CLINICIANS' CORNER

Fabrication of the acrylic splint Herbst appliance

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This article describes the fabrication of one type of Herbst appliance, a removable or fixed functional appliance that causes the posturing of the mandible in a forward position. The type of Herbst appliance described in this article consists of a wire framework to which are attached the various parts of the Herbst bite-jumping mechanism. The acrylic part of the appliance is fabricated from splint Biocryl or from methylmethacrylate. The steps of the fabrication of the appliance are described in detail. (AM J ORTHOD DENTOFAC ORTHOP 1988;94:10-8.)

The purpose of this article is to describe in detail one variation in Herbst appliance design.[1-3] This variation incorporates the use of removable or bonded acrylic splints[4-6] that anchor the Herbst bite-jumping mechanism (Fig. 1) to the wire framework. The clinical management of the appliance is described in detail elsewhere in the literature.[7,8]

FRAMEWORK FABRICATION

The acrylic splint Herbst appliance is fabricated on upper and lower work models, usually poured in stone from maxillary and mandibular alginate impressions. A construction bite also is provided, which postures the mandible approximately 2 to 3 mm in an anterior direction and opens the bite approximately 3 mm incisally. The work models are trimmed with the construction bite in place so that the posterior surfaces of the model are trimmed flush with one another.

At the laboratory the models are checked for proper trimming and any excess plaster is removed. The gingival surfaces are cleaned with a laboratory knife (Fig. 2, *A*) and any voids on the work models are filled with plaster (Fig. 2, *B*).

WIRE FRAMEWORK

Maxillary wire framework

A length of 0.045-inch Elgiloy wire is bent to fit the maxillary work model (Fig. 3, *A*). The palatal arch is formed by placing an omega loop in the center of the dental arch between the second premolar and the first permanent molar (Fig. 3, *B*). A lateral bend is then made at the gingival margin of the upper first premolar, bringing it through the interproximal space. The wire is contoured posteriorly along the buccal surface of the canines and first premolars. The wire then is curved through the interproximal space distal to the first molar and brought anteriorly along the lingual surface of that tooth. The wire is kept approximately 1 mm away from the tooth surfaces just above the gingival margin. A similar configuration is used on the opposite side (Fig. 3, *C*).

Mandibular wire framework

The framework for the lower splint is formed on the mandibular work model by means of 0.040-inch Elgiloy wire that is contoured along the lingual surface of the six lower anterior teeth (Fig. 4, *A* and *B*). The wire then passes through the interproximal surface distal to the canine (Fig. 4, *B* and *C*) and passes distally along the buccal surfaces of the teeth. It then curves around the distal surface of the first molar and follows the lingual contour of the posterior dental segment (Fig. 4, *D*).

Articulation of the work models

After the entire wire framework has been completed, it is removed from the work models. Grooves are cut into the base of the work models and the models are placed in the construction bite (Fig. 5, *A*). A small portion of stone is then placed in the lower half of the fixator model holder and the models that are still related by the construction bite are placed on the stone. A small portion of plaster is added to the upper model and the upper member of the fixator is lowered into place. The upper screw of the fixator model holder is tightened and the models are secured further with more stone (Fig. 5, *A*). Before the fixator is opened, the lower screw is adjusted to maintain the vertical height once the wax bite is removed. The fixator is then taken apart.

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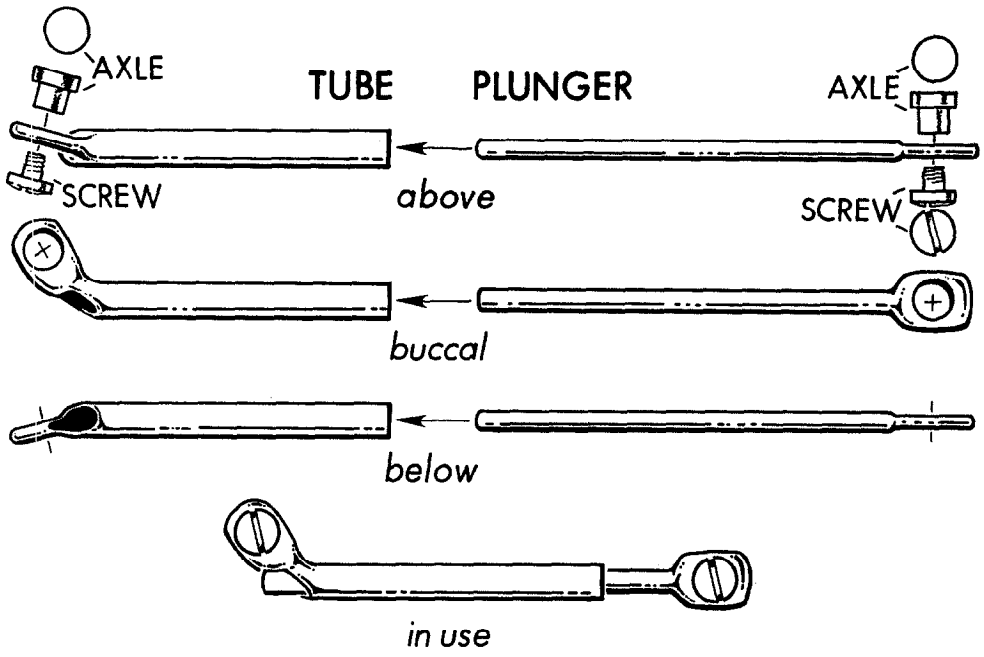

Fig. 1. Components of Herbst bite-jumping mechanism.

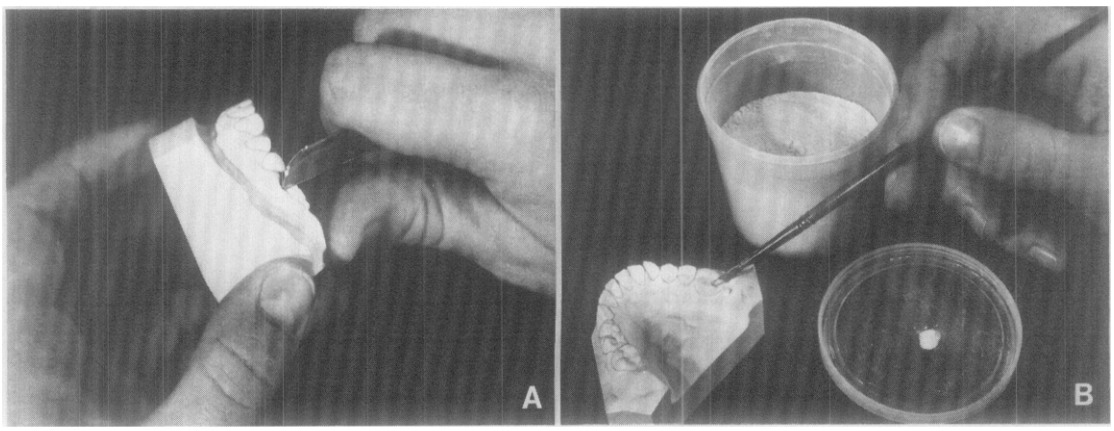

Fig. 2. A, Trimming of the gingival margin with a laboratory knife. **B,** Filling voids in the work model with moistened plaster and a paintbrush.

Placement of the Herbst axles

Each wire framework is placed on its respective work model and secured in place with dental compound (Fig. 5, *B*). If the screws and axles (pivots) have been predrilled to accept ligature wire, they must be kept separate by quadrant since these components are not interchangeable (Fig. 6, *A*). The pivots are oriented in the correct horizontal, vertical, and angular positions and then are welded in place with two wire leads from a spot welder (Fig. 6, *B* and *C*). A jig, as recommended by Pancherz,[3] can be used to orient the axles, preventing the binding of the parts of the Herbst bite-jumping mechanism during movement. If auxiliary tubes are required for attachment of headgear, lip bumper, or utility arch wire in conjunction with the acrylic splints, they are spot-welded at this time.

The axles and auxiliary attachments are secured further with 22-gauge silver solder (Fig. 7, *A*). The palatal wire can be heat-treated at this point (Fig. 7, *B*). If partially erupted second molars are to be omitted from the acrylic splints, the distal extensions are soldered to the framework to prevent the overeruption of these teeth (Fig. 7, *C* and *D*). The wire frameworks are then carefully cleaned, polished, and rechecked for accuracy of fit on the work models (Fig. 7, *D*).

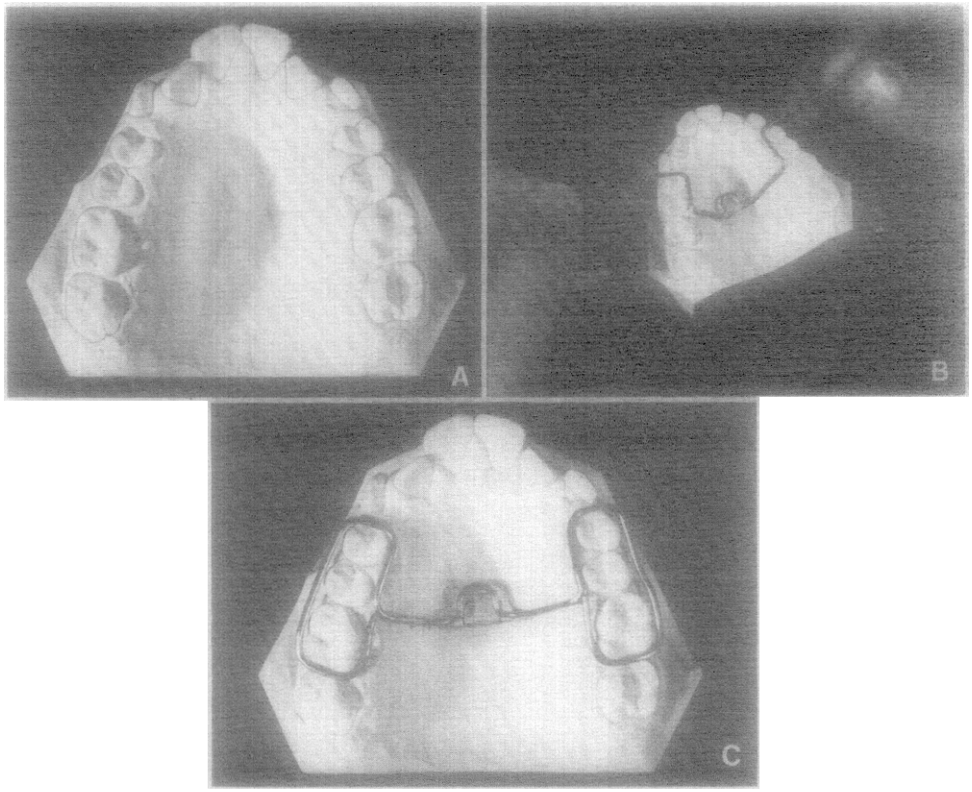

Fig. 3. A, Prepared maxillary work model. **B,** Formation of the palatal wire including the omega loop. **C,** Complete maxillary wire framework.

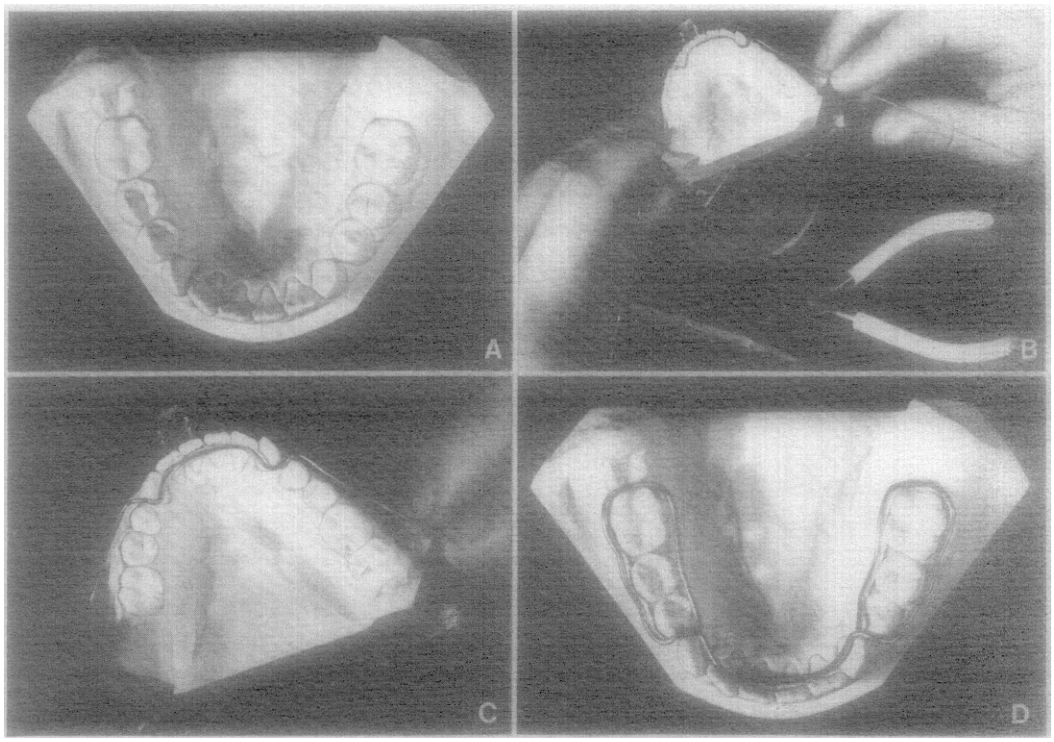

Fig. 4. A, Completed mandibular work model. **B** and **C,** Initial contouring of the mandibular wire framework. **D,** Completed mandibular wire framework.

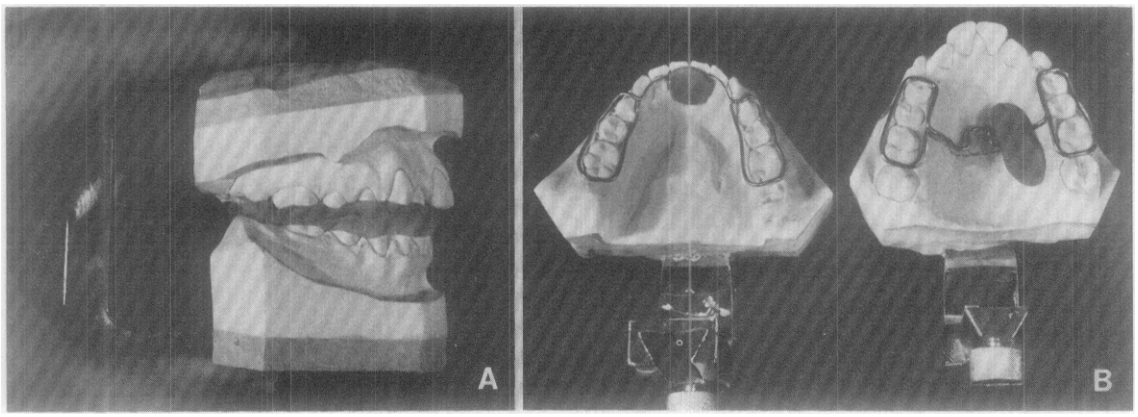

Fig. 5. A, Models mounted in fixator model holder by the use of construction bite. **B,** Wire framework on work models held in place with holding compound.

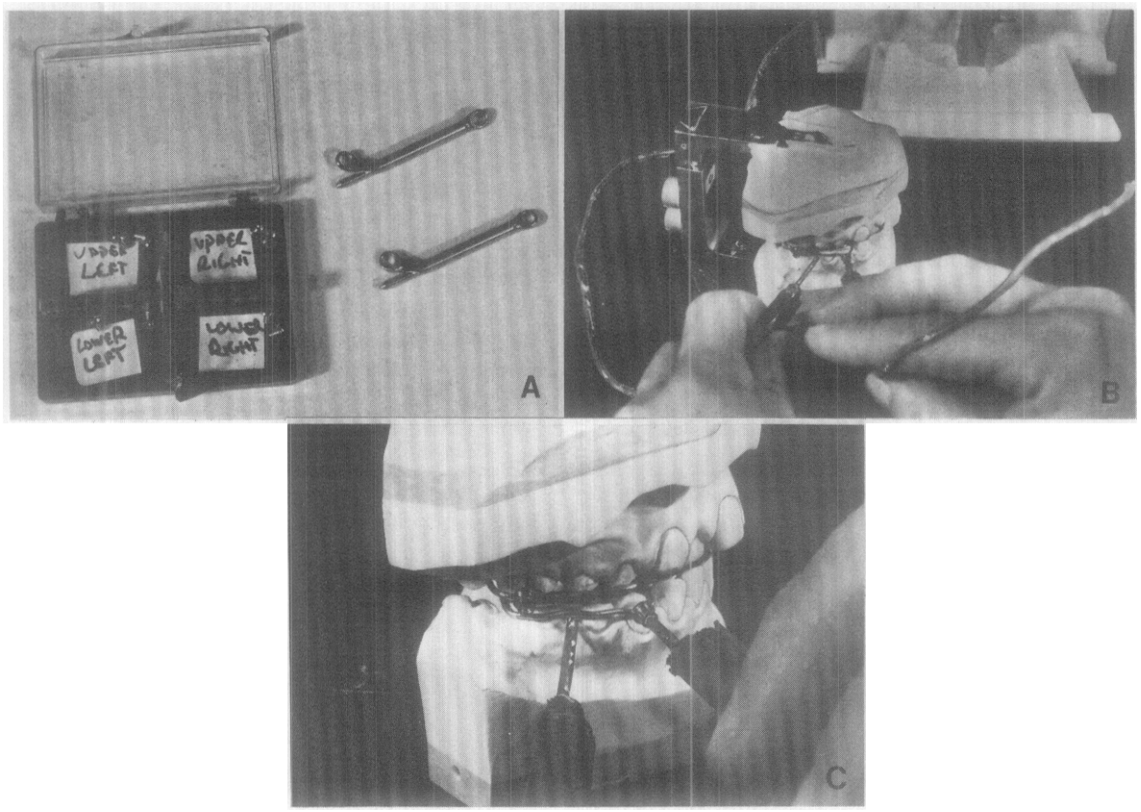

Fig. 6. A, Herbst bite-jumping mechanism. Holes have been placed in each screw and axle combination to allow the ligation of the screw in place. **B** and **C,** Spot welding the axles in place on the metal framework.

PLACEMENT OF THE ACRYLIC

Maxillary acrylic

The maxillary work model is soaked in water for 30 seconds and then coated with an acrylic separating medium (Fig. 8, *A*).

A Biostar* is used to fabricate the acrylic splint. The work model is placed into either the large (125 mm) or small (95 mm) model holder with the gingival margin of the dental cast oriented horizontally (Fig. 8, *B* and *C*).

The maxillary wire framework is secured with wax (Fig. 8, *D*) and metal pellets are placed on those areas in which acrylic contact is to be avoided (Fig. 8, *E*). A small amount of cold-cure acrylic is applied around

*Great Lakes Orthodontic Products, Tanawanda, N.Y.

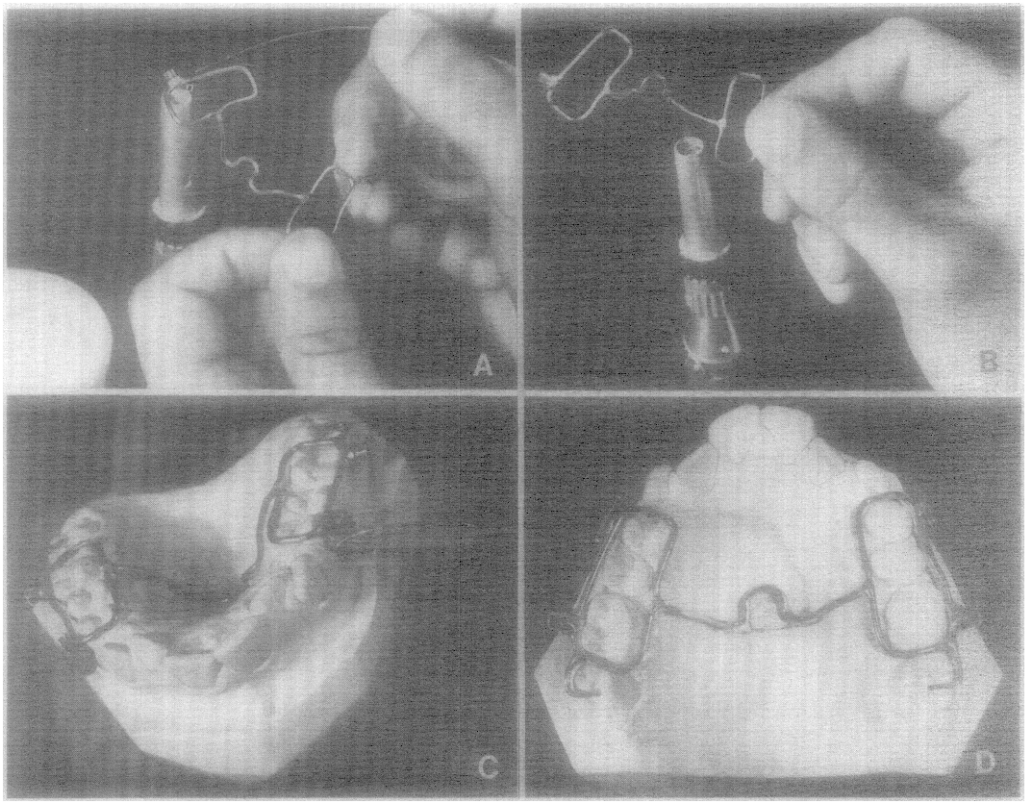

Fig. 7. A, Placement of solder on the maxillary axle. **B,** Heat-treating the palatal wire. **C,** Placement of buccal tubes and wire extensions to the upper second molars. **D,** Completed maxillary wire framework.

the wires to eliminate voids in these areas (Fig. 8, *F*). The models are sprayed with water while still in the model holder.

Depending on the amount of bite opening produced in the construction bite, either 2- or 3-mm thick Biocryl* is used for construction. With the pressure chamber in the open position, a sheet of splint Biocryl is positioned according to the instructions of the manufacturer.

The heating element is moved into position over the pressure chamber and left in place for approximately 60 seconds for 2-mm thick Biocryl or 70 seconds for 3-mm thick Biocryl. Approximately 20 seconds before the end of the heating cycle, a layer of cold-cure acrylic is applied to the wire framework.

After the heating element is removed, the pressure chamber is rotated over the model holder and the handle is engaged. Air pressure is used to push the softened Biocryl onto the work model. After waiting several minutes for the acrylic to set, the pressure is released and the model that is embedded in the Biocryl is removed from the Biostar (Fig. 9, *A*). The splint is released from the plastic sheet by rough outline trimming with a fissure burr (Fig. 9, *B*). Finally, a cone-shaped burr is used to define the gingival margins. With a disk-shaped green stone, a pattern of serrations can be carved into the occlusal surface to make chewing easier. The trimmed maxillary splint is shown in Fig. 9, *C*.

*Great Lakes Orthodontic Products, Tanawanda, N.Y.

Mandibular acrylic

The mandibular splint is fabricated in the same manner as the maxillary splint (Fig. 10, *A* through *D*).

HERBST BITE-JUMPING MECHANISM

The maxillary and mandibular splints are replaced on the work models and then placed in the fixator model holder. The occlusion is checked (Fig. 11, *A* and *B*) with articulating paper and even contact is established (Fig. 11, *B*). If necessary, acrylic can be added to build up areas and establish vertical contact, although the addition of excessive interocclusal acrylic is not recommended.

Fitting of the Herbst appliance

The upper tube and lower plunger are placed on the appropriate pivots. The maxillary tube length (which determines the amount of forward bite advancement)

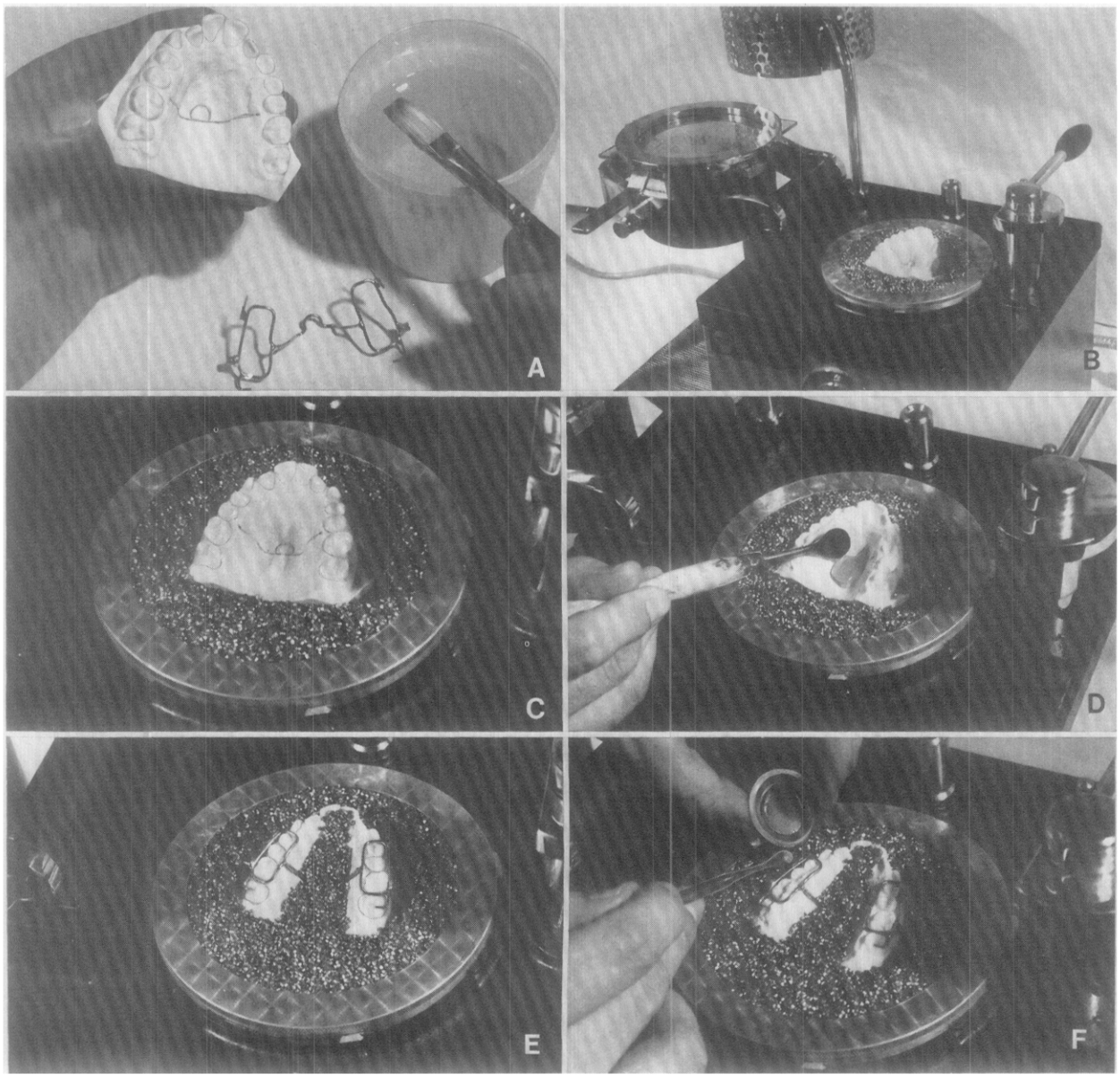

Fig. 8. A, Placement of separating media on the work model. **B** and **C,** Placement of the model in the model holder of the Biostar. **D,** Application of wax in the palatal area to secure the wire framework. **E,** Placement of lead pellets in the palatal region. **F,** Application of a small amount of cold-cure acrylic around the wires.

is sized so that it just contacts the base of the plunger when the upper and lower casts are articulated according to the construction bite.

The plunger is trimmed either flush with the distal end of the opening of the maxillary tube in cases in which there is no second molar present or at the level of the maxillary axle (Fig. 12, *A* and *B*) in cases in which the second molar is present. After a final check of all components, the Herbst appliance is ready for patient delivery (Fig. 13).

FINAL CONSIDERATIONS

This article has described in detail the fabrication of the acrylic splint Herbst appliance. Only minimal mention has been made of the clinical management of this appliance, which is described in detail elsewhere in the literature.[8] A few key points are noted.

1. The amount of bite advancement should not be excessive. Every effort should be made to restrict the amount of bite advancement from 2 to 4 mm at any one time. This amount of bite advancement usually is

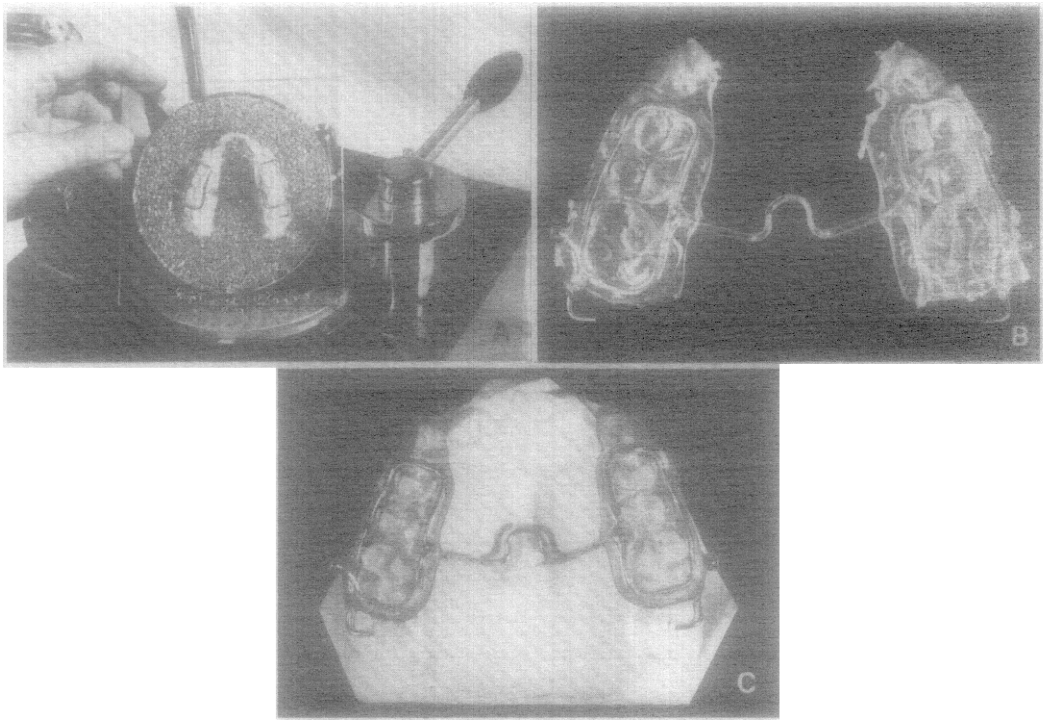

Fig. 9. A, Removal of the maxillary work model embedded in the splint Biocryl. **B,** Rough trimming of the maxillary appliance leaving full palatal coverage. This type of design is used in removable maxillary splints. **C,** The maxillary splint on the work model.

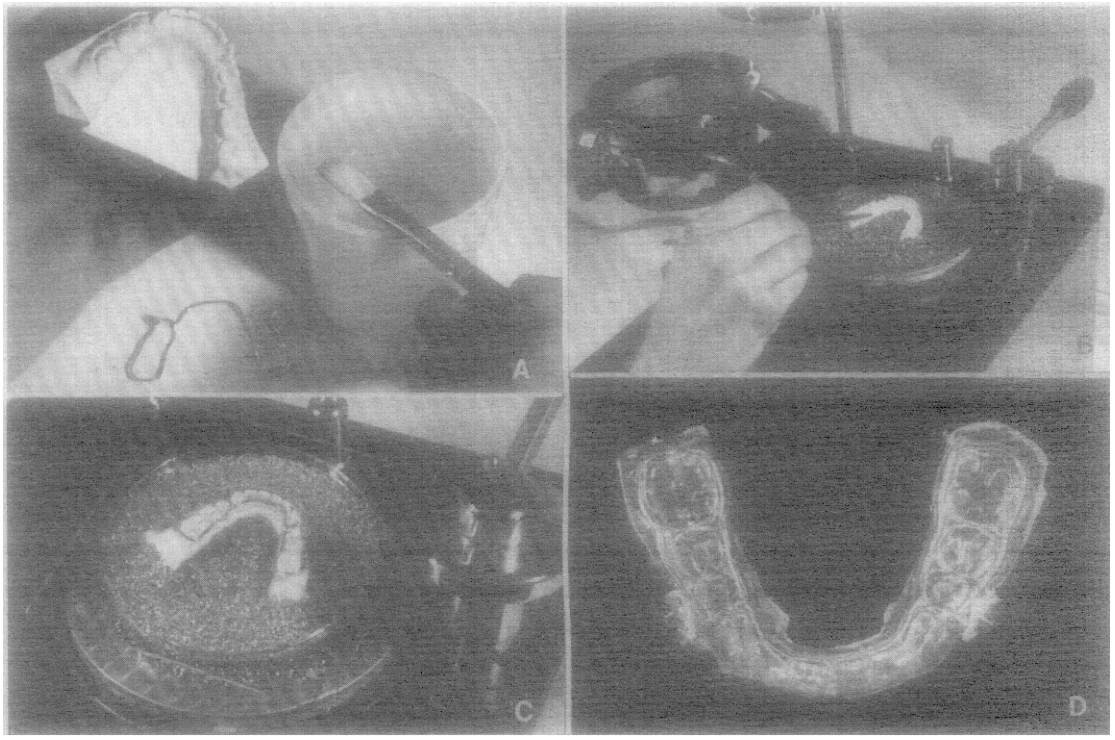

Fig. 10. Fabrication of the mandibular splint. **A,** Placement of separating media on the mandibular work model. **B,** Placement of the work model into the model-holding chamber of the Biostar. **C,** The work model embedded in the splint Biocryl. **D,** Rough-trimmed mandibular splint.

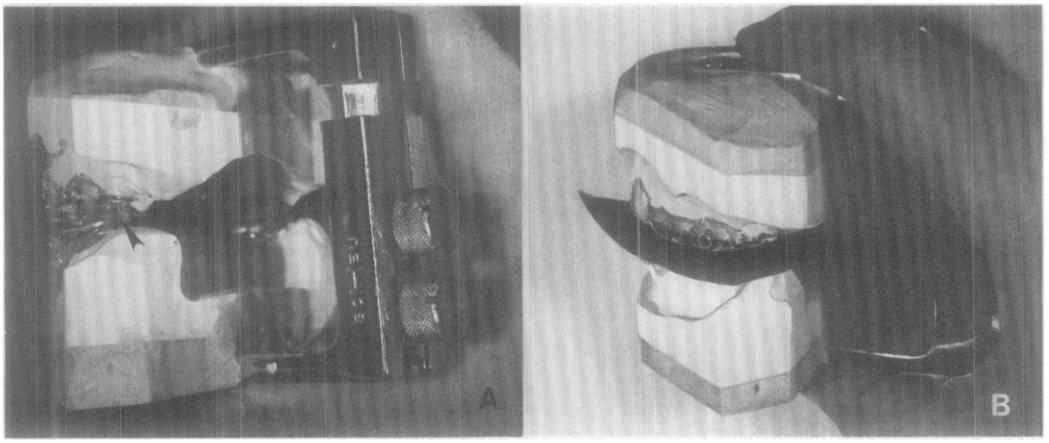

Fig. 11. A, Checking the occlusion after splint fabrication. Note the high area of contact as indicated by the arrow. This area of high contact is removed with a burr and a handpiece. **B,** Use of articulating paper to check the occlusion.

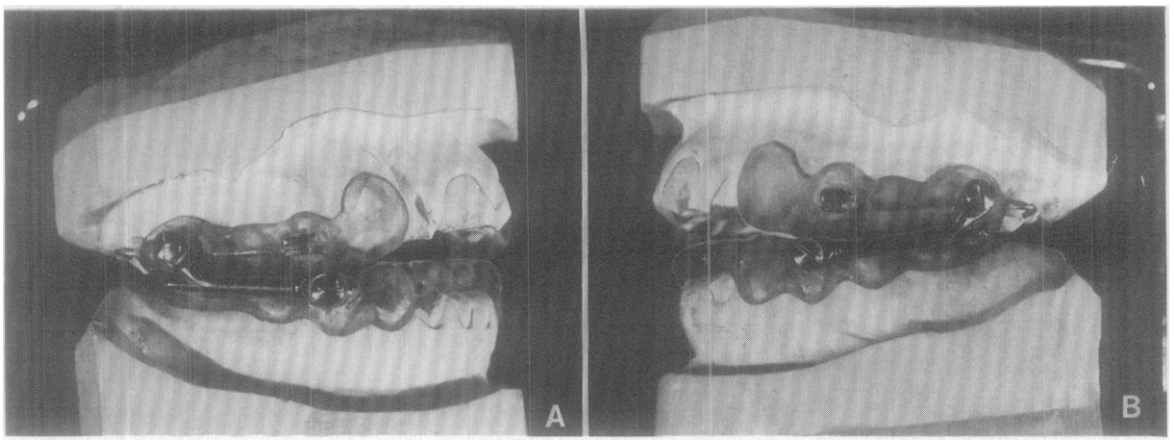

Fig. 12. A and **B,** Trimmed Herbst appliance before final polish. In this instance the maxillary canines have labial coverage in the canine region. This design is used when the maxillary splint is removable.

tolerated quite easily by most patients and seems to reduce the amount of dentoalveolar adaptations produced by the appliance.

2. In most patients the dentition should be decompensated before the placement of a Herbst appliance. This is particularly important in a patient with a deep bite. A forward advancement of the mandible will result in the lower incisors being displaced downward and forward along the lingual aspect of the upper incisors. This movement will increase the vertical dimension of the patient and may result in a posterior open bite existing at the time of appliance removal. In those patients in whom vertical development is desired, it is advisable to use some kind of removable functional appliance to allow for the settling of the posterior teeth without loss in vertical dimension. If a posterior open bite does exist at the end of treatment, a posterior displacement of the mandibular condyle can result.

3. The Herbst appliance should be used as a removable appliance whenever possible. This will minimize the potential for decalcification. However, the appliance usually is bonded in cases in which the rapid palatal expander or an auxiliary arch wire is used. It also should be bonded when most of the teeth are deciduous because of the lack of retention inherent in the shape of these teeth.

The Herbst appliance does provide the opportunity to achieve a rapid change in skeletodental relationships. However, the correct fabrication and clinical management of the appliance are essential if successful treatment is to be achieved.

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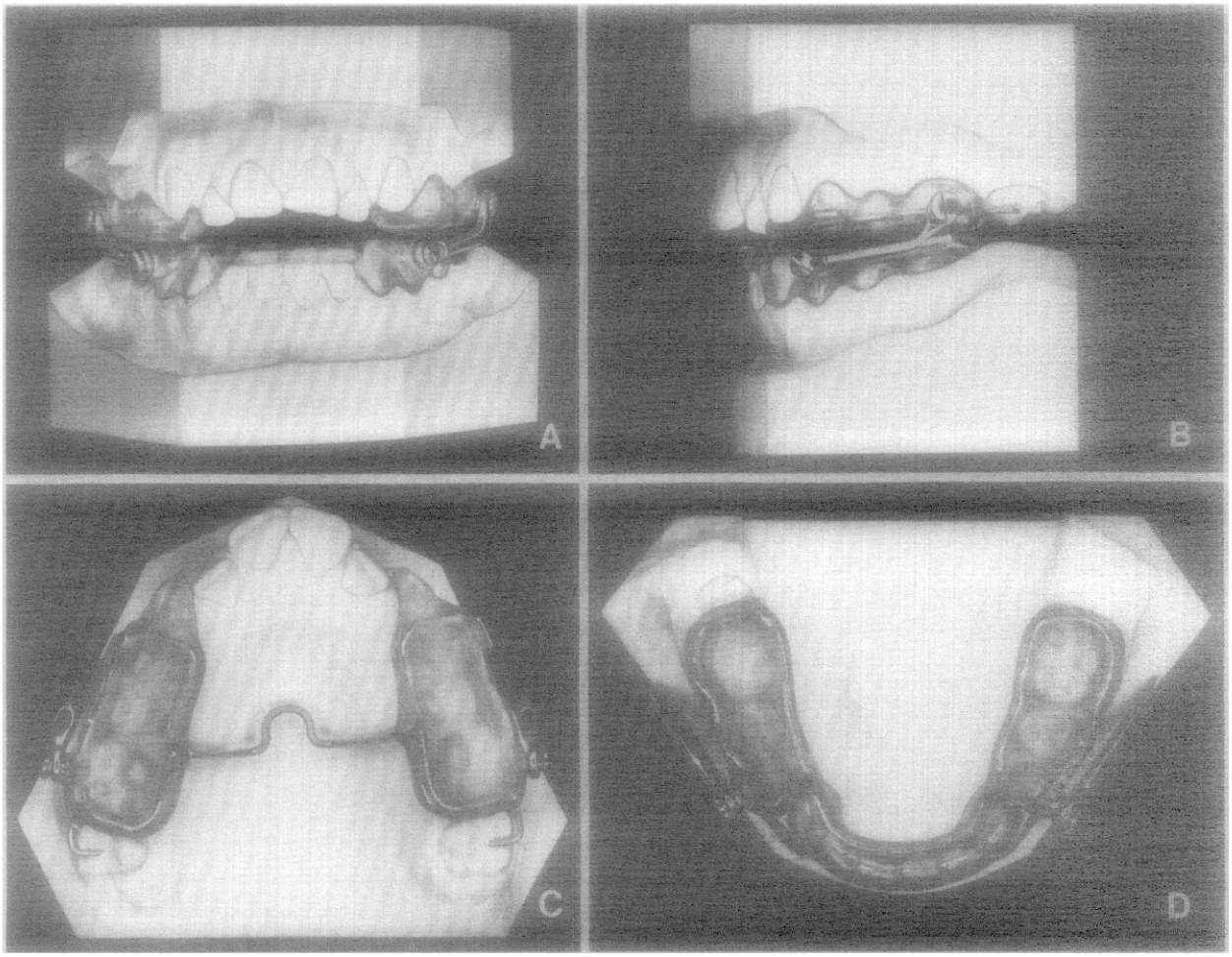

Fig. 13. A through **D,** Trimmed Herbst appliance after final polish. In this case the acrylic extends only to the lingual surface of the upper canine, the design used when the maxillary splint is bonded.

The contents of this article do not confer any license under any existing patents that may be pertinent to the appliance described herein, such as Howe U.S. patent 4,424,032.

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