The correction of interarch malocclusions using a fixed force module

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This article describes the use of a flexible force module (the Jasper Jumper) that can be incorporated into existing fixed appliances to correct various types of sagittal malocclusion. Essentially the spring mechanism described in this article is a modification of the original bite jumping mechanism of Herbst. The flexible spring module provides greater freedom of mandibular movement than is possible with the more rigid mechanism of the Herbst appliance. The facial musculature applies force through these modules to the anchor points to produce a variety of treatment effects. The treatment effects produced by the module mimic those previously described for the Herbst appliance and include posterior movement of the maxillary buccal segments and anterior movement of the mandible or mandibular dentition or both. Specifics of the clinical management of this modular system are discussed, including anchorage preparation and torque application, as well as the methods of anchoring, activating and reactivating the modules. (AM J ORTHOD DENTOFAC ORTHOP 1995;108:641-50.)

A number of appliance systems, both fixed and removable, have been advocated for the correction of malocclusions that are characterized by sagittal discrepancies between the dental arches and/or their bony bases. The most frequently occurring sagittal malocclusion is the Class II type, for which a wide variety of treatment modalities have been developed.

This article describes the basic components of the jumper mechanism (Jasper Jumper), which can be viewed as a modification of the Herbst bite jumping mechanism.[1] This interarch flexible force module allows the patient greater freedom of mandibular movement than is possible with the original bite jumping mechanism of Herbst.

EXTRAORAL VERSUS INTRAORAL APPLIANCES

Appliances traditionally used to treat Class II malocclusion can be divided into two categories: extraoral and intraoral. Typical extraoral appliances include face-bows that attach to tubes on the upper first molar bands and headgears that attach directly to the archwire or to auxiliaries connected to the arch wire.[2-5]

The typical extraoral traction device used in the correction of Class II malocclusion applies forces to the maxillary dentition, either to retard forward movement or growth of the teeth and maxilla and/or to push the maxillary teeth posteriorly. Equally important is the associated vertical vector of force produced by these appliances. A high-pull face-bow produces an intrusive force vector, whereas a cervical-pull face-bow tends to produce an extrusive force vector.[6] The use of a cervical face-bow in a patient with a short lower facial dimension may be indicated, but this type of appliance often is contraindicated in patients with a normal to long lower anterior facial height, due to the adverse vertical forces produced (Fig. 1).

A wide variety of intraoral appliances also have been advocated for the treatment of Class II malocclusions. These appliances can be categorized into two groups: appliances that pull and appliances that push.

Appliances producing pulling forces

The most commonly used device that produces pulling interarch force vectors is intermaxillary elastics. Class II elastics are perhaps the most commonly used means of changing the dentoalveolar (and skeletal) relationship in Class II malocclusion. Not only do Class II elastics produce sagittal forces, but they also create extrusive forces (Fig. 2) produced at the points of attachment (usually the upper canines and lower first or second molars). Such extrusive forces typically are indicated only in those patients in whom an increase in lower anterior facial height is desired. McNamara[7] has shown

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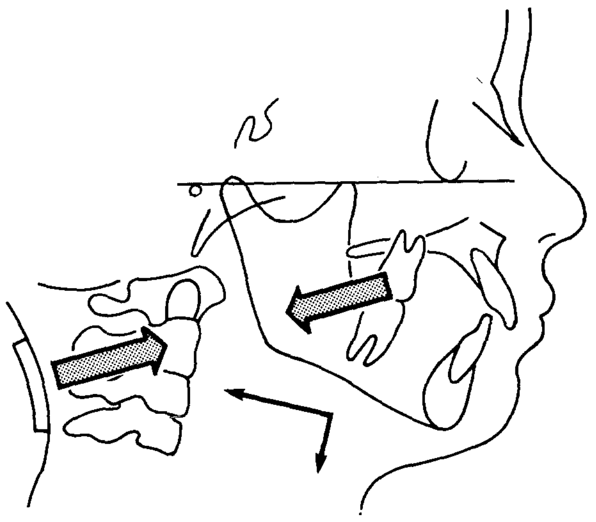

Fig. 1. Diagrammatic view of forces produced by cervical-pull face-bow. Note extrusive vector of force.

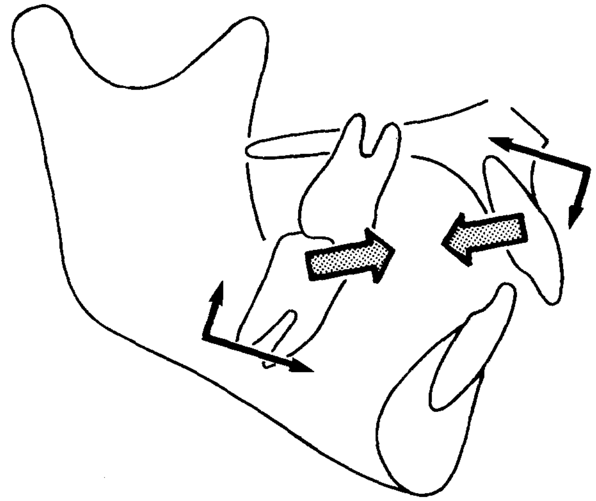

Fig. 2. Vector of force produced by Class II intermaxillary elastics. Although primary force is directed along occlusal plane, extrusive forces are also produced.

that only about 10% of patients with pretreatment Class II mixed dentitions have decreased lower facial height, whereas 30% to 50% have excessive vertical development.

Another appliance system that produces a similar type of pulling force is the severable adjustable intermaxillary force (SAIF) spring developed by Armstrong [personal communication] in 1957. In contrast to intermaxillary elastics that are removed and replaced by the patient, SAIF springs provide a fixed pulling force. This mechanism has not been used widely because of difficulties encountered in appliance management, including breakage, hygiene, and comfort problems.

Appliances producing pushing forces

The second category of intraoral appliances used in the correction of Class II malocclusion includes those appliances that deliver a pushing force vector, forcing the attachment points of the appliance away from one another. This resultant force contrasts with pulling devices, such as intermaxillary elastics, that brings their insertions closer to one another.

Not included in this discussion are the vast number of removable functional appliances that act as active pushing (protrusive) appliances, in that the use of these appliances typically results in a change in the postural level of muscle activity and will, in most instances, result in a change in mandibular posture.[8-11]

Included in this discussion is one of the so-called "fixed functional" appliances, which is the Herbst appliance reintroduced by Pancherz[12-14] after originally having been described by Herbst.[1] This type of pushing appliance is categorized as *rigid* in that the Herbst bite jumping mechanism is composed of two stainless steel "plunger" rod and tube assemblies that usually are attached at the upper first molar and lower first premolar regions. This type of rigid pushing appliance produces vectors of force that are not only sagittal, but also have been shown to be intrusive[14-16] (Fig. 3). In addition, the forces tend to produce transverse expansion and are more oriented along the downward and forward direction of facial growth.

The treatment effects produced by the Herbst bite jumping appliance (banded, cast or acrylic splint design) have been well documented. The studies of Pancherz,[12-15] Wieslander,[17] and McNamara and coworkers[16] have shown that both skeletal and dentoalveolar effects are produced in patients with Class II malocclusions who have worn this appliance. In general, the treatment effects produced are divided about equally between skeletal and dentoalveolar adaptations. The most common skeletal adaptation reported is an increase in mandibular length (approximately 2.0 mm) in comparison to untreated Class II controls.[14,16] Little maxillary skeletal change has been noted. The most pronounced dentoalveolar change has been a relative posterior movement of the upper buccal segment, with about 2.5 mm of distal maxillary first molar movement noted in comparison to untreated controls. Forward movement of the lower molars and proclination of the lower incisors also have been reported.[14,16]

One of the major advantages of the Herbst appliance, and of any other fixed intermaxillary appliance, is the relative speed at which treatment effects are achieved. Traditional approaches to treating a Class II malocclusion (e.g., extraoral traction, Class II elastics) often are hampered by problems with patient compliance. By anchoring the device intraorally, the need for patient cooperation is reduced substantially.

One of the disadvantages of the Herbst appliance is the rigidity of the Herbst bite jumping mechanism itself. Although every attempt is made to allow freedom of movement by enlarging the attachment holes of the tube and plunger to the axles, the bite jumping mechanism restricts lateral movements of the mandible.

In an attempt to overcome these problems, Jasper[18] developed a new pushing device that is flexible. This appliance produces both sagittal and intrusive forces (Fig. 3), as does the Herbst bite jumping mechanism, but affords the patient much more freedom of mandibular movement. These force modules also can be used in other applications and in other types of malocclusions, as will be discussed later.

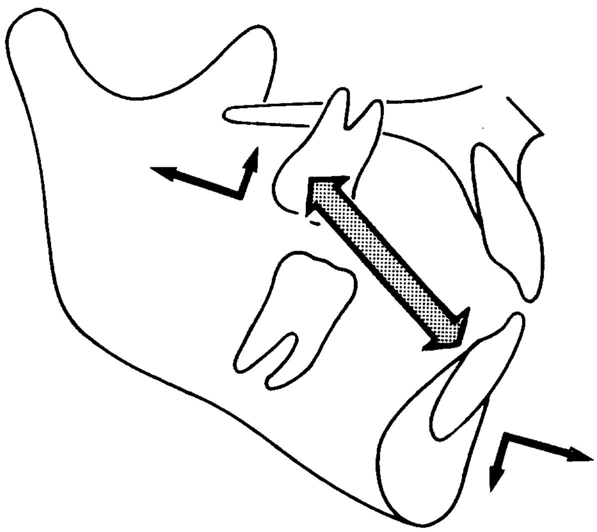

Fig. 3. Pushing vectors of force produced by Herbst appliance and flexible force module. These bite jumping mechanisms guide mandible in forward position, producing protrusive and intrusive forces on lower arch and retrusive and intrusive forces on upper arch.

PARTS OF THE APPLIANCE

This modular system, know as the Jasper Jumper, can be attached to most commonly used fixed appliances. The system is composed of two parts, the force module and the anchor units.

Force Module

The force module, analogous to the tube and plunger parts of the Herbst bite jumping mechanism, is flexible (Fig. 4). The force module is constructed of a stainless steel coil or spring (see inset in Fig. 4) that is attached at both ends to stainless steel endcaps, in which holes have been drilled in the flanges to accommodate the anchoring unit. This module is surrounded by an opaque polyurethane covering for hygiene and comfort. The modules are available (American Orthodontics, Sheboygan, Wis.) in seven lengths, ranging from 26 mm to 38 mm in 2 mm increments. They are designed for use on either side of the dental arch.

When the force module is straight, it remains passive. As the teeth come into occlusion, the spring of the force module is curved axially as the muscles of mastication elevate the mandible, producing a range of forces from 1 to 16 ounces. This kinetic energy then is captured when the force module is curved, and the force is converted to potential energy to be used for a variety of clinical effects.

If properly installed to produce mandibular advancement, the spring mechanism will be curved or activated 4 mm relative to its resting length, thus storing about 8 ounces (250 gm) of potential energy for force delivery. If less force is desired (e.g., force levels that produce tooth movement alone), the jumper is not activated fully. Increasing the activation beyond 4 mm does not yield more force from the module, but only builds excessive internal stress in the module. The tendency to increase the force for faster treatment results is to be avoided.

Anchor Units

A number of methods are available to anchor the force modules to both the permanent and mixed dentitions.

Attachment to the main arch wire. The most common method of attachment of the force module to the dental arches in patients in the permanent dentition is through the use of previously placed fixed orthodontic appliances. When the jumper mechanism is used to correct a Class II malocclusion, the force module is attached posteriorly to the maxillary arch by a ball pin that is placed through

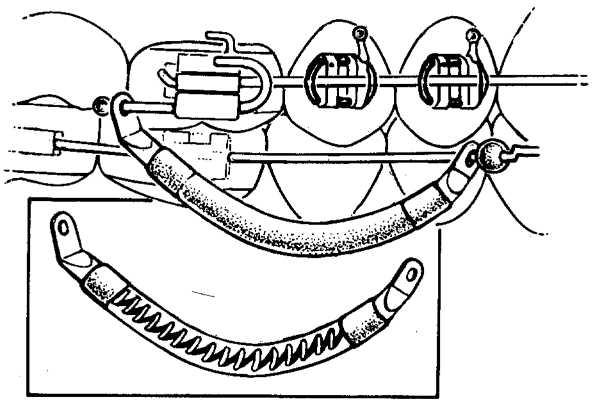

Fig. 4. Attachment of distal end of force module to maxillary dental arch through the use of ball pin. Appliance can be activated by moving ball pin anteriorly. Alignment of spring within jumper mechanism is shown in inset.

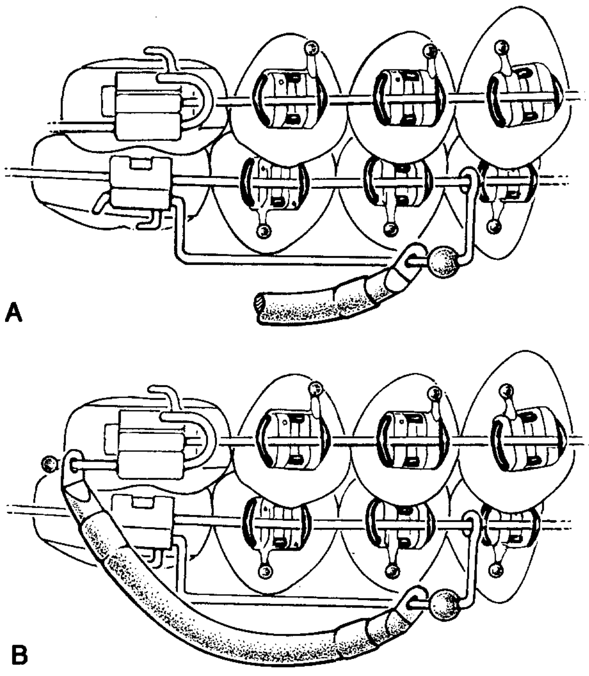

Fig. 5. Use of "outriggers" for anchoring force module. **A,** Rectangular auxiliary arch wire is looped over main arch wire anteriorly and is cinched back through auxiliary tube posteriorly. **B,** Ball pin is inserted through distal hole in jumper module, is placed anteriorly through face-bow tube on upper firstr molar band and is cinched forward to activate module.

the distal attachment of the force module and then extends anteriorly through the face-bow tube on the upper first molar band (Fig. 4). The ball pin is anchored in position by having the clinician place a return bend in the ball pin at its mesial end.

Anteriorly, the module is anchored to the lower arch wire. Bayonet bends are placed distal to the mandibular canines and small Lexan beads are slipped over the arch wire to provide an anterior stop. The mandibular arch wire is threaded through the hole in the anterior endcap and then ligated in place. The removal of the brackets on the lower second premolars in addition to the lower first premolars (as advocated originally) allows the patient greater freedom of movement.

Attachment to auxiliary arch wires. An alternative design incorporates the use of "outriggers"[19] (Fig. 5). This 0.016 × 0.022-inch (0.018-inch slot) or 0.018 × 0.025-inch (0.022-inch slot) auxiliary sectional wire allows the clinician to leave the premolar bonds or bands in place by attaching the force module to a sectional wire that is anchored anteriorly to the main archwire between the first premolar and canine (Fig. 5, *A*). In addition, because freedom for the modules to slide is increased, there is a greater range of jaw movement. Repairs and replacement of the jumper components are simplified with this outrigger modification.

The segmental arch wire is attached posteriorly through an auxiliary tube located on the lower first molar band (Fig. 5, *A*). The auxiliary wire can be bent so that the vestibular section is parallel to the occlusal plane (as shown in Fig. 5), or a shorter vertical step can be placed posteriorly so that the inclination of the outrigger more closely approximates the downward and forward growth direction of the patient's face. The posterior part of the jumper module is attached to the ball pin placed through the maxillary molar tube (Fig. 5, *B*), as described previously.

If outriggers are used to anchor the module to the mandibular dentition, care must be taken to assure that the sectional arch wire provides adequate space between the alveolus and the gingiva to allow the module to slide without tissue impingement. Contouring the sectional arch wire and placing first-order step-out bends in the arch wire may be helpful. Once the module has been placed, the module should slide smoothly along the sectional outrigger wire.

Attachment in the mixed dentition. The force module also can be used in patients with mixed dentitions whose premolars have not yet erupted (Fig. 6). The maxillary attachment is similar to that previously described, in that the ball pin is used to attach the force module to maxillary first molars. The mandibular attachment of the force module is through an arch wire that extends from the brack-

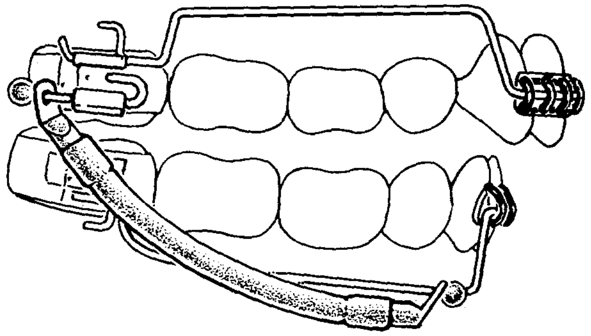

Fig. 6. Use of force module in patient with mixed dentition. In this instance, bayonet bend is placed distal to canine and Lexan ball acts as stop for force module anteriorly. In this example, upper and lower rectangular utility arches connect anterior and posterior teeth.

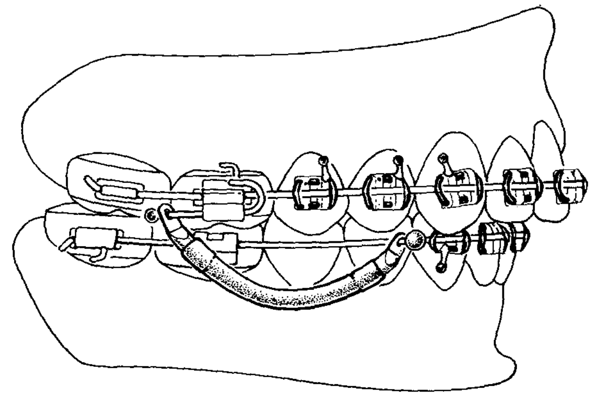

Fig. 7. Maximum anchorage setup for force module. Note maxillary and mandibular arch wires extend to second molars and are cinched back posteriorly. Tie backs also can be used. Offset bend in main arch wire (see Fig. 8) is obscured by Lexan ball.

ets on the lower incisors posteriorly to the first permanent molars, bypassing the region of the deciduous canines and molars (Fig. 6). In a patient with a mixed dentition, the use of a transpalatal arch and fixed lower lingual arch is mandatory so as to control potential unfavorable side effects produced by the appliance (e.g., molar and incisor tipping and flaring).

CLINICAL MANAGEMENT

Preparation of Anchorage

The most important aspect of the clinical management of this appliance system is the preparation of lower anchorage and the control of mandibular mesial tooth movement. As with the Herbst appliance, mesial movement of the lower incisors has been reported with this appliance system.[20,21] Unfavorable dentoalveolar adaptations can be minimized in the mandible through proper anchorage preparation.

Alignment of the upper and lower anterior teeth during the initial phases of orthodontic treatment must be completed. Full-sized (or nearly full-sized) arch wires should be inserted into the brackets in both arches before the placement of the force modules. The arch wires should be tied or cinched back posteriorly to increase anchorage (Fig. 7), including second molars whenever possible. In addition, the clinician can place posterior tip-back bends in the mandibular arch wire to enhance anchorage.

When jumpers are anticipated in the treatment plan, anterior lingual crown torque can be placed in the arch wire. Alternatively, lower incisor brackets with 5° of lingual crown torque incorporated into the slot of the bracket also can be used to prepare anchorage. Lingually torqued lower incisor brackets are used in addition to, not as a substitute for, anchorage in the mandible.

Use of Stabilization Wires

Two types of auxiliary arch wires can be used to enhance anchorage: the transpalatal arch and the lower lingual arch. A transpalatal arch (Fig. 8, *A*) can be used in those instances in which distal maxillary molar movement is to be minimized and mandibular adaptations are to be maximized. A transpalatal arch is not incorporated into the appliance system if maxillary dentoalveolar movement is desired.

The use of a fixed lower lingual arch (Fig. 8, *B*) is encouraged strongly in most instances. This type of anchorage preparation is used routinely except when significant lower incisor proclination is desired as part of the overall treatment plan (e.g., patients with mandibular dentoalveolar retrusion).

Preparation of the Arches

As noted previously, the jumper mechanisms are not placed until the initial leveling and alignment of the dentition has been completed and full-sized or nearly full-sized arch wires have been placed in both arches. After the arch wires have become passive, the mandibular arch wire is disengaged and the brackets on the first and second premolars are removed bilaterally (Figs. 7 and 8). Unless outriggers are used, bayonet bends are placed in the arch wire distal to the lower canine bracket, and 3 mm Lexan beads are slipped over the ends of the arch wire and moved forward to

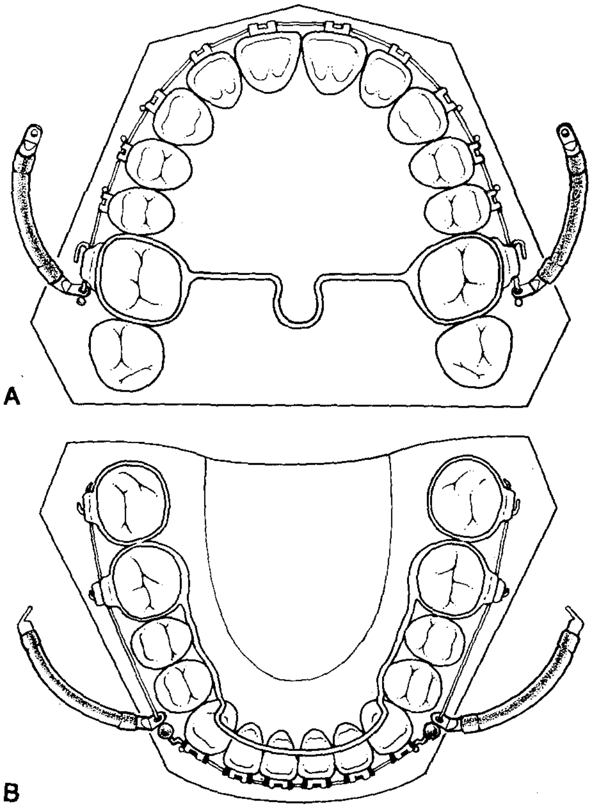

Fig. 8. A, Use of transpalatal arch combined with fixed appliances to enhance maxillary anchorage. **B,** Use of lower lingual arch in conjunction with fixed appliances to enhance mandibular anchorage.

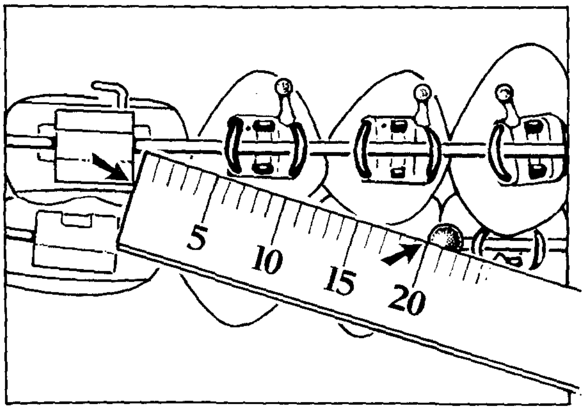

Fig. 9. Determination of proper length of force module. Twelve millimeters are added to measurement of distance between mesial aspect of face-bow tube and distal aspect of Lexan ball. In this example, distance from ball to face-bow tube is 20 mm. Thus 32 mm module should be selected.

rest against the bayonet bends bilaterally (Figs. 7 and 8).

Selection and Installation of the Modules

To determine the proper length of the module, measure from the mesial of the upper molar tube to the distal of the lower Lexan bead (Fig. 9). Adding 12 mm to this measurement will give the appropriate length for the module. The arch wire then is threaded through the hole in the anterior endcap of the force modules. The mandibular arch wire is ligated in place, and the ends of the arch wire are cinched or tied back firmly to prevent proclination of the lower anterior teeth during treatment. Thus, the force generated by the module theoretically is distributed throughout the mandibular dentition. Then the ball pin is placed through the distal hole in the force module and inserted anteriorly into the face-bow tube on the maxillary first molar band and cinched forward, as described previously (Fig. 4).

In patients with high mandibular plane angles, the pin is cinched to achieve approximately 2 mm of module deflection (150 gm per side). In patients with normal or low mandibular plane angles, the ball pin is cinched forward to achieve 4 mm of module deflection (300 gm of force per side). The patient should be coached to practice opening and closing movements slowly at first and told to avoid excessive wide opening during eating and yawning. The patient is cautioned to note any sticking of the module and is taught how to move the module forward with his or her fingers to "unlock" them. The clinician must warn the patient against biting on the jumpers or "popping" them as this will result in breakage.

Activation of the Module for Orthodontic or Orthopedic Effect or Both

The protocol advocated here is based primarily on clinical experience. As previously described, the jumper modules initially are selected and placed so that the module assumes a mildly curved contour when the patient is holding his or her jaw in a comfortably retruded position. If molar distalization is desired, as can be accomplished in an adult patient, a transpalatal arch will not be placed and the maxillary arch wire will not be tied or cinched back. The jumper is placed in this instance so that only 2 to 4 ounces of force is produced by the module (a measuring gauge can be used to determine the precise amount of activation). In a growing patient in whom an orthopedic repositioning of the mandible is desired, higher force levels (e.g., 6 to 8 ounces) are used continuously.

Reactivation of the Module

If the Class II molar relationship is not corrected completely by the initial activation of the appliance, the modules should be reactivated 2 to 3 months after initial placement. The modular system is activated most easily by shortening the attachment to the maxillary first molar bands. The pin extending through the face-bow tube is pulled anteriorly 1 to 2 mm on each side to reactivate the module (patients with higher mandibular plane angles are activated 1 mm per side). One should avoid shortening the ball pin excessively so that the jumper will not bind against the distal aspect of the face-bow tube and prevent its rotation. Two to four millimeters of the pin should extend distally when the pin is activated maximally.

Activation of the force module also can be made through adjustments in the lower arch. Crimpable stops (e.g., 1 mm, 2 mm) placed mesial to the Lexan ball can be used to produce a precise, controlled activation of the modules. Activation of the appliance in this manner is more accurate and easier to perform. It also avoids unintentional restriction of the ball pin/molar tube relationship as well as the necessity to replace the module with a larger size.

At each appointment, the clinician should check to be certain that none of the anchoring bands or tiebacks have become loosened. In addition, the distal extensions of the ball pin often must be restraightened so that it is parallel with the occlusal plane. If outriggers are used, the anterior portion must be adjusted so as not to contact the distal of the lower canine bracket. Observance of increasing interdental spacing in the anterior segment indicates a breakdown of appliance integrity.

TYPES OF FORCES PRODUCED

Directions of force generated by the modules bilaterally include sagittal as well as intrusive and expansive forces. The sagittal forces will distalize the posterior anchor unit (e.g., maxillary first molars or maxillary first and second molars) and also will apply an anterior force to the mandible and mandibular dentition (Fig. 3). In addition, an intrusive force is produced in the maxillary posterior region as well as the mandibular anterior region.

A buccal force also is produced by the module (Fig. 10). An intrusive force applied along the buccal surface of a tooth will produce maxillary arch expansion, a treatment response typically observed using the jumper mechanism in combination with fixed appliances. In addition, the modules curve toward the buccal, producing a modest vestibular shielding effect (Fig. 11).

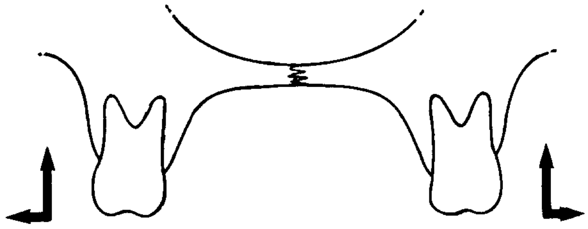

Fig. 10. Expansive forces are positive side effect produced by intrusive forces of jumper mechanism.

Expansive forces can be minimized or eliminated through the use of a transpalatal arch (Fig. 8, *A*) and/or a heavy arch wire that has been narrowed and to which buccal root torque has been applied. Indeed, clinicians are encouraged to add buccal root torque if arch expansion, not molar tipping, is desired. The expansive forces produced by the module can be contrasted to the lingual crown torque that is produced by extrusive pulling mechanics (e.g., Class II elastics).

TREATMENT EFFECTS

After the dental arches has been prepared properly, the modules can be used to produce numerous treatment effects.

Maxillary Adaptations

Headgear effect. One of the treatment effects produced most easily by the force modules is the distalization of the upper posterior segment (i.e., the headgear effect). This type of movement is achieved by not cinching or tying back the maxillary arch wire but rather by allowing the arch wire to remain straight and slightly extended past the buccal tubes. Light forces (e.g., 2 to 4 ounces) then can be expressed by the modules to distalize the upper molars. Because the forces are resisted by the entire lower dentition, minimal changes in mandibular dentition are noted. The headgear effect can be produced not only in actively growing patients, but also in some adult patients in whom maxillary molar distalization is desired.[22] There is no evidence to support the hypothesis that this type of appliance can be used to promote mandibular growth in adult patients.

Once the desired distal movement has been achieved, the module can be left in place to support the retraction of the premolars and canines. Segmental or continuous arch mechanics can be used to retract these teeth while maintaining molar an-

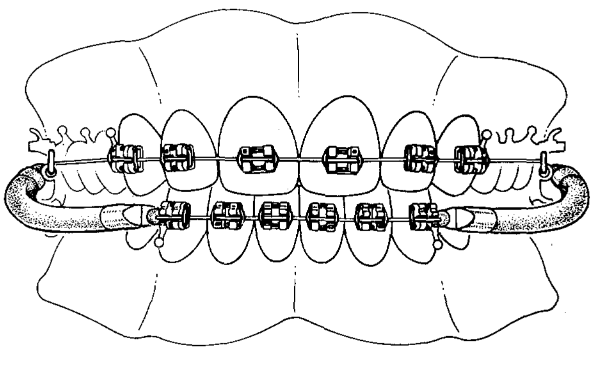

Fig. 11. Force module curves to buccal, producing shielding effect on dentition. Offset bends in main arch wire are not observable in this view.

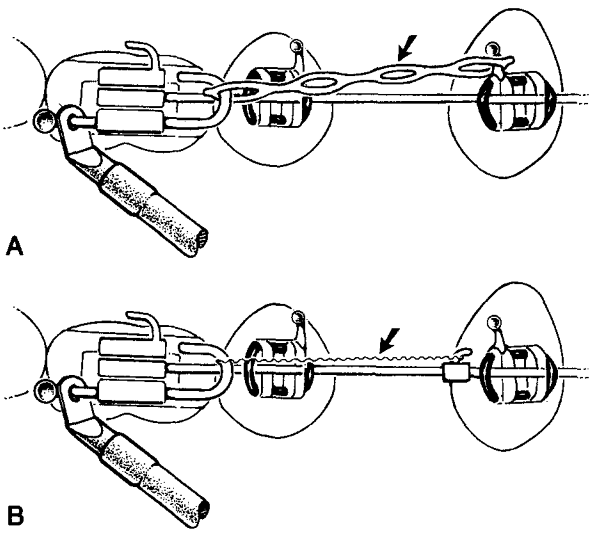

Fig. 12. Retraction of upper canine with ball pin and force module. NiTi spring or elastomeric chain can be attached from ball pin anteriorly to either **(A)** canine bracket or **(B)** maxillary arch wire. In this manner, anterior retraction is anchored posteriorly by forces generated against mandibular dentition rather than maxillary dentition.

chorage. Alternatively, the force module can be left in place to support the molars while the premolar and canine teeth spontaneously move posteriorly as a result of the pull of the gingival transseptal fibers between the teeth (the so-called "driftodontic effect"). A transpalatal arch or Nance holding arch also may be used to maintain the correction.

Retraction of anterior teeth. Canines can be retracted in both extraction and nonextraction patients with the posterior maxillary dentition supported by the force module (Fig. 12, *A*). In addition, a NiTi coil or an intramaxillary elastic attached to the pin through the face-bow tube can be used to retract upper canines or the six anterior teeth en masse. The pull on the pin is resisted by the modules and the mandibular dentition (Fig. 12, *B*).

Dental asymmetries. The force module system also can be used in patients who have sagittal dental asymmetries. In a Class II subdivision-type patient, the maxillary arch wire can be tied back on the side of the existing Class I molar relationship. Asymmetrical orthopedic effects may be developed as well.

Mandibular Adaptations

As stated previously, every effort should be made to incorporate maximum anchorage techniques when preparing the mandibular arch for this appliance (Fig. 7). In growing patients, changes in mandibular position and presumably changes in mandibular length are achieved after force module application. To date, no major prospective research evaluating the effectiveness of the appliance has been conducted. However, it may be assumed that the treatment effects produced by this flexible force module are similar to those of the Herbst appliance, due to the similarities in their mechanisms of action (Fig. 3).

When attempting to produce mandibular advancement, the major variation in clinical management is the preparation of the maxillary anchor unit. To maximize mandibular change, the movement of the maxillary posterior dentition must be minimized. The arch wire should be cinched or tied back, as is accomplished routinely in the mandibular dentition. In addition, a transpalatal arch (Fig. 8, *A*) should be used to obtain intraarch anchorage and minimize posterior tooth movement. A fixed lower lingual arch also is recommended.

As previously discussed, when mandibular advancement is desired, generally the level of force generated by the module is greater (i.e., 6 to 8 ounces) than that when maxillary molar distilization is intended (2 to 4 ounces). By maximizing the force values produced by the module, patients tend to posture their jaw in a forward position. In contrast to the Herbst bite jumping mechanism, however, the spring mechanism allows more freedom in both sagittal and lateral movements.

ADDITIONAL APPLICATIONS

This article thus far has considered the use of the jumper mechanism primarily in the treatment of Class II malocclusion, the typical application of this type of appliance. This system of modules also has been used to support anchorage for the retraction of maxillary anterior teeth (described previously) in patients with Class I malocclusions.

Jumper modules also can be used in the patient with Class III malocclusion. In contrast to the rigid bite jumping mechanism of the Herbst appliance, the flexibility of the jumper mechanism allows its use in patients with Class III malocclusions. It is recommended that this appliance be used in patients who are characterized by maxillary skeletal retrusion rather than mandibular prognathism.

When using this system in a patient with Class III malocclusion, the mandibular anchor points are mesial to the permanent first molars. Bands that have auxiliary headgear tubes or lip bumper tubes are used to anchor the ball pin of the distal endcap of the force module. Anteriorly, the Lexan ball is placed distal to a bayonet bend just behind the bracket on the upper canine (or at an appropriate place on the upper arch wire if the canines are not yet erupted). This appliance in patients with Class III malocclusions can be used in conjunction with rapid maxillary expansion. Forces generated when the modules are used in this manner usually are light (e.g., 2 to 4 gm). This type of treatment should be discontinued immediately if any signs or symptoms of temporomandibular disorders develop.

Other potential applications may include the correction of anterior crossbites in patients with functional (pseudo) Class III malocclusions, the postsurgical stabilization of patients with Class II or Class III malocclusions, and presurgical muscle conditioning of patients with Class II malocclusions.

DISCUSSION

This article has considered a flexible type of bite jumping mechanism that pushes against the maxillary and mandibular dentitions. This module is a modification of the bite jumping mechanism of Herbst that was developed nearly 100 years ago.[1] The well-documented treatment effects of the Herbst bite jumping mechanism appear similar to those produced by the force module described in this article. Both systems produce a relatively rapid correction of a Class II malocclusion by producing both sagittal and intrusive forces. Both skeletal and dentoalveolar adaptations have been observed with the jumper mechanism.[20,21]

This flexible force module system differs from the Herbst bite jumping mechanism in a number of significant areas. First, the amount of force applied by the modules is more easily controlled by the clinician. The flexibility of the force module has been shown to increase patient comfort because greater lateral and sagittal movements are possible. In addition, the force module curves away from the dental arches in its activated position, thus making mastication and oral hygiene procedures easier to perform than with the Herbst appliance.

Another advantage of this auxiliary appliance system is that it can be added to existing appliances virtually at any point after arch preparation. The modules can be used as a primary method of treatment or can be added at a later time after alternative treatments (e.g., extraoral traction, functional jaw orthopedics) have proven unsuccessful. There is no need to remove the entire fixed appliance setup before the force modules are placed, nor is there additional laboratory cost or lost time during treatment if the fabrication of lower lingual or transpalatal arches is not required.

As with any fixed force system, there are disadvantages associated with the use of these modules. The two most significant disadvantages are breakage and unwanted tooth movement. The fact that these modules often are used on "uncooperative" patients increases the concern of breakage.

The appliance system has been improved over the last 10 years, so that now the modules are more resistant to fracture during appliance wear. Patients should be instructed not to chew on the appliance and also not to perform wide open movements. Strict dietary controls are mandatory. In addition, the patient should be cautioned repeatedly not to "pop" the modules after yawning or excessive wide opening.

As mentioned earlier, it is critical that the clinician must prepare anchorage before the force module is placed against the lower arch. If the arch wire is full sized (or nearly so) and is properly anchored posteriorly, forward movement of the lower dentition is minimized. The placement of lingual crown torque anteriorly and tip-back bends posteriorly will further enhance anchorage. If the clinician is concerned about the mesial movement of the lower dentition, use of lighter forces with the module is advocated.

As is usual with the incorporation of a new technique or appliance into an established regimen, clinical experience is necessary before the practitioner becomes comfortable with the manipulation and handling of the new adjunct. Thus, initial case selection is important for first-time users of the appliance. For example, a seeminly cooperative patient presenting with mild Class II diagnostic features and minimal anchorage requirements is ideal. The treatment of noncooperative patients, "bail-out" patients, or patients who have severe skeletal Class II problems should be left to practitioners who have considerable experience in manipulation of the modules.

If used appropriately, this appliance system provides the opportunity of minimizing patient cooperation in the correction of sagittal discrepancies. If proper anchorage preparation is achieved and force values are kept within physiologic limits, successful treatment outcomes can be attained.

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REFERENCES

1. Herbst E. *Atlas und Grundis der Zahnärztlichen Orthopädie.* Munich: Lehmann Verlag, 1910.
2. Kloehn SJ. Guiding alveolar growth and eruption of teeth to reduce treatment time and produce a more balanced denture and face. Angle Orthod 1947;17:10-23.
3. Graber TM. Extra-oral force—facts and fallacies. AM J ORTHOD 1955;41:490-505.
4. Poulton DL. The influence of extraoral traction. AM J ORTHOD 1967;53:1-18.
5. Watson W. A computerized appraisal of high-pull headgear. AM J ORTHOD 1972;62:561-79.
6. Baumrind S, Korn EL, Isaacson RJ, West EE, Molthin R. Quantitative analysis of the orthodontic and orthopedic effects of maxillary retraction. AM J ORTHOD 1983;84:384-98.
7. McNamara JA Jr. Components of Class II malocclusion in children 8-10 years of age. Angle Orthod 1981;51:177-202.
8. Balters W. Die Technik und Ubung der allgemeinen and und speziellen Bionator-therapis. Quintessence 1964;1:77.
9. Ascher F. *Praktische Kieferorthopädie.* Munich: Urban and Schwarzenberg, 1968.
10. Fränkel R. *Technik und Handhabung der Funktionsregler.* Berlin: VEB Verlag Volk und Gesundheit, 1976.
11. Fränkel R, Fränkel C. *Orofacial Orthopedics with Function Regulator.* Munich: S. Karger, 1989.
12. Pancherz H. Treatment of Class II malocclusion by jumping the bite with the Herbst appliance: a cephalometric investigation. AM J ORTHOD 1979;76:432-42.
13. Pancherz H. The effect of continuous bite-jumping on the dento-facial complex: a follow-up study after Herbst appliance treatment of Class II malocclusion. Eur J Orthod 1981;3:49-60.
14. Pancherz H. The Herbst appliance—its biologic effects and clinical use. AM J ORTHOD 1985;87:1-20.
15. Pancherz H. The mechanism of Class II correction and Herbst appliance treatment: a cephalometric investigation. AM J ORTHOD 1982;83:104-13.
16. McNamara JA Jr, Howe RP, Dischinger TG. A comparison of the Herbst and Fränkel treatment in Class II malocclusion. AM J ORTHOD DENTOFAC ORTHOP 1990;98:134-44.
17. Wieslander L. Intensive treatment of severe Class II malocclusions with a headgear-Herbst appliance in the early mixed dentition. AM J ORTHOD 1984;86:1-13.
18. Jasper JJ. *The Jasper Jumper—a fixed functional appliance.* Sheboygan, Wisconsin: American Orthodontics, 1987.
19. Blackwood HO. Clinical management with the Jasper Jumper. J Clin Orthod 1991;25:755-60.
20. Fraser ED. A pilot study on the evaluation of short-term effects of Jasper Jumper therapy. [Master's thesis.] Loma Linda, California: Loma Linda University, 1992.
21. May TW, Chada J, Ledoux WR, Wineberg R, Block MS, McMinn RW. Skeletal and dental changes using a Jasper Jumper appliance. J Dent Res 1992:IADR Supplement.
22. Cash RG. Case report: adult nonextraction treatment with a Jasper Jumper. J Clin Orthod 1991;25:43-7.

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