Modified Alt-RAMEC Treatment of Class III Malocclusion in Young Patients with Down Syndrome

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Down syndrome (DS) is a genetic disorder caused by the presence of an extra copy of chromosome 21, occurring once in every 600 births. It is characterized by some degree of cognitive disability and by easily recognizable physical features. Thanks to recent medical advances, children with DS now have a longer life expectancy, which has led more parents to seek dental services such as orthodontic treatment for the typical malocclusion. DS patients can be challenging for clinicians to manage, however, since they require full commitment and collaboration from their parents or caregivers in maintaining oral hygiene and caring for their appliances. Detailed education of the parents and weekly appointments may be necessary to ensure proper motivation.

Anatomically, DS patients tend to display inadequate orofacial development, leading to a flattened bridge of the nose and bones of the midface, and a prognathic mandible, resulting in Class III dental and skeletal relationships. Their overall musculature is hypotonic; muscular weakness and anterior positioning give the appearance of an abnormally long and large tongue (relative macroglossia). Poor facial esthetics and difficulty in eating and swallowing can lead to medical and social problems that are essential to address in the early stages of development. Many dental conditions common to children with DS are well suited for orthodontic intervention and should be considered for correction at the appropriate time.

Although several orthodontic treatment op-
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Fig. 1 6-year-old female Down syndrome patient with concave profile, maxillary and malar hypoplasia, everted lower lip, mesial-step occlusal relationship, and anterior and posterior crossbites before treatment.
anterior crossbite and poor upper-jaw growth. Clinical examination showed a concave profile with malar and maxillary hypoplasia, a retrusive maxilla, mandibular protrusion, counterclockwise rotation of the mandible, and deficient lower facial height. The deciduous teeth were in mesiocclusion, with anterior and posterior crossbites, a deep overbite, and retroclined upper incisors (Fig. 1). Cephalometric evaluation (Table 1) indicated a skeletal Class III growth pattern (ANB = −2.0°, Wits appraisal = −11.6mm) and a flat mandibular plane (FMA = 15.3°). The upper and lower incisors were both retroclined, with an overjet of −3.5mm.

Treatment objectives were to protract the maxilla for enhanced malar projection and anteroposterior growth, to resolve the crossbite, and to improve the facial profile. Options included the conventional protocol of rapid palatal expansion combined with a Delaire facemask. Another alternative was to use Class III elastics, anchored by mini-implants between the maxillary molars and the mandibular symphysis, to achieve the orthopedic effects needed for skeletal Class III correction. Other possibilities were to wait until after

<table>
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<tr>
<th>TABLE 1</th>
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Diagnosis and Treatment Plan

A 6-year-old female was brought in for evaluation by her mother, with the chief concerns of cleft lip and palate patients with midface deficiencies. The present article describes the treatment of young DS patients with maxillary deficiencies using the Alt-RAMEC protocol and maxillary protraction.
the pubertal growth spurt and camouflage the malocclusion by extracting the lower first premolars, or to wait until the cessation of growth and perform maxillary advancement surgery. The parents did not want to wait that long to begin treatment, however, and they declined the use of mini-implants because of the cost.

We therefore proposed a treatment plan involving the use of Alt-RAMEC to disarticulate the maxillary sutures, followed by maxillary protraction with a facemask to correct the anteroposterior jaw discrepancy. Apprised of the reported effectiveness of this procedure in early childhood, as well as the potential complications and risks of treatment, the parents signed an informed-consent agreement. The family was made aware of the importance of cooperation in achieving a successful outcome.

Treatment Progress

A Hyrax* rapid palatal expander was bonded in place, and .045" buccal wires were extended from the acrylic forward to the canine areas, ending in hooks for the attachment of elastics from the facemask (Fig. 2). The expansion/constriction protocol was modified from the recommendation of Liou and Tsai as follows (Table 2): The patient was instructed to activate the appliance one-quarter turn in the morning and one-quarter turn in the evening for the first week (expansion), then to turn the jackscrew backward at the same rate during the second week (constriction). This alternation was continued for five weeks, ending in an expansion week.

After the expansion/constriction protocol, a facemask with adjustable forehead padding, chin cup, and anterior bar was placed, and a force of 400-500g per side was delivered using ¾", 14oz elastics (Fig. 3). To avoid opening the bite as the maxilla was protracted, the elastics were attached to the hooks near the maxillary canines with a downward and forward pull of 30° to the occlusal plane. The patient was instructed to wear the protraction facemask 10-12 hours a day for 12 months, until the molars were overcorrected to a Class II relationship. A lower-anterior inclined plane was then placed for three weeks to increase the angulation of the upper incisors (Fig. 4).

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Facial esthetics in DS patients.25 Oral hygiene during this regimen was fairly poor, however, and the technique does not address anteroposterior skeletal problems. González and colleagues reported positive results in a Class III DS patient using orthodontic camouflage treatment after extraction of the lower first premolars.26

In 2005, Liou and Tsai proposed the Alt-RAMEC protocol to disarticulate the maxillary sutures and enhance forward movement of the maxilla by means of protraction springs.13,14 This procedure resulted in more than 5mm of maxillary protraction, compared to only 2mm using one-time expansion and protraction. Wang and colleagues also found much greater opening of the maxillary sutures with the Alt-RAMEC protocol, although it did require more than five weeks of expansion and constriction.27 On the other hand, Do-deLatour and colleagues observed no difference in forward movement of the maxilla between the Alt-RAMEC and one-time expansion protocols.28 This pilot study used a different expansion/constriction device from the one described by Liou and Tsai,13 however, and required patient cooperation in wearing the facemask.

In another study, Isci and colleagues measured differences between the two protraction protocols in Class III patients with an average age of 11½.29 In the rapid palatal expansion group, the jackscrew was activated .2mm twice a day for a week. In the expansion/constriction group, subjects alternated .2mm of opening twice a day for a week with .2mm of closing twice a day for the next

<table>
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<th>Week</th>
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</tr>
<tr>
<td>2</td>
<td>Constriction: ¼ turn morning, ¼ turn evening</td>
</tr>
<tr>
<td>3</td>
<td>Expansion: ¼ turn morning, ¼ turn evening</td>
</tr>
<tr>
<td>4</td>
<td>Constriction: ¼ turn morning, ¼ turn evening</td>
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<td>5</td>
<td>Expansion: ¼ turn morning, ¼ turn evening</td>
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<td>6</td>
<td>Facemask for one year</td>
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**Treatment Results**

Eighteen months after treatment, the patient exhibited adequate overbite and overjet and good facial balance (Fig. 5A). A significant improvement was observed in the soft-tissue convexity of the profile, with the midface projected forward, the lip position normalized, and the lower facial height increased. Cephalometric analysis confirmed that the posterior occlusion had improved to a straight terminal plane (Fig. 5B, Table 1). The anterior crossbite was corrected, as were the angulation of the upper incisors (99.5° to 122.9°) and lower incisors (80.3° to 86.7°). Significant skeletal changes were also observed: A point advanced by 4.2mm, the maxilla increased in size by 5mm, SNA improved by 3.6°, B point was retracted by 2.3mm, SNB was reduced by 4°, mandibular rotation remained stable, and the anterior facial height and Wits appraisal improved substantially.

**Discussion**

Some 65% of DS patients present with Class III malocclusions due to maxillary hypoplasia.6 Most of these malocclusions are severe,21,22 making it even more important to consider early orthopedic treatment.13 Several methods have been proposed to enhance perioral muscle function, breathing, swallowing, and chewing.6,23,24 Pietrzak and Kowalska recommended the use of removable plates, as described by Castillo-Morales,23,24 followed by Schwarz plates to improve speech and facial esthetics in DS patients.25 Oral hygiene during this regimen was fairly poor, however, and the technique does not address anteroposterior skeletal problems. González and colleagues reported positive results in a Class III DS patient using orthodontic camouflage treatment after extraction of the lower first premolars.26

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Fig. 4 After 12 months of protraction, lower inclined plane placed to increase inclination of upper incisors.

week, repeating the procedure over four weeks. Each patient was then instructed to wear a facemask with a force of 700g per side 16-18 hours a day, followed by three months of Class III elastics. Corroborating the findings of Liou and Tsai, as well as the present report, the expansion/constriction group showed a 4.13mm advancement of A point vs. 2.33mm in the rapid palatal expansion group. Both groups exhibited clockwise mandibular rotation and increased anterior facial height.

Yen analyzed the effects of the Alt-RAMEC protocol in a sample of adolescent patients with cleft lip and palate. Activation and deactivation of the Hyrax expansion screw were performed over nine weeks. Maxillary protraction springs were not used because the author felt they fractured too easily and produced anterior bite opening in most cases. Instead, each patient was instructed to wear a facemask at night and Class III elastics during the day to retain the nighttime protraction effects. The facemask was worn until an overcorrected Class II molar relationship was achieved. In 24 of 30 patients, the treatment produced an 8-9mm overjet, along with rotation of the occlusal plane and dentoalveolar compensation.

Another modification of the Alt-RAMEC protocol, using skeletal anchorage to minimize dental side effects, was introduced in 2011 by Kaya and colleagues. The expansion/constriction protocol was performed with an activation of .5mm per day for eight weeks. Miniplates were then surgically inserted for attachment of the elastics to the facemask, so that the force would be directed between the lateral incisors and upper canines. The authors found significant forward movement of the maxilla, a slight counterclockwise maxillary rotation without dental effects, a clockwise mandibular rotation with slight inclination of the lower incisors, an increased vertical dimension, and a significant improvement in facial profile and posterior displacement of the chin.

The treatment protocol used for the DS patient shown here was originally proposed by Franchi and colleagues. We preferred to treat the patient at a younger age, however, to reduce the risk of periodontal problems from the Alt-RAMEC protocol. In addition, the treatment would be less effective after the pubertal growth spurt due to ossification of the circummaxillary sutures. The results of our case were similar to those observed by Franchi and colleagues in non-DS patients. In the two cases reported by Franchi and colleagues, SNA increased by an average 4.4°, compared to our increase of 3.6°; on the other hand, Liou and Isci and colleagues reported increases of only 3.4°. Franchi and colleagues measured an average advancement in A point of 3.6mm, compared to 4.2mm of advancement in our case, while Liou reported 5.8mm of advancement and Isci and colleagues 3mm. We also noted an improvement of 10mm in the Wits appraisal, which improved by an average of only 3.2mm in Franchi and colleagues’ study. Franchi and colleagues observed an average 1.9° clockwise mandibular rotation, while our patient’s jaw remained stable.

It is important to note that the few published studies of the Alt-RAMEC protocol have been inconsistent in terms of age, type of device, hours
Fig. 5 A. Patient 18 months after end of treatment. B. Superimposition of pre- and post-treatment cephalometric tracings.
of use, and other variables. Nevertheless, all studies except the one by Do-deLatour and colleagues\(^2\) have shown superior correction of Class III malocclusion due to maxillary hypoplasia, as compared to the combination of rapid palatal expansion and facemask therapy. Future researchers should consider using a well-defined protocol with large samples at similar ages, either in normal patients or in patients with DS, to obtain reliable results on which clinical practices can be based.

**REFERENCES**