

# Lever-Hook Edgewise Arch for Midfacial Protraction

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Orthopedic correction of patients with midfacial deficiencies and related Class III malocclusions presents a particular challenge. The appliances used should promote growth and development of the maxilla and its surrounding structures while controlling the soft tissues that resist skeletal displacement. A common undesirable side effect with protraction facemasks, however, is the proclination of the maxillary incisors, which can be confused with orthopedic correction and thus contribute to relapse.

Subtelny introduced the concept of placing edgewise labial root torque in the maxillary incisors during facemask therapy to avoid incisor proclination, minimize stripping of the labial alveolar crests, and stimulate development of A

point.<sup>1</sup> He also recommended that the protraction force be applied to the anterior region of the maxillary dentition, rather than the posterior regions, to avoid counterclockwise rotation of the maxillary complex.

I have developed a custom edgewise arch that provides *automatic* torque control of the maxillary incisors during facemask traction. This functional appliance also restrains the pressure of the upper lip, so that the orthopedic force is efficiently transmitted to the midface.<sup>2,3</sup>

## Appliance Design

The arch is activated by two lever hooks between the maxillary central and lateral incisors

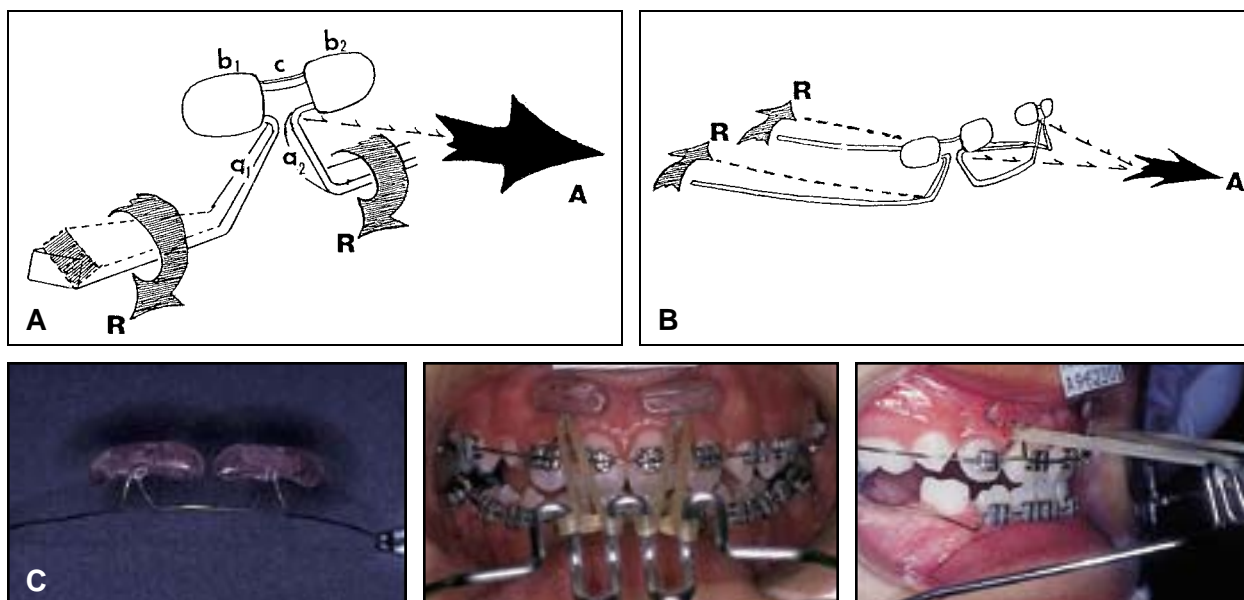
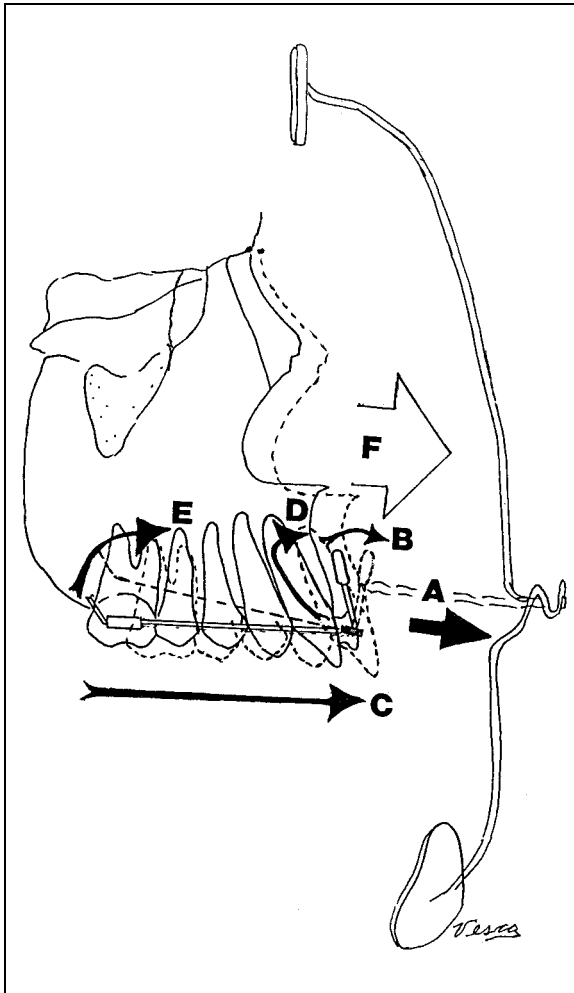


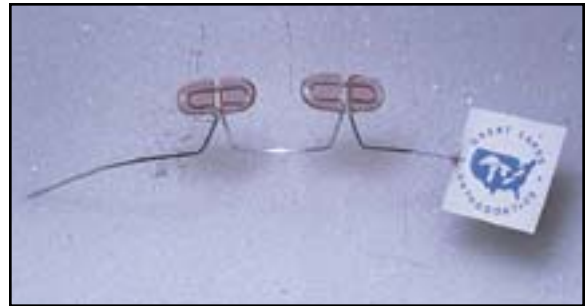
Fig. 1 A. Force diagram of lever hook (A = action of facemask elastics in labial direction; R = Reaction of lever hook, automatically placing labial root torque in edgewise archwire; a<sub>1</sub> and a<sub>2</sub> = inclined arms that keep elastics on top of hook for lever effect; b<sub>1</sub> and b<sub>2</sub> = acrylic labial shields; c = connecting wire for comfort adjustment). B. Force diagram of Vesco arch (A = action of facemask elastics in labial direction; R = reaction of posterior segments, producing upward force on posterior teeth to avoid counterclockwise rotation of maxilla). C. Initial design of Vesco arch, combined with midfacial protraction in two different patients.



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**Fig. 2** Effects of facemask and Vesco arch on mid-face. Orthopedic force of elastics (A) pulls forward on lever hooks (B) and transmits anterior traction to maxillary crowns (C). Labial root torque, produced automatically by lever hooks, creates proportional anterior force on incisor roots (D). Upward force of posterior segments transmits mesial root-tipping force to posterior teeth (E). These forces facilitate protraction of maxillary complex through roots of maxillary teeth (D,E) and counterbalance anterior pull of elastics on crowns of maxillary teeth (C). Overall response is thus skeletal (F), without dental proclination.



**Fig. 3** Commercial version of Vesco arch.

(Fig. 1). These hooks apply a labial root torque to counteract the labial pull of the facemask on the crowns of the maxillary incisors, turning the anterior segment into an anchorage unit. This ensures that the response to protraction is essentially skeletal (Fig. 2).

In conventional edgewise mechanics, the countertorque would have to be bent into the wire. Consequently, the torque would be overexpressed during the periods when the facemask was not worn, and the effect would be compounded if the patient did not wear the mask as directed. The lever hooks produce torque only when the facemask is worn.

Labial shields attached to the lever hooks make the appliance more comfortable and act as an upper lip bumper. The protraction force of the facemask prevents this bumper from moving the maxillary teeth distally. Combined with the upward force expressed by the posterior segments of the archwire, the anterior traction also helps avoid undesirable counterclockwise maxillary rotation.

This originally custom-made arch is now commercially manufactured as the Vesco arch\* (Fig. 3).

\*Great Lakes Orthodontics, Ltd., 199 Fire Tower Drive, Tonawanda, NY 14150.

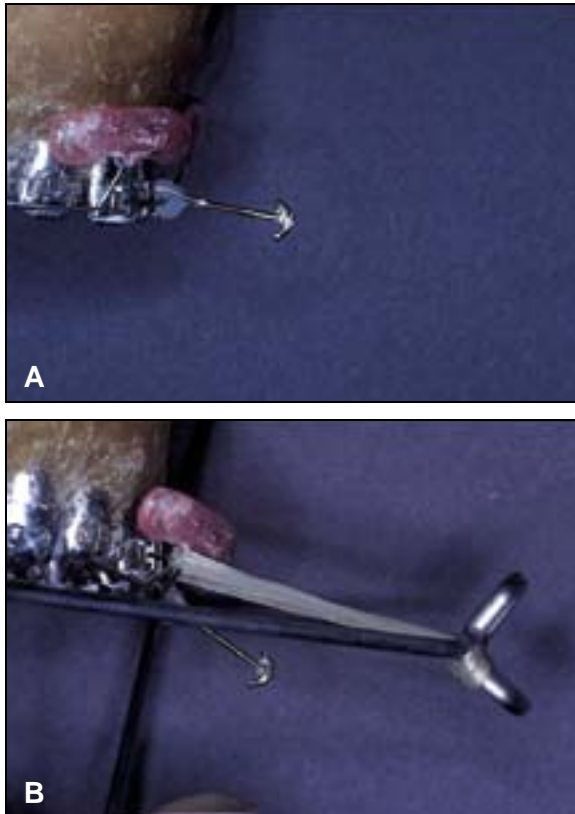


Fig. 4 A. Passive Vesco arch on typodont (glued arrow indicates occlusal plane). B. After attachment of facemask elastics, note change in orientation of arrow ( $20^\circ$  labial root torque).

### Laboratory Testing

Laboratory tests simulating facemask traction to the Vesco arch, with  $\frac{3}{8}$ ", 6oz elastics stretched 25-35mm, produced a torque of  $-20^\circ \pm 2^\circ$ . This exceeded the  $-16^\circ$  leeway of an  $.016" \times .022"$  arch in  $.018"$  brackets, thus placing  $-4^\circ$  of effective torque on the anterior teeth. Similar results were observed with an  $.018" \times .025"$  arch in  $.022"$  brackets (Fig. 4).

Using two elastics per side (a total force of 300-400g per side) produced an effective labial root torque of  $-20^\circ$  in the  $.016" \times .022"$  Vesco arch. The  $.018" \times .025"$  arch needed three elastics per side to achieve the same  $-20^\circ$  torque.

Although these orthopedic forces are with-

in the 600-1,000g limits advised by Verdon and Delaire,<sup>4</sup> it may appear that the Vesco arch would not be able to withstand such forces. I have found that it does, as long as it is made of stainless steel. The labiolingual direction of pull places the stress on the thicker cross-section of the wire. The inclined arms of the lever hooks also help distribute the force, and the lever hooks add resilience to the arch. Consequently, no deformation has been noted after removing an arch from the brackets.

### Clinical Application

In a mixed-dentition case, ordinary preadjusted edgewise brackets are bonded to the maxillary incisors, and molar tubes are banded to the maxillary first permanent molars. When all the permanent teeth are present, the entire arch is bonded or banded. Any lingual root torque built into the desired appliance prescription will be expressed as usual during protraction with the Vesco arch, because of the counterbalancing labial root torque of the lever hooks.

As soon as the arch has been leveled, the Vesco arch is inserted. The lever hooks can be tilted back slightly and the labial shields adjusted for patient comfort, as long as zero torque is maintained in the archwire. Similar adjustments can be made at subsequent appointments, although patients have not reported any significant discomfort from the appliance. Most patients see an immediate improvement in appearance, since the Vesco arch adds volume to the deficient midface in the upper lip area.

Facemask protraction can be started at the same time the arch is inserted, or at the next visit. The mask should be worn about 14 hours per day (five hours after school and nine at night), using two  $\frac{3}{8}$ ", 6oz elastics per side for an  $.016" \times .022"$  arch or three elastics per side for an  $.018" \times .025"$  arch. To align dental midlines or open space for cuspids, the arch is left uncinched, reducing the total orthodontic force to 200-350g.

Prior maxillary expansion is indicated in some cases, such as cleft-palate patients. A retrognathic maxilla would be expected to produce

**TABLE 1**  
**CEPHALOMETRIC CHANGES WITH FACEMASK AND VESCO ARCH**

Patient No.		ANB	SNA	SNPo	1-SN	A Point Movement	1 Tip Movement	Nasion Growth
1.	Pretreatment	-1.5°	80.0°	82.0°	110°			
	Progress	+4.0°	85.0°	81.5°	100°	5.0mm	3.5mm	0.0mm
2.	Pretreatment	-2.0°	84.0°	86.0°	103°			
	Progress	+1.5°	88.0°	87.0°	105°	6.0mm	7.0mm	2.5mm
3.	Pretreatment	-1.5°	83.5°	86.0°	105°			
	Progress	+3.0°	89.0°	87.0°	107°	4.5mm	5.5mm	0.0mm
4.	Pretreatment	-3.0°	76.0°	79.0°	106°			
	Progress	+7.0°	85.0°	78.5°	104°	10.0mm	11.5mm	3.5mm
5.	Pretreatment	-1.5°	74.0°	76.0°	101°			
	Progress	+4.0°	80.0°	77.0°	101°	8.0mm	9.0mm	3.0mm
6.	Pretreatment	-1.0°	87.0°	88.0°	110°			
	Phase I	+1.0°	89.0°	88.0°	123°	1.0mm	5.0mm	0.5mm
	Phase II	+7.5°	95.0°	88.0°	112°	6.5mm	3.0mm	1.5mm

a crossbite once the maxilla is related to a wider part of the mandible. A simple diagnostic procedure—displacing the maxillary study cast anteriorly to approximate a Class I occlusion with the mandibular cast—can help determine whether palatal expansion is needed, or whether maxillary protraction alone will correct the crossbite, as it does in most cases.

If facemask therapy is initiated in the late mixed dentition (about a year before eruption of the maxillary cuspids), the skeletal correction can be completed before the full eruption of the permanent dentition. Remaining dental corrections can then be accomplished with full fixed appliances in one overall phase of treatment.

### Case Reports

Figure 5 shows a patient treated with the Vesco arch as outlined above. Table 1 is a cephalometric summary of five more patients treated for midfacial deficiency with the Vesco arch and protraction facemask, as well as one case treated first with conventional facemask therapy and then with the Vesco arch. All patients were in the late mixed dentition when the Vesco arch was

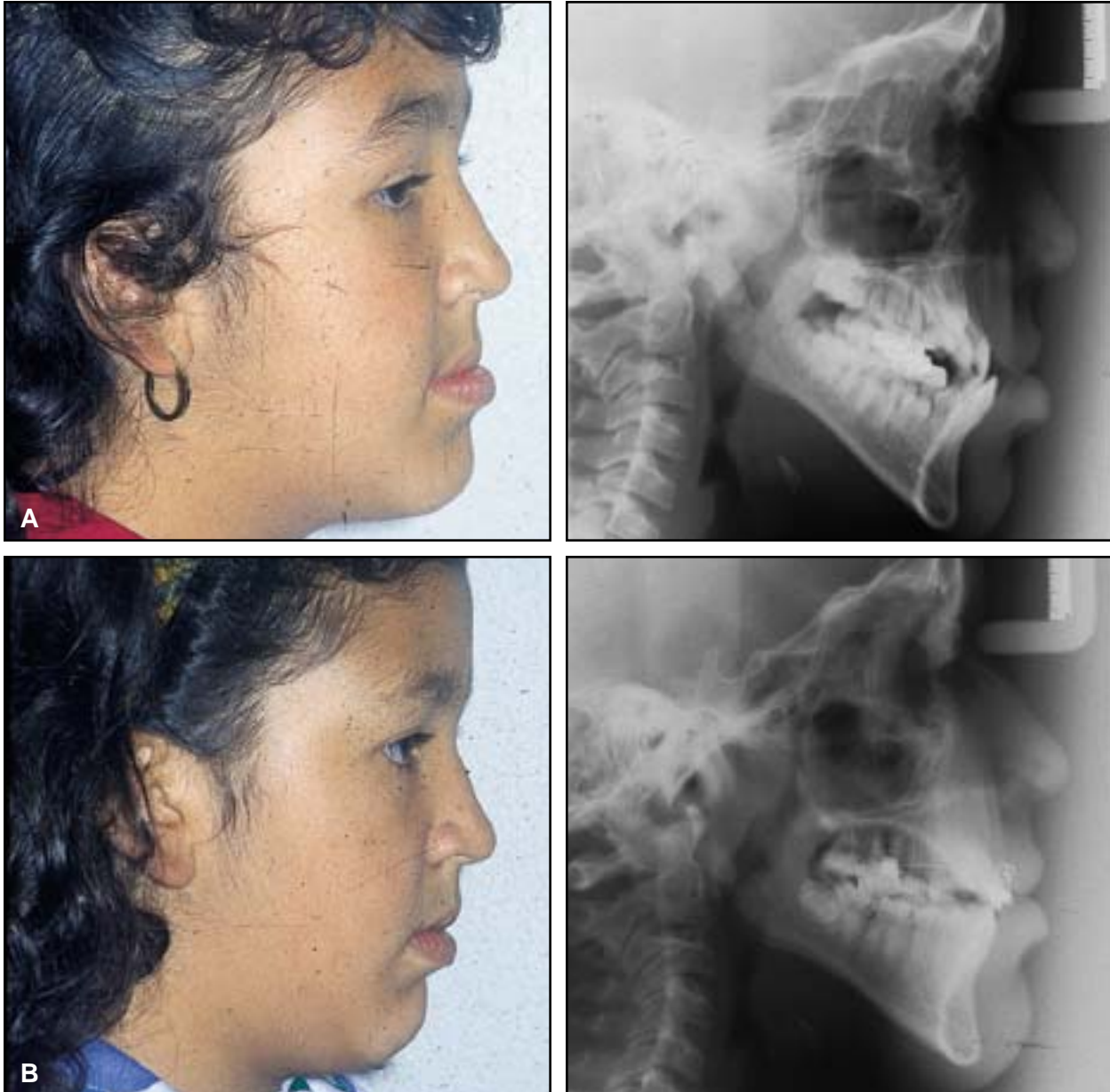
placed.

In these six cases, the increase in SNA ranged from 4° (Case 2) to 9° (Case 4). Displacement of A point ranged from 4.5mm (Case 3) to 10mm (Case 4). Almost no change in SNPo was observed in any case, while ANB increased between 3.5° (Case 2) and 10° (Case 4).

The relationship of maxillary incisor crown tip displacement to movement of A point is considered to be an indication of dental movement during facemask traction. In four of these cases (2-5), there was only 1-1.5mm more movement of the incisor tip than of A point. There was less movement compared to A point in the other two cases.

Maxillary incisor long axis to SN was used to evaluate changes in inclination of the maxillary incisors. This angle was basically maintained in Cases 2-5, and the incisors were uprighted in Cases 1 and 6.

Case 6 was a male patient who presented at age 7½, in the early mixed dentition. In Phase I, before the maxillary incisors had fully erupted, he was treated with a facemask attached to a labiolingual double arch. This appliance, with buccal and lingual segments of .036" or .040" round



**Fig. 5 A. Patient before treatment. B. After nine months of treatment with facemask and Vesco arch (continued on next page).**

stainless steel wire, is soldered to the maxillary first permanent molar bands and has “C” hooks at the distal aspects of the maxillary lateral incisors. To avoid any tipping that might give the

appearance of a correction, the lingual wire was closely adapted to the gingival margins of the incisors.

After eight months of treatment, an

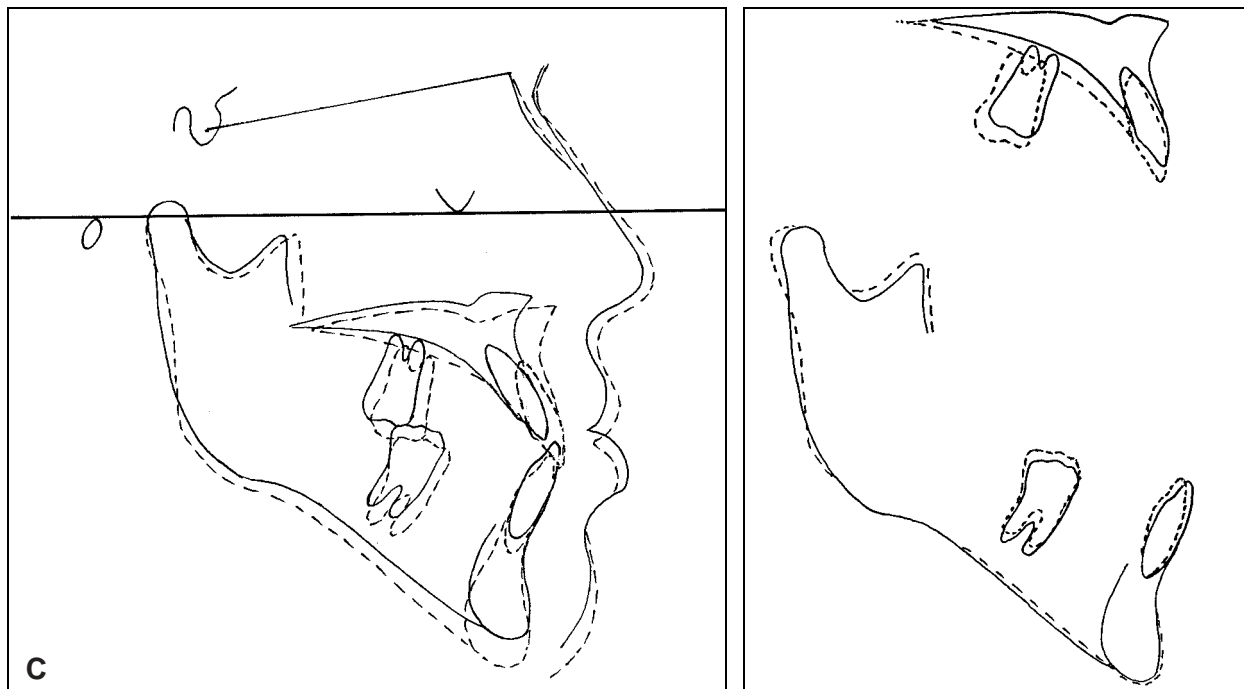


Fig. 5 (cont.) C. Superimposition of cephalometric tracings before (solid line) and after (dashed line) treatment. Note marked protraction of midface without proclination of maxillary incisors. Maxillary and mandibular superimpositions show slight uprighting of incisors and molars, change in mandibular form, and maxillary growth.

improvement of  $2^\circ$  was noted in SNA, with SNPo remaining unchanged (Table 1). ANB increased only from  $-1^\circ$  to  $+1^\circ$ , but a marked proclination of the maxillary incisors occurred, as shown by an increase of  $13^\circ$  in maxillary incisor to SN. Displacement of A point was 1mm, compared to maxillary incisor tip movement of 5mm.

The patient was retreated with a facemask and Vesco arch at almost 11 years of age, in the late mixed dentition. After nine months, SNA had increased by  $6^\circ$ . SNPo stayed the same, and ANB increased by  $6.5^\circ$ . The maxillary incisor was uprighted  $11^\circ$  to SN, nearly recovering from the proclination that occurred in Phase I. While A point moved 6.5mm, the maxillary incisor tip moved only 3mm.

## Discussion

These cases support the principle of an “automatic lever” that transmits a protraction force to the midface while controlling the inclination of the maxillary dentition. The maxillary incisors were not proclined by the orthopedic forces, and in some cases were even uprighted. The edgewise arch seemed to be effective in producing a pure skeletal response without undesirable dental movements.

Many patients with retrusive midfaces exhibit some mandibular protrusion as well. These cases all showed an increase in SNA without a change in SNPo, thus achieving a better overall orthopedic correction. The posteriorly directed pressure on the mandible from the chin cap produced some autorotation, with an increase in lower facial height of 1-3.5% of total facial height, but the vertical proportions of the

faces remained within normal limits.

This Class III treatment approach may eliminate the need for an early phase of therapy, since it is effective at any age while the patient is still growing. No prior maxillary expansion is needed in most cases, because the anteroposterior or skeletal correction usually resolves any posterior crossbite. If the mandible grows disproportionately during late adolescence, the maxillary incisors would tend to procline slightly, but the overall esthetic appearance would not be compromised.

Advantages of facemask therapy with the Vesco arch can be summarized as follows:

- Achieves effective and rapid skeletal protraction of the maxilla and midface without proclination of the maxillary dentition or counterclockwise maxillary rotation.
- Controls incisor torque and molar tip automatically when elastics are hooked to the arch.
- Uses the maxillary anterior protraction force to prevent overextrusion of the molars.

- Produces a functional effect through its labial shields.
- Can be used with .018" or .022" brackets of any prescription.
- Can align dental midlines or open space for cuspids.
- Can be used with a palatal expander.
- Combines maxillary protraction with fixed orthodontic therapy in one overall phase of treatment.
- Can be used in the mixed dentition or the permanent dentition, as long as growth remains.

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