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**Original Article**

**ORTHODONTIC TREATMENT FOR  
JAW DEFORMITIES IN CLEFT LIP AND  
PALATE PATIENTS WITH THE COMBINED USE OF  
AN EXTERNAL-EXPANSION ARCH  
AND A FACIAL MASK**

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**Abstract**

Patients with cleft lip and palate can suffer from contraction of the maxillary arch and anterior cross-bite accompanied by skeletal growth retardation. We use an appliance called an external-expansion arch and induce maxillary protraction using a facial mask in order to correct the anterior cross-bite and maxillary retrusion. In this paper, the method of application of these appliances and the effects of this therapy are reported here.

The external-expansion arch consists of a labial wire, bands and a sectional arch. The 0.045-inch stainless steel wire extends along the maxillary dental arch. Hooks are soldered immediately distal to the lateral incisor and the distal leg of the vertical loop. The brackets are bonded to the maxillary anterior teeth, and a 0.016×0.016 inch sectional arch is set. The external-expansion arch is inserted into the headgear tube and ligated with the sectional arch using elastic thread. The maxillary bone is pulled by use of the facial mask and the elastic band. For traction, the force is about 300 g on each side, applied parallel to the occlusal plane or slightly downward. The duration of use is 8 to 12 hours per day.

The external-expansion arch has several advantages: it can be applied from the early period of Hellman's dental age IIIA or IIC to improve anterior cross-bite. As it is easy to expand the anterior teeth and move individual teeth to the labial and buccal sides, establishment of a dental arch from severe collapse is not difficult. When an expanding device such as the Quad-helix is incorporated, lateral expansion becomes easier. Furthermore, it is easy to control the teeth vertically, and patient compliance is not necessary. Hence, this method is effective as a phase 1 treatment for orthodontic patients with cleft lip and palate characterized by maxillary retardation.

Key words: Cleft lip and palate—External-expansion arch—Facial mask—  
Early treatment

## INTRODUCTION

Patients with cleft lip and palate can suffer from contraction of the maxillary arch and anterior cross-bite accompanied by skeletal growth retardation due to the effects of cheiloplasty and palatoplasty<sup>1,7)</sup>. We treat these patients using a 2-phase 3-steps method<sup>3)</sup> (Table 1). As the phase 1 therapy, we use an appliance called the "external and expansion arch" (hereinafter "external-expansion arch") and maxillary protraction using a facial mask in order to correct the anterior cross-bite and maxillary retrusion from the early period of Hellman's dental age IIIA. The method of application of these appliances and the effects of this therapy are reported here.

## METHODS

### 1. Fabrication of the external-expansion arch (Fig. 1)

The external-expansion arch consists of a labial (buccal) wire, bands and a sectional arch. The 0.045-inch stainless steel wire extends along the maxillary arch, and its anterior portion is located 4–5 mm away from the incisors.

The vertical loop is bent at the mesial point of the buccal molar tube for adjusting the length of the external-expansion arch. The

brackets are bonded to the maxillary anterior teeth, and a 0.016 × 0.016 inch sectional arch is set. The bands with a headgear tube are cemented to the maxillary first molar or second deciduous molar. If maxillary lateral expansion is needed, a removable or fixed Quad-helix appliance<sup>6)</sup> is incorporated at the same time.

### 2. External-expansion arch placement

The external-expansion arch is inserted into the headgear tube and ligated with the sectional arch using elastic thread.

First, the elastic thread is wound one turn around the external-expansion arch and orthodontic wire. Second, the elastic thread emerging on the cervical side is wound two turns around the external-expansion arch. Third, the elastic thread emerging on the occlusal side is wound one turn around the external-expansion arch. Finally, the elastic thread is activated and double knotted (Fig. 2). When activated, it will exert about 200 g of force and move the incisors labially. Ligation of the elastic thread is performed between brackets.

The patient is checked every four weeks, and the elastic thread is reactivated. If the anterior teeth are to be moved labially, the vertical loop is opened to adjust the length of the external-expansion arch. When a Quad-helix appliance is used, this is also adjusted.

Table 1 2-phase 3-steps method

	Therapeutic procedure
Phase I	Orthopedic therapy
Step 1	Expansion in deciduous dentition period
	1) Lateral expansion of maxillary arch 2) Growth inhibition of mandible
Step 2	Expansion in transitional dentition
	1) Improvement of anterior cross-bite of permanent anterior teeth, together with maxillary protraction (transitional dentition earlier period) 2) Lateral expansion of posterior teeth
Phase II	Orthodontic therapy
Step 3	Orthodontic treatment of irregular teeth by the multi-bracket method



Fig. 1 Fabrication of the external-expansion arch

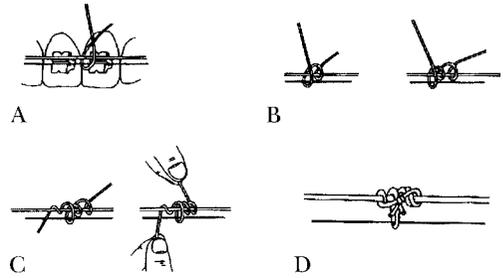


Fig. 2 Method of ligating the external-expansion arch with the elastic thread

- A: The elastic thread is wound one turn around the external-expansion arch and orthodontic wire
- B: The elastic thread emerging on the cervical side is wound two turns around the external-expansion arch
- C: The elastic thread emerging on the occlusal side is wound one turn around the external-expansion arch
- D: The elastic thread is activated and double knotted

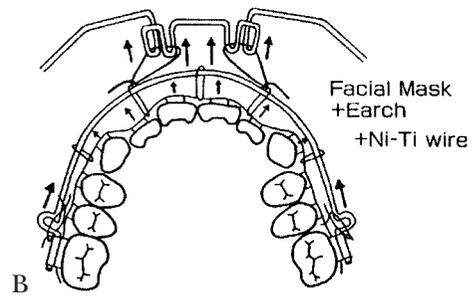
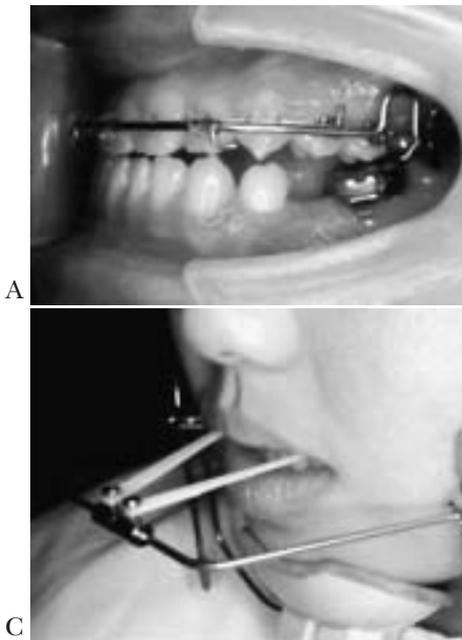


Fig. 3 Maxillary protraction by combined use of the external-expansion arch and the facial mask

- A: External-expansion arch
- B: Schema of the external-expansion arch and facial mask
- C: Facial mask

### 3. Maxillary protraction by combined use of the external-expansion arch and the facial mask

The application method for the external-expansion arch and facial mask is as follows (Fig. 3). Hooks are soldered immediately distal to the lateral incisor and the distal leg of the vertical loop. The external-expansion arch is

inserted into the headgear tube of the molar, and the external-expansion arch and molar are tied back. The maxillary bone is pulled by use of the facial mask and elastic band.

For traction, the force is about 300 g on each side, applied parallel to the occlusal plane or slightly downward. The duration of use is 8 to 12 hours per day.

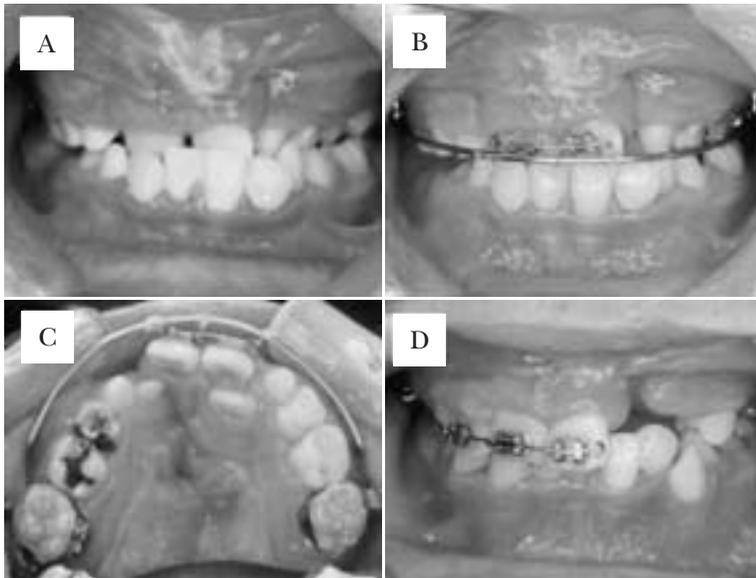


Fig. 4 Anterior expansion  
A: Pretreatment, B: During treatment (Frontal view),  
C: During treatment (Occlusal view), D: Posttreatment

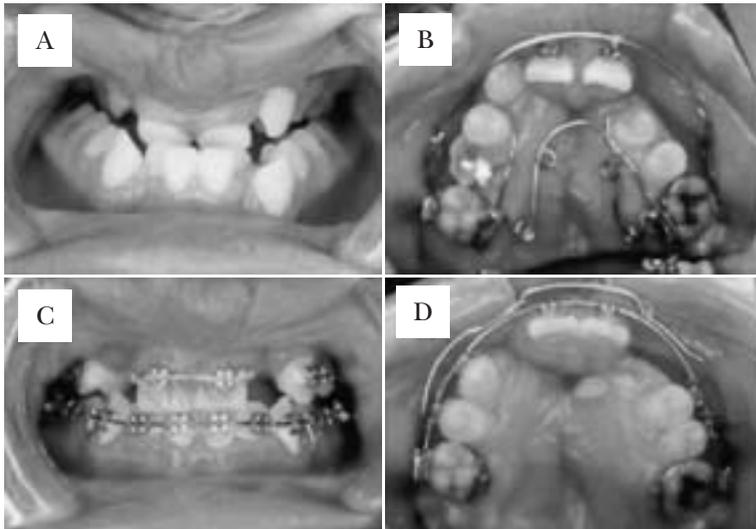


Fig. 5 Lateral expansion  
A: Pretreatment, B: During treatment (Occlusal view),  
C: Posttreatment (Frontal view), D: Posttreatment (Occlusal view)

## RESULTS

The external-expansion arch can be used as follows.

### 1. Case 1: Anterior expansion (Fig. 4)

The case was a 9 year and 7 month old boy with left unilateral cleft lip and palate and anterior cross-bite. By using the external-expansion arch, the anterior teeth were

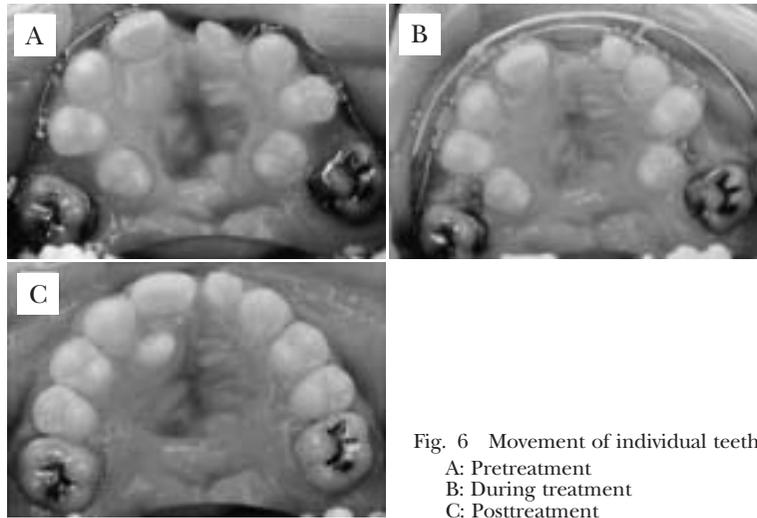


Fig. 6 Movement of individual teeth

A: Pretreatment  
B: During treatment  
C: Posttreatment

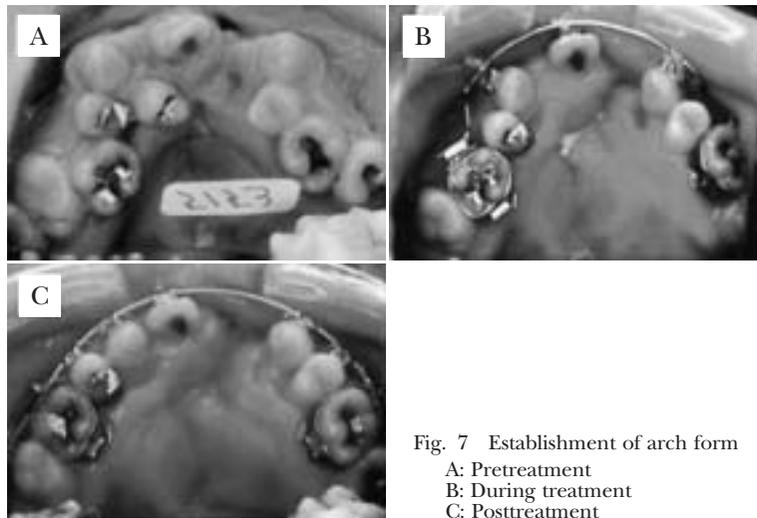


Fig. 7 Establishment of arch form

A: Pretreatment  
B: During treatment  
C: Posttreatment

expanded anteriorly after three months.

### 2. Case 2: Lateral expansion (Fig. 5)

The case was an 11 year and 4 month old boy with bilateral cleft lip and palate and total cross-bite. By combined use of the external-expansion arch and Quad-helix for six months, the maxillary arch was expanded laterally.

### 3. Case 3: Movement of individual teeth (Fig. 6)

The case was a 12 year and 3 month old boy

with left unilateral cleft lip and palate and 2nd premolar palatal displacement. They were moved into the maxillary arch by an external-expansion arch and elastic thread.

### 4. Case 4: Establishment of arch form (Fig. 7)

The case was a 22 year and 5 month old male with left unilateral cleft lip and palate and collapse of maxillary arch. The right and left first premolar and first molar were displaced lingually. After extraction of the right

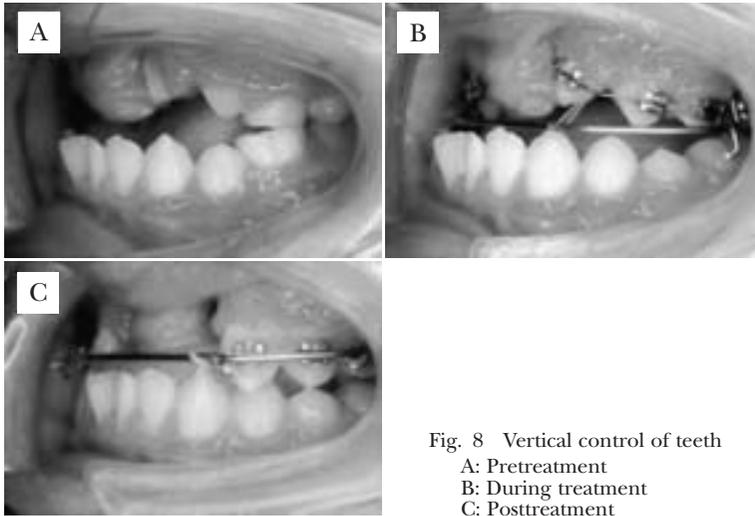


Fig. 8 Vertical control of teeth

A: Pretreatment  
B: During treatment  
C: Posttreatment

and left first premolars, the maxillary arch form was established by an external-expansion arch and elastic thread.

#### 5. Case 5: Vertical control of teeth (Fig. 8)

The case was a 10 year and 4 month old boy with bilateral cleft lip and palate and infraersion of the canines. After five months, his submerged canines were moved to the level of the occlusal plane.

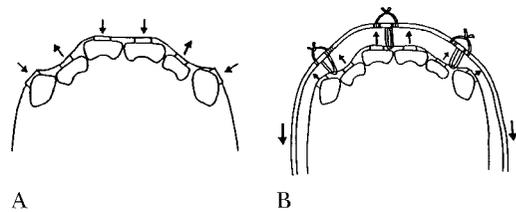


Fig. 9 External-expansion arch

A: When using Ni-Ti wire, there is no benefit of arch expansion by the counter-force as indicated by the arrow.  
B: The addition of the external-expansion arch assures expansion.

## DISCUSSION

The external-expansion arch was modified from Angle's expansion arch (E-arch)<sup>4)</sup> and was so named because it is located external to the teeth and used to expand the maxillary dental arch.

When the dental arch is expanded by using a leveling wire such as a nickel-titanium wire, teeth located lingually are moved labially. However, adjacent teeth are moved lingually by reciprocal force. On the other hand, by ligating the orthodontic arch wire along the external-expansion arch using an elastic thread, the mutual reaction force acts as the expanding force in the labial and buccal directions, so that the dental arch can be efficiently expanded (Fig. 9).

Orthodontic patients with cleft lip and palate are characterized morphologically by anterior cross-bite, contraction of the maxillary arch, and maxillary retardation. During the period of transitional dentition, the purposes of treatment are achievement of proper anterior and lateral overjet and correction of the antero-posterior skeletal discrepancy. In most cases, RPE (rapid palatal expansion)<sup>2)</sup> is suggested for maxillary palatal expansion. However, it has certain drawbacks in that the appliance cannot improve the anterior cross-bite or be used until the maxillary first molar fully erupts.

The external-expansion arch has several advantages: it can be applied from the early period of Hellman's dental age IIIA or IIC

and improve anterior cross-bite from the early period of transitional dentition. Early correction of anterior cross-bite can provide a favorable environment for maxillary growth<sup>5)</sup>. As it is easy to expand the anterior teeth and move individual teeth to the labial and buccal side, establishment of a dental arch with severe collapse is not difficult. When an expanding device such as the Quad-helix is incorporated, lateral expansion becomes easier, and the united bilateral molars provide a strong anchorage. Furthermore, it is easy to control the teeth vertically, and patient compliance is not necessary. This apparatus also has functions as a lip and buccal bumper to isolate these muscle functions.

Combined use of the external-expansion arch and a facial mask allows simultaneous improvement of the anterior cross-bite and lateral expansion of the maxillary arch and maxillary protraction. Tieback of the external-expansion arch and first molars prevents the side effect of molar movement and the distal inclination that may aggravate the class III relation of the molars. In addition, this method allows not only advancement of maxillary growth, but also backward and downward mandibular movement<sup>8)</sup>.

## CONCLUSION

This method of treatment by maxillary protraction with combined use of an external-expansion arch and facial mask improves the anterior cross-bite from the early period of transitional dentition and allows simultaneous lateral expansion of the maxillary arch and

maxillary protraction. Hence, it is especially effective as a treatment of step 2 of phase 1 for orthodontic patients with cleft lip and palate characterized by maxillary retardation.

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