Early Alt-RAMEC and Facial Mask Protocol in Class III Malocclusion

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One of the most common orthopedic treatment protocols for Class III malocclusion involves a combination of rapid maxillary expansion and facial-mask (RME/FM) therapy.[1] Many reports have described favorable short-term effects of this approach,[2,3] but a recent long-term study showed that significant improvements in sagittal dentoskeletal relationships were mainly due to alterations in the sagittal position of the mandible, while maxillary changes reverted completely.[4]

Both short- and long-term studies on the effects of RME/FM therapy have emphasized the importance of achieving an overcorrection of the dentoskeletal imbalance during the active phase of orthopedic treatment as a means of counteracting the unfavorable growth changes that are likely to occur after treatment.[2,4] Over the past decade, several approaches have been introduced to improve the skeletal effects of Class III treatment on the maxilla. Several of these involve skeletal anchorage, including the use of miniplates or screws for maxillary expansion and protraction with the facial mask,[5,6] miniplates for the application of intraoral Class III elastics,[7] and miniscrews with the Hybrid Rapid Palatal Expansion Advancer.[8] Another protocol, consisting of alternate rapid maxillary expansion and constriction (Alt-RAMEC), was introduced by Liou with the aim of disarticulating the circummaxillary sutures and thus improving the effectiveness of maxillary protraction.[9]

In Liou's original system, a two-hinged RME was banded to the maxillary first premolars and molars, with extensions bonded to the anterior permanent teeth. One day after cementation, the expander was activated according to the Alt-RAMEC protocol, which consisted of seven to nine weeks of alternating rapid maxillary expansion and constriction for one week each. The maxilla was expanded or constricted 1mm (four


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Fig. 1 Acrylic-splint maxillary expander with soldered hooks for facial mask.

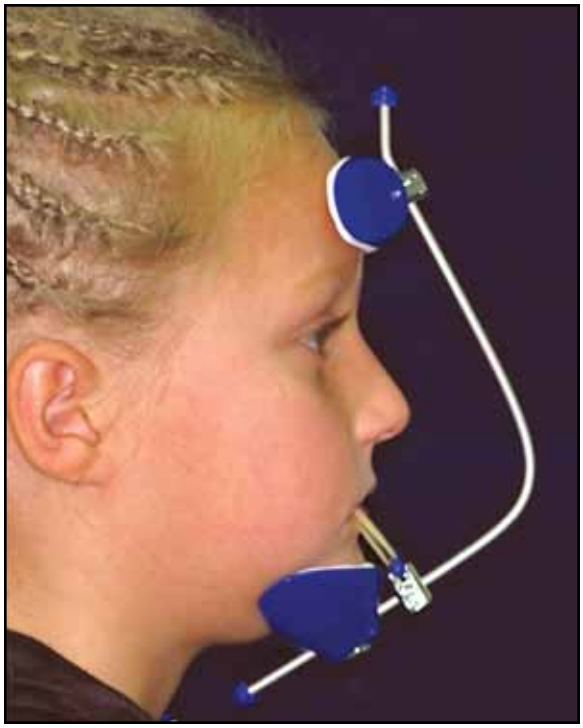

Fig. 2 Facial mask with extraoral elastics inclined downward and forward (at least 30° to occlusal plane).

turns of the screw) per day. After this period, the maxilla was protracted with intraoral maxillary springs, delivering 300-400g of horizontal and upward force on each side, for one to two months. The maxillary protraction springs were then kept in place without adding extraoral forces for another two to three months.

The most evident problem with the Alt-RAMEC protocol is the potential risk to the periodontal health of the anchorage teeth, since the forces generated during the repetitive weekly expansion and constriction could produce negative effects on the maxillary first premolars and molars. Additionally, the use of the protocol in the permanent dentition would often coincide with the pubertal or even postpubertal stages of skeletal maturation and thus might not induce the best response by the maxillary structures to orthopedic forces.[10]

This article introduces a modified Alt-RAMEC/FM protocol, using deciduous teeth as anchorage to avoid detrimental consequences in the dental and periodontal tissues of the anchor teeth and to maximize skeletal changes in the maxilla.[10]

Treatment Protocol

An acrylic-splint maxillary expander with soldered hooks for a facial mask is bonded to the deciduous canines and the first and second deciduous molars[1] (Fig. 1). The patient's parents are instructed to activate the expansion screw* twice a day (.20mm per turn) for one week, then to deactivate the screw twice a day for one week. This alternating protocol is repeated twice. After four weeks of Alt-RAMEC therapy, an additional twice-daily activation of the expansion screw is performed until the desired transverse width is achieved.

The patient is seen weekly, after each activation or deactivation period, so that the screw opening or closing can be checked. As soon as the expansion is completed, a facial mask is delivered for maxillary protraction (Fig. 2). Elastics

*Part A2620, Leone Orthodontic Products, Sesto Fiorentino, Florence, Italy; www.leone.it.

TABLE 1
CASE 1 CEPHALOMETRIC DATA

	Pretreatment	Post-Treatment
SNA	79.9°	85.4°
SNB	81.5°	78.4°
ANB	–1.7°	7.0°
A-N⊥	1.2mm	5.0mm
Pog-N⊥	2.8mm	–3.0mm
Wits appraisal	–3.5mm	–0.5mm
Palatal plane to FH	–6.0°	–6.8°
Mandibular plane to FH	23.5°	24.5°
Palatal plane to mandibular plane	31.6°	32.8°
Co-Go-Me	131.1°	128.8°
Co-Gn	90.7mm	93.6mm
Ptm-A	40.2mm	45.9mm

producing orthopedic forces of as much as 400-500g per side are attached from the hooks on the maxillary expander to the support bar of the facial mask in a downward and forward direction (at least 30° to the occlusal plane[11]). The patient is instructed to wear the mask a minimum of 14 hours per day for six months, then at night only for another six months.

Case 1

A 5-year-old male presented with a dentoskeletal Class III malocclusion, a negative overjet (–1.5mm), and a unilateral posterior crossbite on the left side (Fig. 3, Table 1). The Class III dental relationships did not improve when the patient postured the mandible into the rest position, thus ruling out a pseudo-Class III.

After four weeks of activation and deactivation of the bonded RME, the patient underwent another 15 days of maxillary expansion to correct the posterior crossbite. At the end of expansion, the patient was instructed to wear the facial mask. Six months later, he showed a positive overjet and full Class II occlusal relationships.

After 14 months of orthopedic treatment with the facial mask, the patient had a Class II dentoskeletal relationship with an ANB angle of 7° (about 9° of improvement compared to the pretreatment measurement) and a positive overjet of about 4mm (Fig. 4). The alteration of the occlusal plane shown in Figure 4A was probably due to intrusion of the upper deciduous incisors (Fig. 4C) from a low and forward tongue posture, which was caused by the low position of the expansion screw. To avoid this side effect, the expansion screw should be positioned closer to the palatal vault. Maxillary advancement was demonstrated by the increases in SNA (5.5°) and in A-N perpendicular (about 4mm, Table 1). Pogonion moved back about 6mm, and the SNB angle decreased by 3.1°. The mandibular plane angle and intermaxillary divergency showed an insignificant increase of only 1° each, confirming control of the vertical skeletal relationships. The gonial angle appeared to be more closed (–2.3°) than before treatment. Superimposition on the anterior cranial base[12] revealed that the vertical inclination of the elastics induced a bodily displacement of the maxilla in a forward and downward direction (Fig. 4B). No extrusion of the upper deciduous molars occurred, as shown by the regional maxillary superimposition[13] (Fig. 4C). The regional mandibular superimposition[12] demonstrated upward and forward

growth of the condyle, allowing vertical displacement of the mandibular plane with no clockwise rotation (Fig. 4C).

A removable mandibular retractor[14] was delivered at the end of active therapy for retention of the results.

Case 2

A 7-year-old female presented with a dentoskeletal Class III malocclusion, a skeletal deep bite (mandibular plane angle = 20.8°), a negative overjet (–1.5mm), and a unilateral posterior crossbite on the right side (Fig. 5, Table 2). No pseudo-Class III occlusal relationship could be detected.

After four weeks of Alt-RAMEC protocol and 15 additional days of maxillary expansion, the patient was instructed to wear the facial mask. The right mandibular second deciduous molar was extracted during active orthopedic treatment due to caries. A soldered lingual arch was attached to the mandibular first molars to prevent mesialization of the lower right first molar. After six months of FM therapy, the patient showed a Class II occlusal tendency and a positive overjet.

Fifteen months after the start of treatment,

Fig. 3 Case 1. 5-year-old male patient with skeletal Class III malocclusion, negative overjet, and posterior crossbite on left side before treatment.

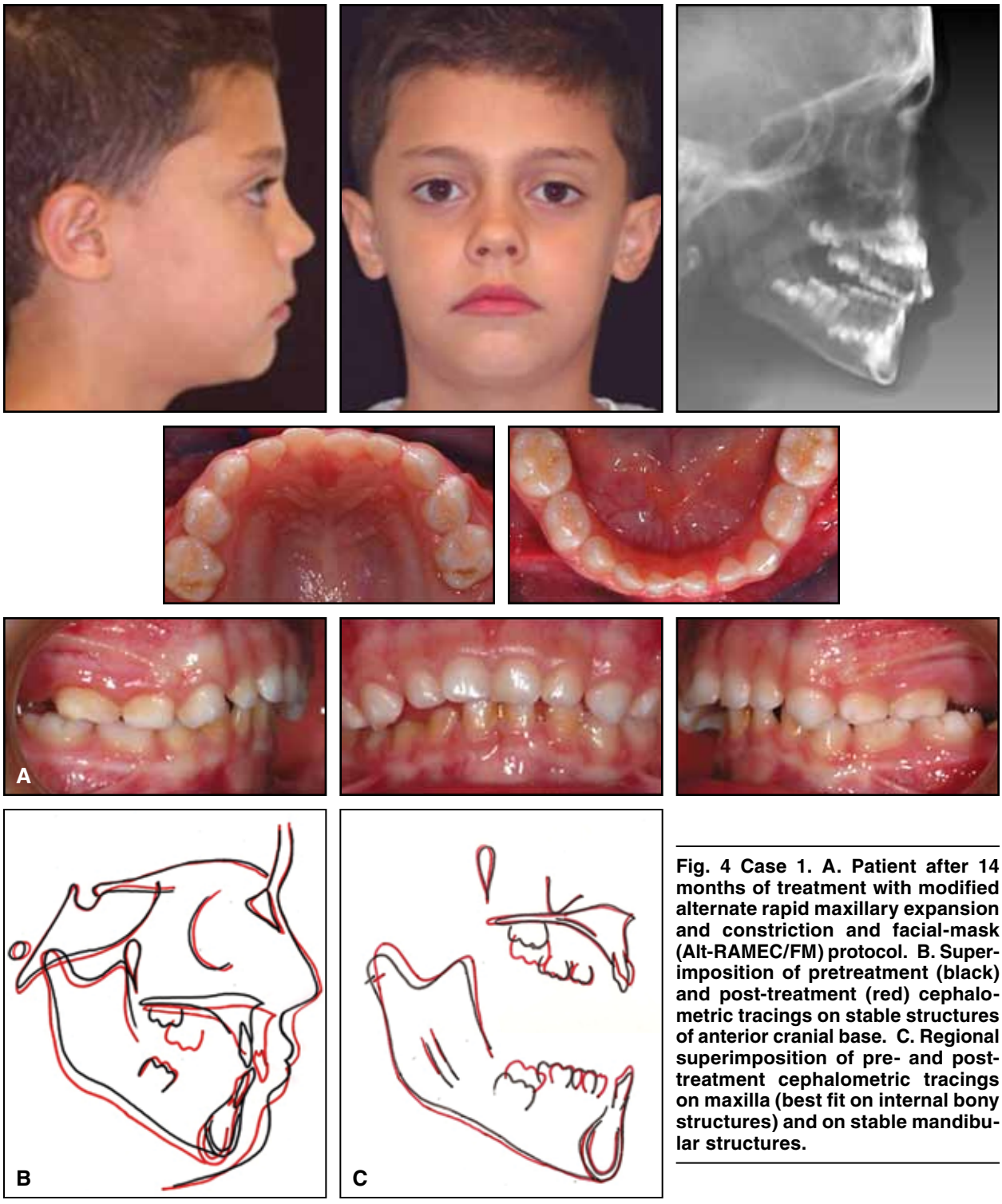

Fig. 4 Case 1. A. Patient after 14 months of treatment with modified alternate rapid maxillary expansion and constriction and facial-mask (Alt-RAMEC/FM) protocol. B. Superimposition of pretreatment (black) and post-treatment (red) cephalometric tracings on stable structures of anterior cranial base. C. Regional superimposition of pre- and post-treatment cephalometric tracings on maxilla (best fit on internal bony structures) and on stable mandibular structures.

cephalometric analysis confirmed the correction of the dentoskeletal Class III malocclusion (Fig. 6, Table 2). The maxilla was advanced by 3.3° (SNA) and 3.5mm (A-N perpendicular), while the mandibular protrusion was controlled (SNB, –.4°; Pog-N perpendicular, –1.8mm). The skeletal vertical relationship was unchanged. The mandibular plane angle increased by less than 1°, and the gonial angle showed a reduction of about 1.5°. As in Case 1, the maxilla exhibited bodily displacement in a forward and downward direction (Fig. 6B) without extrusion of the upper deciduous molars (Fig. 6C). The mandible also showed vertical displacement with no clockwise rotation, as a consequence of the upward and forward growth of the condyle (Fig. 6C).

A removable mandibular retractor was delivered for retention.

Discussion

The Alt-RAMEC protocol has been shown

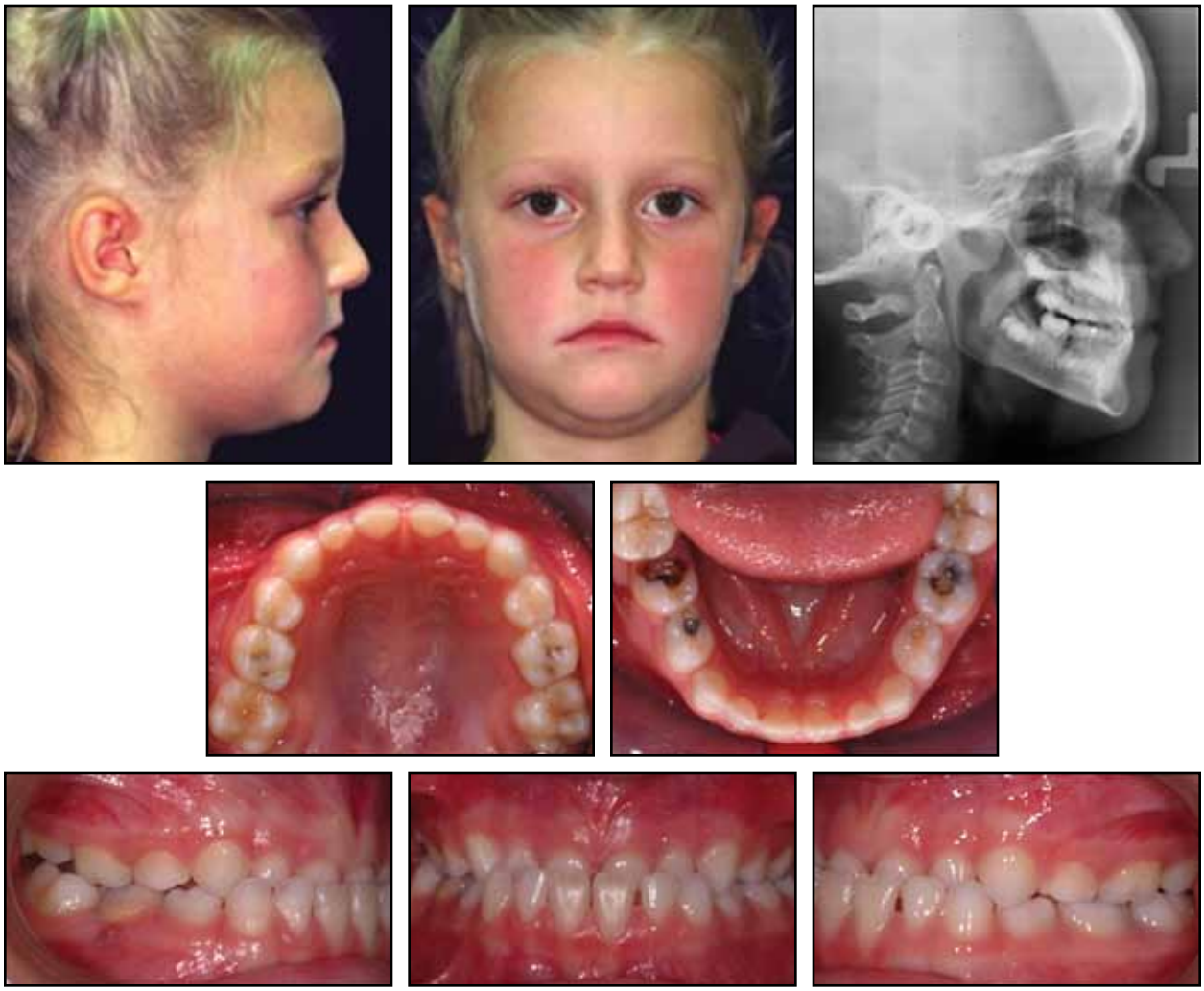

Fig. 5 Case 2. 7-year-old female patient with dentoskeletal Class III malocclusion, skeletal deep bite, negative overjet, and posterior crossbite on right side before treatment.

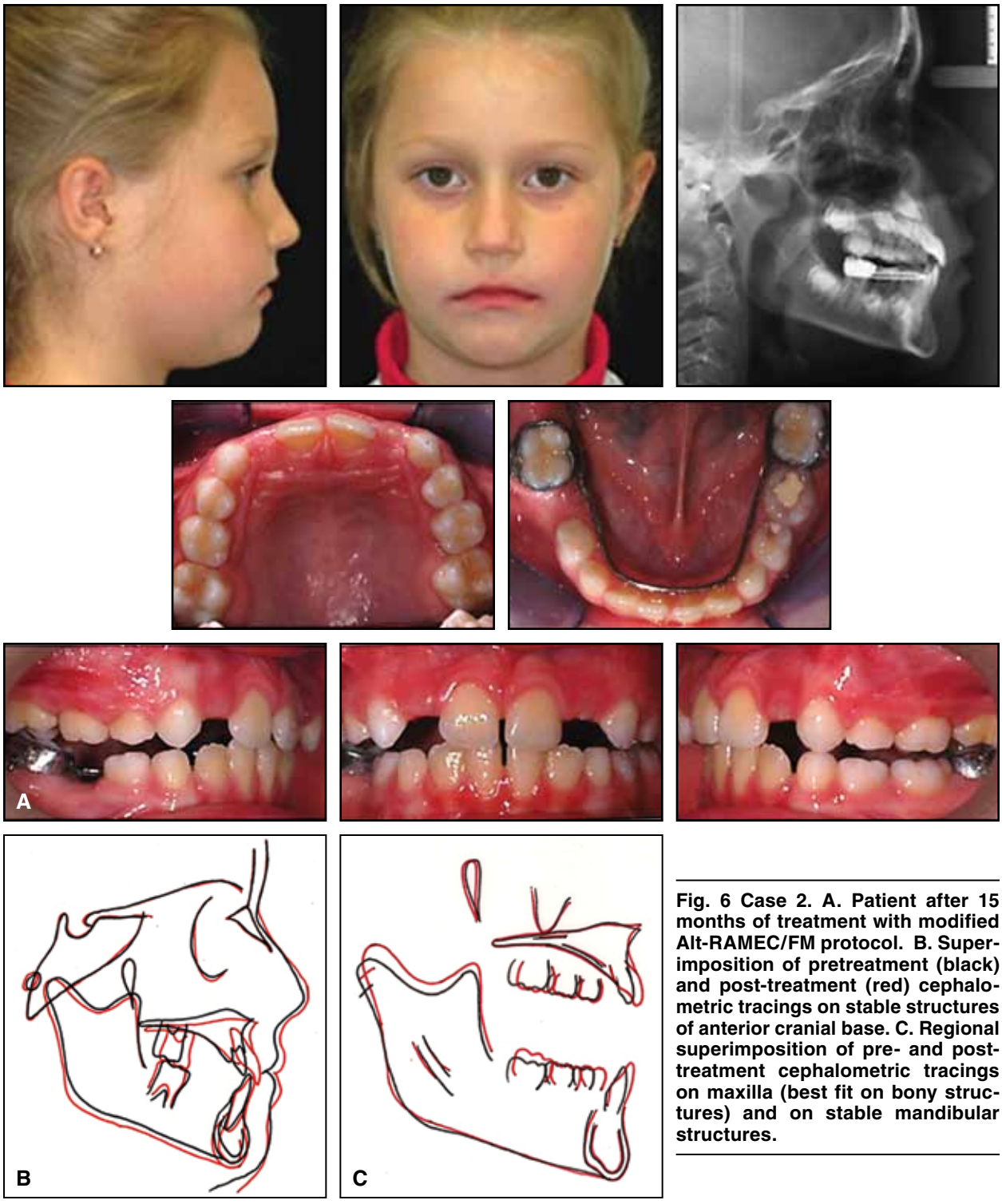

Fig. 6 Case 2. A. Patient after 15 months of treatment with modified Alt-RAMEC/FM protocol. B. Superimposition of pretreatment (black) and post-treatment (red) cephalometric tracings on stable structures of anterior cranial base. C. Regional superimposition of pre- and post-treatment cephalometric tracings on maxilla (best fit on bony structures) and on stable mandibular structures.

TABLE 2
CASE 2 CEPHALOMETRIC DATA

	Pretreatment	Post-Treatment
SNA	79.0°	82.3°
SNB	79.6°	79.2°
ANB	–0.6°	3.1°
A-N⊥	0.0mm	3.5mm
Pog-N⊥	1.1mm	–0.7mm
Wits appraisal	–3.7mm	0.3mm
Palatal plane to FH	–2.9°	–5.9°
Mandibular plane to FH	20.8°	21.7°
Palatal plane to mandibular plane	23.7°	27.6°
Co-Go-Me	124.3°	122.7°
Co-Gn	110.2mm	114.0mm
Ptm-A	49.5mm	51.0mm

to produce significant anterior movement of point A in cleft-palate patients when used in combination with intraoral protraction springs.[15,16] Current studies disagree, however, regarding the effects of this protocol compared to conventional RME/FM treatment. In a recent pilot study of subjects treated at a mean age of 8.5, Do-deLatour and colleagues found no significant difference in the amount of maxillary advancement between Alt-RAMEC (1mm of activation/deactivation per day over seven weeks) and conventional expansion followed by maxillary protraction.[17] On the other hand, Isci and colleagues reported a significantly greater increase in SNA (+1.2°) and improvement in ANB (+1.6°) and overjet (+2.2mm) in a group treated with Alt-RAMEC (.4mm of activation/deactivation per day over four weeks) and facial masks compared with an RME/FM group, both with a mean age of about 11.5 at the start of treatment.[18]

In the face of these conflicting studies, all of which used permanent teeth as anchorage for the RME appliances,[16-18] we introduced a modified Alt-RAMEC protocol with deciduous teeth as anchorage, reducing activation/deactivation to .4mm per day over four weeks to accommodate the deciduous dentition. Another reason for starting treatment early was to maximize skeletal effects on the maxilla.[10]

The first patient in this report (Case 1) showed an increase of 5.5° in SNA and almost 9° of improvement in ANB, which compares favorably with the values reported by Isci and colleagues (3.5° and 5.1° respectively).[18] In fact, this was more maxillary sagittal advancement than has ever been reported for traditional RME/FM treatment.[2,4,11,17] In both of our cases, the maxilla showed bodily movement with an equal amount of forward and downward displacement, but Case 1 demonstrated a greater amount of both sagittal and vertical displacement of the maxilla (Fig. 4B). It has been suggested that maxillary vertical displacement can be reduced if the force is delivered to the RME by an extraoral facebow inserted in buccal tubes and connected to the facial mask with horizontal elastics at the level of the maxillary center of resistance.[19] This design appears to be rather bulky, however, and can lead to an accentuated clockwise rotation of the occlusal plane. In Case 1, SNB was reduced by about 3°, compared to an average improvement of only 1.5° in the study by Isci and colleagues,[18] and the mandibular plane angle increased by only 1°, less than the 2.2° reported by Isci and colleagues.[18]

Case 2 showed less maxillary advancement than Case 1 at the end of treatment, with SNA increasing by 3.3° and ANB by 3.7°. These figures

are similar to those reported for conventional RME/FM therapy.[2,17,18] SNB remained about the same, and the mandibular plane angle increased by only 1°, as in Case 1. It should be noted that compliance with the facial mask was optimal in Case 1, but only moderate in Case 2, especially during the first three months of orthopedic therapy. Patient motivation and collaboration in the use of extraoral elastics and the facial mask have been shown to be key factors in the outcome of Class III orthopedic treatment.[4]

The clinical significance of the present short-term results is supported by reports that the long-term success of Class III treatment depends on the amount of correction (or overcorrection) of the dentoskeletal imbalance during the active phase of orthopedic treatment.[2,4] More detailed studies with larger samples are needed to confirm the effects of this innovative treatment protocol, to compare these effects with those of conventional Class III therapy over the short and long term, and to identify predictive variables, other than compliance, that may account for individual differences in orthopedic responses to treatment.

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