splint is removable. **B**, Frontal view. **C**, Left sagittal view. This drawing demonstrates the design of the maxillary splint when the splint is bonded.

Appliance check

After the assembled appliance has been returned from the laboratory, the appliance is replaced on the construction models and tested for protrusive opening and lateral movements. If the appliance binds in any of these movements, the upper and lower parts of the bite-jumping mechanism are removed, keeping left and right sides separate, and each of the four connection holes are enlarged to permit more freedom of move-

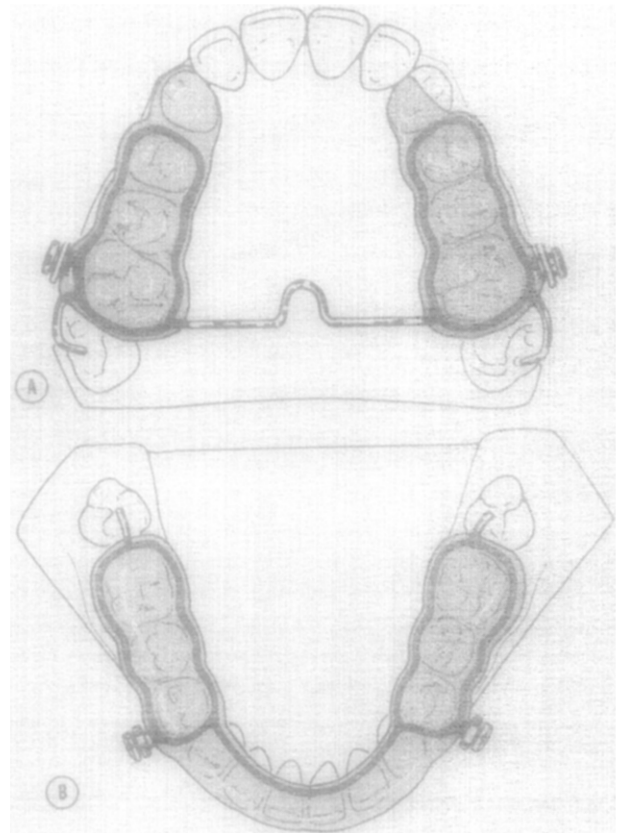


Fig. 3. The acrylic splint Herbst appliance. **A**, Maxillary view. The right side of the appliance demonstrates full canine coverage, which is used when the splint is removable. On the left side, the acrylic extends only to the lingual aspect of the upper canines. This design is used when the upper splint is bonded. **B**, Mandibular view. Mandibular splint with full occlusal and incisal coverage is shown. If the lower splint is to be bonded (not recommended), incisal coverage is not used.

ment.¹⁴ The appliance is then reassembled and rechecked on the construction models. Even though this procedure is usually performed at the laboratory, it is important to recheck the freedom of movement since binding may dislodge the splints during function.

Appliance placement

The upper and lower halves of the appliance are tried in the mouth separately to check the fit of each acrylic splint. Then the splints are inserted with the plungers and sleeves engaged in order to check the length of the lower plungers as they exit the distal end of the upper sleeves. Whenever second molars are present, the distal end of the lower plunger can extend as far back as the distal end of the maxillary axle (Fig. 1). However, if second molars are not present, the *distal end of the plunger must be cut flush with the posterior opening of the upper tube*. This is done to

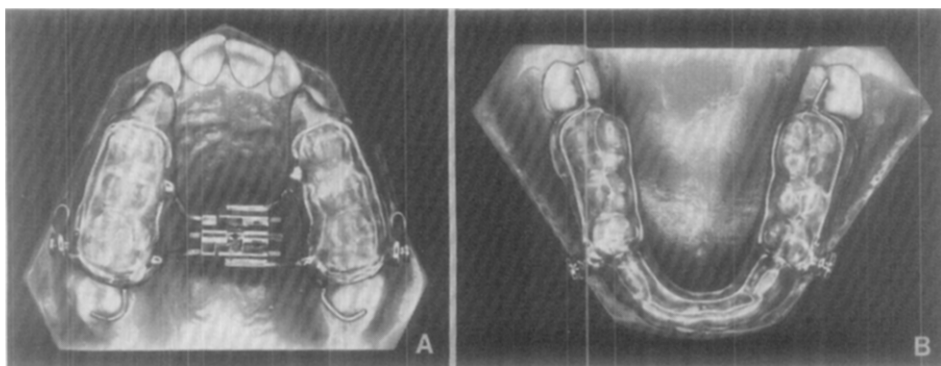


Fig. 4. Acrylic splint Herbst appliance incorporating rapid palatal expansion screw.

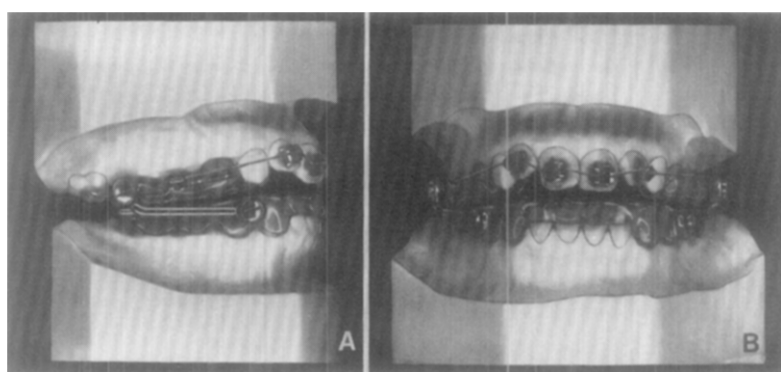


Fig. 5. Acrylic splint Herbst appliance with buccal tubes. This type of appliance can be used in association with an arch wire to the anterior teeth.

prevent the plungers from impinging on and ulcerating the mucosa overlying the mandibular ramus, which is repositioned forward by the appliance. If either the left or the right plunger extends too far out of the distal end of its sleeve and impinges on the mucosa, it is marked, removed, and shortened to the desired length. Once rounded, it is replaced and rechecked. If this step is omitted and the plunger impinges on the mucosa, ulceration and serious infection can result.

Bonding procedures

Whenever possible, bonding is avoided. However, in some cases bonding is carried out until the patient accommodates to the appliance or until simultaneous rapid palatal expansion or incisor repositioning is completed. Then the bonded splint may be debonded and worn as a removable appliance. If particular care is taken, long-term bonding of the maxillary splint is possible. However, strict compliance from the patient is required to avoid decalcification and decay of the teeth underlying the splints.¹³ Bonding of the mandibular splint is routinely avoided.

With a rotating rubber cup and nonfluoridated pumice, the appropriate teeth are cleaned. The maxillary dental arch is then isolated using cheek retractors that

have extensions into the buccal vestibule but do not cross over the occlusal surface of the dental arches. Absorbent dri-angles are placed in the buccal vestibule bilaterally to block the secretion of the parotid gland. The teeth then are carefully etched with a dilute (37%) phosphoric acid solution. For the bonding of the Herbst appliance, only the buccal and lingual surfaces of the teeth, as well as the distal surface of the last molar, are etched. *The occlusal surfaces are not etched*, thus facilitating the removal of the appliance. In cases of limited retention, the occlusal surface of deciduous teeth may be etched.

The etching continues for 60 to 90 seconds, with the longer time being used in geographic regions in which the water is fluoridated. Deciduous teeth may require up to 2 minutes for the proper amount of etching to occur. The etching solution is dabbed in place continuously rather than rubbed on the tooth in a circular motion.

After the etching material has been applied, the area is rinsed thoroughly with a continuous stream of water. Each tooth is rinsed for approximately 10 to 20 seconds. Then the teeth are dried with a clean, dry air source and inspected for a uniform chalky appearance.

A bonding agent with low viscosity and long work-

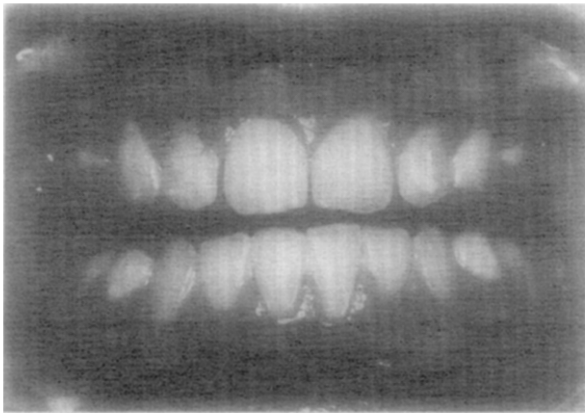


Fig. 6. Intraoral view of the wax construction bite. Three millimeters of space should be present interincisally. The midlines should be aligned.



Fig. 7. If sharp edges remain on the screws after fabrication, the edges should be rounded and polished.

ing time that is well suited to the bonding of large acrylic appliances is recommended. The bonding system usually includes a two-part sealant, a plastic primer, and a two-part bonding agent. A mixed system is recommended because of the ultimate thickness of the bonding agent in some areas under the splint. Use of a no-mix system would not allow for the proper set of the bonding agent in all areas.

A four-hand approach is recommended during the bonding procedure. As the sealant is being applied by the clinician, an auxiliary paints the inside of the acrylic splint with the plastic primer and then begins to mix the two-part bonding agent. The auxiliary then fully fills the maxillary splint and passes it to the clinician, who places the loaded acrylic splint on the maxillary dental arch and holds it in place. Firm pressure is applied initially to force the excessive bonding material out of the splint. In most cases pressure then can be removed from the splint and the clinician can clean up

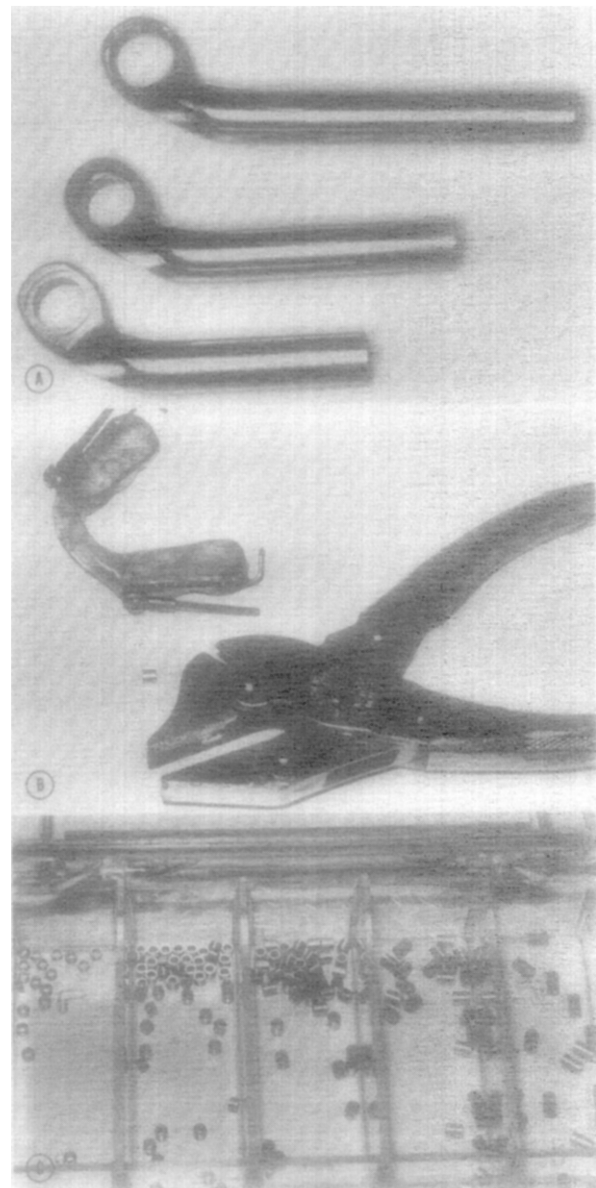


Fig. 8. A, Maxillary tubes of varying sizes can be used to sequentially activate the appliance. B, Sleeves used to activate the Herbst appliance are crimped on the mandibular plunger with a heavy wire cutter. C, Shims are available in sizes 1 to 5 mm.

the excess with cotton applicators and a scaler. When the material is first setting, it is not viscous and cotton applicators are useful to remove the excess material from the appliance. The finger of the clinician also can be used to clean around the outside of the splint. As the gel phase of the setting bonding agent is approached, the material becomes much more viscous and then is easily removed from the appliance with a hooked scaler. Particular attention must be paid to the part of the appliance that is distal to the last molar. Once the bonding

agent has set, it is extremely difficult to remove. A burr and handpiece may be necessary to remove the excess.

After the excess material has been cleared away, the splint then should be checked for any voids, particularly along the gingival margin. A second application of bonding agent then can be used to fill any voids that are evident. Failure to fill a void can result in decalcification of the associated teeth during treatment.

Assembly of the appliance

If the entire appliance is removable, the parts of the appliance can be joined together before placement by the patient in his or her mouth.

If the maxillary splint is bonded in position, the upper portions of the Herbst mechanism are left attached to the splint. The screws should have been tightened firmly to prevent loosening during appliance wear. The removable mandibular splint is placed in the mouth by the patient. In some instances it is possible to assemble the Herbst mechanism after the appliance is in place; other times it is necessary to place the plungers of the lower splint into the tubes of the upper splint before seating the mandibular appliance. The patient is instructed to close and the bite is then checked. If "fulcruming" of the splints is detected, the occlusal contact is adjusted until even contact is established.

With the telescoping mechanism in place, the patient is asked to gently move the mandible through all excursions while the clinician explains that the appliance will limit the range of movement. The clinician then should show the patient how to avoid forceful lateral and retrusive movements of the lower jaw.

Next the patient is given a mirror and asked to open the mouth as wide as possible. During wide opening if the plunger and sleeve assemblies become disengaged, the patient is shown how to reinsert the lower plungers into the upper sleeves by holding the mouth wide open, aligning the lower plungers with the upper tubes, and then closing the mouth so that the plunger reinserts into the sleeve. Also the patient is instructed to keep the lower jaw postured forward, just avoiding contact of the tube-plunger mechanism at all times.

Home care instructions

Once appliance placement is complete, the patient and the patient's parents are given the following information.

The appliance should be worn on a full-time basis, including at mealtime. The splints are removed only during brushing and flossing and while the appliance is being cleaned. The lower jaw should be held forward during the time the appliance is not in place.

It will take several days to get used to the Herbst appliance. During this period the jaw muscles may become tired and sore. However, with time the patient will become increasingly comfortable. The amount of patient discomfort has been minimized greatly by limiting the initial advancement to 2 to 3 mm.

Some difficulty in chewing will likely be experienced, particularly during the first few weeks. A soft diet is suggested until the patient accommodates to the appliance and is able to chew.

Discomfort may also be experienced if the appliance connections rub against the cheeks, causing irritation. This condition is temporary and can be ameliorated by placing soft wax over the connections until the irritation passes. If any sharp edges are present on the attachment screws, the edges should be reduced and polished (Fig. 7).

The patient's responsibility in caring for the Herbst appliance and for oral hygiene includes attention to diet, teeth cleaning, and fluoride rinsing. The patient is cautioned to avoid hard and sticky foods that may dislodge the appliance. It is especially important for the patient to restrict intake of foods containing sugar to avoid damage to the teeth from decalcification and dental caries. The patient also is instructed to clean the teeth and the appliance by brushing carefully several times each day and to use a fluoride rinse (an oral irrigation device can be used in addition to the toothbrush).

The initial difficulty in wearing the Herbst appliance usually passes quickly. However, if the patient experiences pain that increases over time and is accompanied by hot or swollen cheeks and a bad taste or odor in the mouth, an ulcerated area of mucosa may be infected and the patient must be seen immediately.

Heavy contact sports should be avoided during Herbst appliance therapy.

Subsequent advancement

Usually the initial amount of mandibular advancement built into the Herbst appliance at the time of construction is not sufficient to establish acceptable skeletal and dental relationships. Thus the appliance can be reactivated every 2 or 3 months after initial placement. This is accomplished either by substituting progressively longer sleeves on the upper splint (Fig. 8, A), or by adding sleeves of tubing over the mandibular plunger (Fig. 8, B). These sleeves then are pinched or spot welded in place. Tubing can be purchased in kits of 1 through 5 mm increments to facilitate accurate stepwise advancement (Fig. 8, C). Subsequent advancements can be performed at regular intervals until the desired amount of mandibular repositioning is obtained.

Discontinuance of Herbst appliance therapy

The Herbst appliance is left in place 5 to 6 months after the last activation of the appliance. The recommendation concerning the time interval is made solely on the basis of clinical observation, not on comparative clinical trials. The total treatment time with the Herbst appliance in place is usually 9 to 12 months. This average treatment interval is somewhat longer than that advocated by those clinicians who advocate an initial incisal end-to-end bite advancement.

If the maxillary appliance has been bonded, the splint is removed with a pair of bond-removing pliers with a nylon tip on one side of the pliers and a sharp edge on the other. Usually after the acrylic seal is broken, the appliance can be removed easily.

If undercuts prevent easy appliance removal, the base wire can be cut with a high-speed handpiece before appliance removal is attempted. In addition, the occlusal acrylic can be removed to the level of the dentition with a large round burr. The bond-removing pliers then can be placed on the enamel of the tooth, facilitating appliance removal. If any discomfort is felt by the patient during appliance removal, a local anesthetic can be used.

SUMMARY AND CONCLUSIONS

This article has described the clinical management of one variation in Herbst appliance design—the acrylic splint Herbst. The Herbst appliance has been shown to be a device capable of producing rapid skeletodental changes leading to the correction of a Class II malocclusion. Pancherz⁴ has shown that both skeletal and dental adaptations are produced with this type of appliance.

Our clinical experience has led us to the following cautions regarding the use of the acrylic splint Herbst appliance.

1. The appliance should be removable whenever possible. This reduces the risk of decalcification that may occur under the bonded appliance.

2. The appliance should be activated in a step-by-step fashion with the mandible brought forward no more than 2 to 3 mm at any one time. This appliance is easily reactivated through the use of sleeves on the mandibular portion of the appliance.

3. The maxillary portion of the appliance may be bonded when auxiliaries are used. These auxiliaries include the use of rapid palatal expansion and buccal tubes for the attachment of arch wires.

4. As with any orthodontic appliance, excellent oral hygiene must be maintained by the patient.

5. Almost all cases that are treated with an acrylic splint Herbst appliance benefit from a final phase of comprehensive fixed appliance therapy. Also many cases may benefit from a preliminary stage of partial fixed appliance therapy to decompensate the dental arches.

6. This type of an appliance may be very effective in the treatment of certain types of Class II malocclusion. It may be especially effective in Class II cases in which the lower anterior facial height is either normal or excessive. However, the use of the acrylic splint Herbst appliance may be contraindicated in those patients who have a shorter than normal vertical facial dimension because vertical facial development often is prevented by the acrylic splints.

Proper techniques of clinical management are essential if this type of Herbst appliance is to be used on a routine basis.

The illustrations for this article were produced by Mr. William L. Brudon.

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