

Dentofacial Effects of Modified Alt-RAMEC Protocol Combined with the Facial Mask for Treatment of Preadolescent Caucasian Class III Patients

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ABSTRACT

Introduction: In this study we analyzed dentoskeletal effects of orthopedic therapy with rapid palatal expander (RME), used according to modified Alt-RAMEC protocol, followed by facial mask in preadolescent patients with class III malocclusion.

Materials and methods: The sample consisted of 10 patients treated consecutively with the alternate rapid maxillary expansions and constrictions (Alt-RAMEC) protocol and facial mask before the pubertal growth spur the patients were re-evaluated after about one year of treatment. We compared the cephalometric analyses at T0 (before the treatment) and T1 (just after the end of the treatment—about 1 year), evaluating 18 parameters. The normality of each distribution was assessed with D'Agostino-Pearson normality test and significative differences between T0 and T1 were assessed with paired *t* test ($p < 0.05$).

Results: Sagittal measurements of the maxilla (SNpSNa distance) showed significant improvements ($p < 0.0001$) with protraction effect at point A. Significant improvements were recorded also at Wits appraisal and overjet. Measures of the mandibular growth (Co-Gn) showed increased values at T1, as well as vertical dimension (SNpSNa-GoGn). No significant variations were recorded at the dental parameters.

Conclusion: This protocol induces important skeletal effects, like advancement of the maxilla, also in preadolescent patients, while dental changes are minimal. Alt-RAMEC protocol seem to modulate maxillary development in patients near the pubertal growth spurt.

Keywords: Alt-RAMEC, Facial mask, Maxillary expansion, Maxillary growth, Third class.

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INTRODUCTION

Class III malocclusions are dentoskeletal deformities that represent the result of the interaction of many factors (genetic and environmental) on the normal development process.¹

There are several studies that investigate the effects of the treatment on this kind of malocclusion; nevertheless, different opposing opinions exist about timing, duration, devices, and type of treatment.²⁻⁹

It seems that the best type of treatment consists of two phases: the first one with a maxillary expansion appliance that has to be activated until the desired transverse width is achieved, and the second one with a facial mask to obtain the advancement of the maxillary complex; the aim of the first step is not only to increase the transverse dimension of the palate but also to open the sutures of the midface complex¹⁰⁻¹² to amplify the protraction effect of the face mask. But this treatment remains limited to the deciduous or early mixed dentition^{13,14} and, after this period, the posteroanterior traction produces more dental effects than skeletal ones.

The alternate rapid maxillary expansions and constrictions (Alt-RAMEC protocol) followed by facial mask has been successful also in the late mixed or permanent dentition, when the patient is close to the pubertal growth spurt, because it seems to produce an adequate distraction of circummaxillary sutures, condition that supports the second phase of protraction of the maxilla.^{15,16}

The purpose of the present study is to evaluate the effects of a modified Alt-RAMEC protocol followed by face mask on maxillary and mandibular structures and dentoalveolar compensations in 10 class III patients who are all in a prepubertal stage of growth (a requisite to have orthopedic effects on the circummaxillary sutural system).

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MATERIALS AND METHODS

The sample was collected prospectively and consisted of 10 consecutive patients (4 females, 6 males) (mean age, 11.35 ± 1.3 years), with similar dental and skeletal characteristics.

All the patients were treated by a single operator with the Alt-RAMEC protocol followed by maxillary protraction with the Delaire facial mask.

At the time of initial observation (T0), all patients had class III malocclusion characterized by Wits appraisal of -1 mm or less, A point, nasion, B point (ANB) of 0° or less, class III molar relationship, and anterior cross-bite or incisor end-to-end relationship. All patients were in a prepubertal stage of skeletal maturity cervical vertebrae stage (CS1-CS2), according to the cervical vertebral maturation (CVM) method.¹⁷

The study patients with dental anomalies (supernumeraries, hypodontia, and impacted teeth), skeletal asymmetries, cleft or other craniofacial syndromes, and systemic diseases that could interfere with the treatment were excluded. We excluded also patients with previous treatment and pseudo-class III malocclusion.

Radiographs were taken at T0 and immediately after the end of the therapy (T1, about 1 year from the beginning): the orthopantomography was taken to evaluate the dentition, before and after treatment, while the lateral cephalometric radiographs were used to gain cephalometric analyses that were traced by the same operator at T0 and T1.

An informed consent was signed by patients' parents before treatment. Each patient received the same instructions from the orthodontist.

Variations due to compliance were not evaluated in this study.

Alt-RAMEC Protocol and Face Mask Appliance

We used in this study three appliances for the protocol: a rapid maxillary expander, a Delaire face mask, and heavy extraoral elastics. First, we bonded on the first maxillary molars the rapid maxillary expander (Hyrax type) to which were attached vestibular hooks extending in the anterior direction; we decided to use a Hyrax expander instead of a 2-hinged expander because, in some patients, the first premolars were not present at the beginning of the treatment; anyway, according to the literature,¹⁵ this does not influence negatively the final outcome of sutural distraction.

The Alt-RAMEC protocol consisted of three palatal expansion/constriction cycles, instead of two, that were considered not sufficient to distract the sutures¹⁶; therefore, patients' parents were instructed to activate the appliance two times (0.5 mm) a day for 6 weeks, alternating expansion and constriction weekly. In seven patients, another week of expansion was necessary to correct the palatal transverse width.

The patients were controlled weekly during this phase to check the opening or closing of the screw.

The aim of this phase is to disarticulate the circummaxillary sutures and to promote the next advancement of the maxilla.

Immediately after the Alt-RAMEC phase, patients were given the Delaire face mask, with pads fitted to the chin and forehead to reduce the discomfort. The Delaire mask was adapted to the face of the patient to avoid the impaction of the elastics on the lips and to reduce the risk of periodontal damages at the lower incisors by the chin pad.

Extraoral elastics were positioned from the hooks of the expander to the support bar of the face mask with a downward and forward direction and with an inclination of 30° for the purpose of avoiding a counterclockwise rotation of the maxilla and reproducing the normal growth pattern, producing orthopedic forces (250 g during the first 2 weeks and then 400 g per side).

The patients had to wear the face mask at least 16 hours per day during the first 4–6 months, until a positive overjet was achieved (and eventually a class II molar relationship), and only during the nighttime for the other 4–6 months to avoid early relapse.

Patients were visited monthly during this phase.

All cephalograms were hand traced by a single operator at T0 and T1, following the reference system of Gianni. Eighteen parameters (7 linear and 11 angular measurements) were selected and analyzed before and after treatment (Table 1).

The statistical analyses were done using Prism 6.0 software (GraphPad Software, Inc.). At exploratory analyses by the D'Agostino–Pearson test, all the data revealed a normal distribution. Therefore, the parametric statistic was applied (paired *t* test) to compare the data at T0 and T1.

RESULTS

All patients well tolerated the treatment, even if some of them reported light pain in the nasal zone and the anterior part of the maxilla during the first cycle of expansion and constriction; eight of them also reported pain in the teeth the palatal expander was bonded to. Nevertheless, none of them asked to stop the treatment for these reasons.

Some parameters showed significant differences between T0 and T1: posterior nasal spine–anterior nasal spine length (SNpSNa)

Table 1: Measurements used and variation at T0 and T1

	Mean T0	SD	Mean T1	SD	Difference	p-value (t)
SNA (°)	78.65	3.801	81.15	4.09	+2.5	0.0009
SNB (°)	79.95	3.632	79.75	4.071	−0.2	0.637
ANB (°)	−1.3	1.829	1.4	1.853	+2.7	0.0007
Indice di Wits (mm)	−4.75	2.189	−0.5	3.073	+4.25	<0.0001
Overjet (mm)	−0.55	1.189	1.55	0.5986	+2.1	0.001
SNpSNa (mm)	45.65	2.947	49.86	2.876	+4.215	<0.0001
Co–Go (mm)	48.99	4.634	52.04	5.201	+3.046	0.0008
Co–Gn (mm)	105.7	5.381	110.8	6.586	+5.107	0.0059
Go–Gn (mm)	67.74	2.915	70.08	2.946	2.339	0.0059
SN–GoGn (°)	33.5	4.848	33.65	4.083	+0.15	0.8311
SN–SNpSNa (°)	8.3	4.283	6.75	5.035	−1.55	0.0361
SNpSNa–GoGn (°)	25.3	5.741	26.9	5.567	+1.6	0.0089
SNpSNa–Occl. (°)	6.7	3.19	7	3.801	+0.3	0.6833
Occl.–GoGn (°)	18.85	4.021	19.75	4.912	+0.9	0.2947
Overbite (mm)	1	0.9718	1	0.9129	0	>0.9999
Interincisivo (°)	135.1	11.4	134.2	8.44	−0.9	0.6399
Inc. S.–SNpSNa (°)	115	6.534	115.5	6.155	+0.5	0.7582
Inc. I.–GoGn (°)	85.1	6.757	86.2	8.453	+1.1	0.5855



Fig. 1: Clinical case before treatment



Fig. 2: Upper arch before Alt-RAMEC protocol



Fig. 3: Upper arch after Alt-RAMEC protocol

distance increased significantly ($p < 0.0001$) with an average improvement of +4.21 mm, demonstrating the active skeletal effect of the face mask on the maxilla. Also, Wits appraisal changed significantly with a difference in the means of +4.25 mm. SNA and ANB angles increased to 2.5° and 2.7°, respectively, and overjet improved significantly (+2.1 mm).

Sella nasion B point (SNB) angle did not change (only in two cases, a retrusion was obtained, probably caused by the post-rotation of the mandible), while linear measurements of the mandible (ramus, body, and mandibular total growth—condylen-gnation (Co–Gn)) increased significantly, in particular, the segment Co–Go (+3.04 mm).

The total vertical dimension (SN—GoGn angle) did not show a significant modification. Just a small, but significant, counterclockwise rotation of the maxilla (palatal plane SNpSNa) ($p < 0.05$) and clockwise rotation of the mandible (SNpSNa—GoGn) ($p < 0.01$) were found.

Overbite increased in some patients, but the modification was not significant. No significant changes were recorded at the other parameters (interincisal angle, IncS—SNpSNa angle, and Incl—GoGn angle); therefore, we did not find any dental changes.

DISCUSSION

The use of rapid palatal expander combined with face mask represents the traditional treatment for class III malocclusion, but it does not allow to gain good results in the preadolescent period due to the synostosis process evolution at the circummaxillary sutural system. The Alt-RAMEC protocol was developed to open the circummaxillary sutures, without the necessity of overexpanding the maxilla (according to previous studies, 12–15 mm of expansion would be necessary to gain sufficient distraction of sutures, but it is not possible to do it in the most of cases^{18,19}); indeed, it amplifies the effects of rapid palatal expansion through alternate cycles of expansions and constrictions.

The results of this study are promising. The comparison of the cephalometric data at T0 and T1 showed some significant favorable changes: at T1, all the patients showed positive skeletal modifications, in particular, a significant increase of the length of the maxilla (SNpSNa distance; mean increase: +4.21 mm; $p < 0.0001$) with advancement of the point A; an increase in SNA (mean of 81.15° at T1) demonstrated a great increase in the sagittal position of the maxilla. Even Wits appraisal showed a significant increase at T1 (–0.5 mm), as well as ANB angle (mean of 1.4° at T1).

These data showed the efficacy of the therapy in the correction of the class III skeletal malocclusion that was reached in all patients in a period of 4–6 months of traction with the face mask.

These results are consistent with others of similar studies.¹⁵ As for the mandibular sagittal skeletal measurements, the comparison of the cephalometric data at T0 and T1 revealed significant modifications ($p < 0.05$). The length of the mandible (Co–Gn) increased during the treatment and this could indicate that the face mask is not able to restrain efficiently the total mandibular growth. One reason could be that the face mask is a removable appliance, worn just for a few hours during the day. Another hypothesis is that condylar growth of the mandible is limited and a great part of mandible enlargement is due to bodily growth that appliance cannot restrict.

The projection of point B did not show significant modifications as well and this could mean that the face mask is able to control the position of the mandible.

These results are not in agreement with some of the previous studies in which a significant decrease of SNB was reported.²⁰ Poor control of the position of the mandible could be associated with poor compliance of the patients.

Counterclockwise rotation of the maxilla and clockwise rotation of the mandible were observed, but they were irrelevant and did not cause an increase in the total vertical dimension. Therefore, we could consider this protocol convenient also for class III patients with an increased vertical dimension, a condition usually difficult to manage.²¹

Finally, dental effects were minimal: no significant changes were reported at the incisor position in relation to the bispal plane and

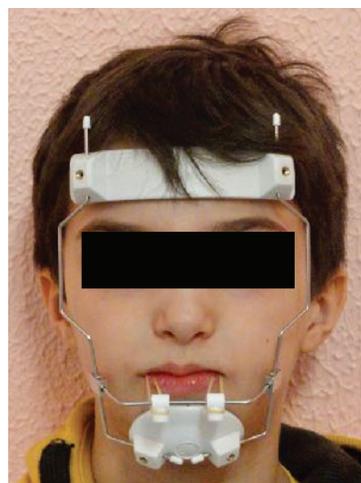


Fig. 4: Facial mask in position

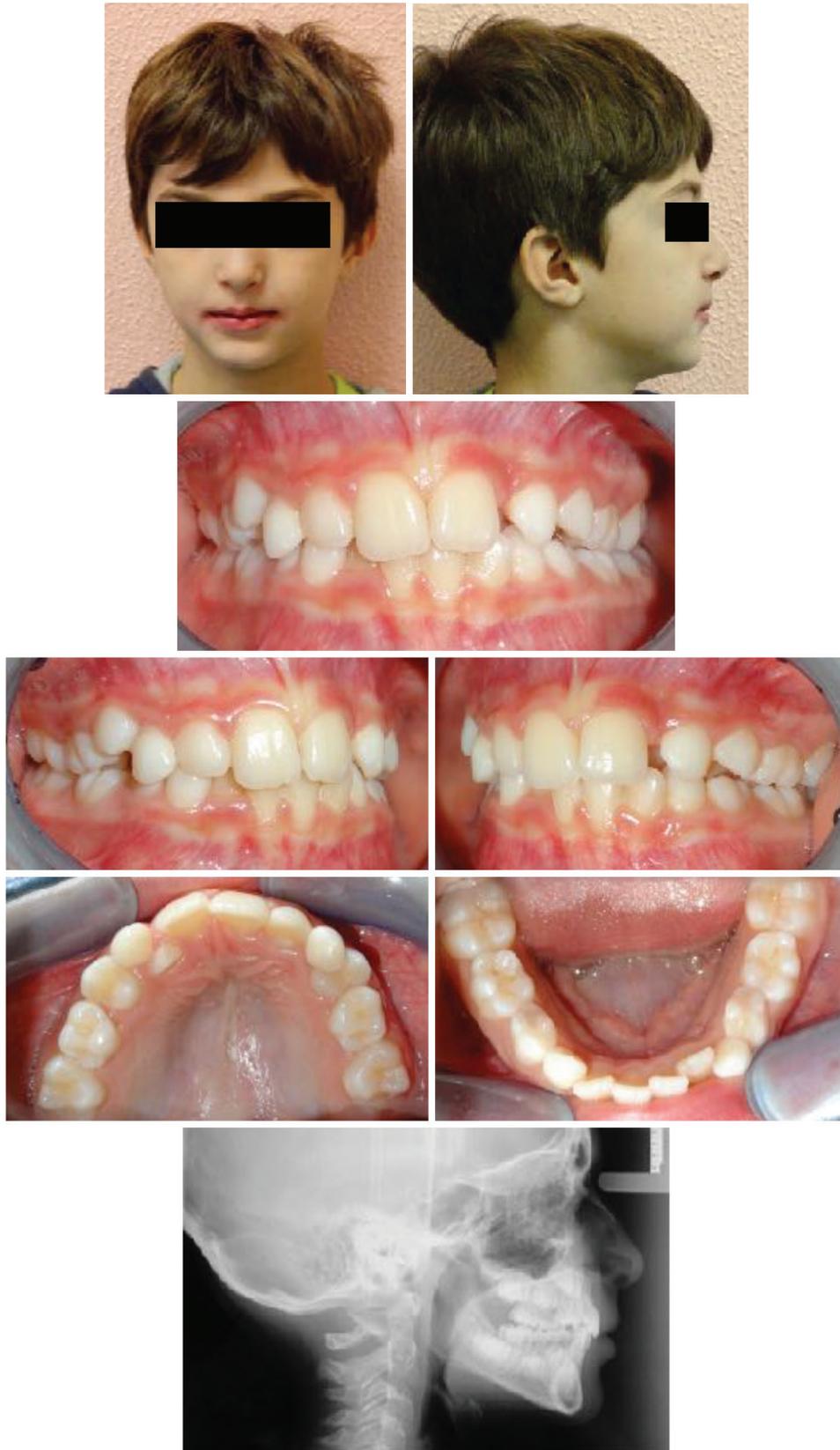


Fig. 5: Clinical case after Alt-RAMEC protocol

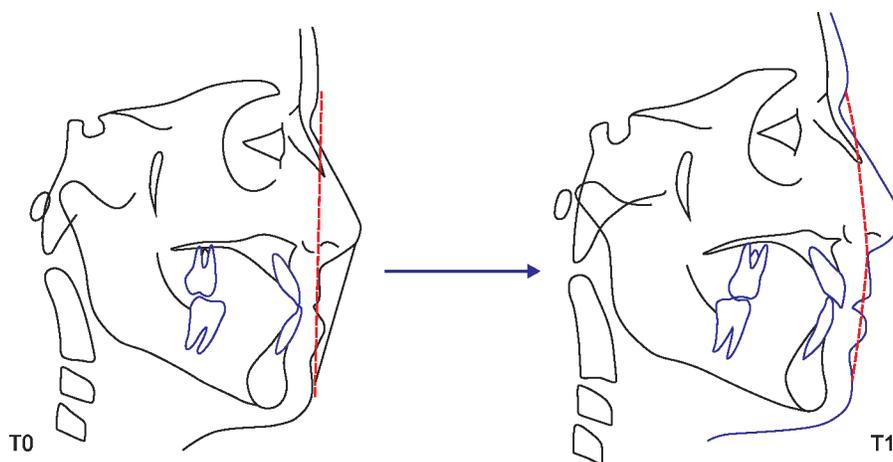


Fig. 6: Lateral cephalogram before and after treatment



Fig. 7: Healing of gingival recession in progress

the mandibular plane. Interincisal angle did not show significant modifications. Therefore, it is reasonable to assert that Alt-RAMEC protocol combined with facial mask does not produce relevant dental effects that could compensate the basal malocclusion and that all the modifications reported are skeletal.

CASE 1

An 11-year-old male came to our observation with skeletal class III malocclusion, class III molar relationship, and negative overjet (−1 mm). At the initial observation, he was in the CS1 stage of skeletal maturation, according to the CVM method (Fig. 1).

The patient was treated with the protocol described in the Materials and Methods section: we bonded a rapid palatal expander to the first upper molars using a vetroionomer cement; in this case, we did not use a two-hinged expander because first premolars were not present (Fig. 2). Each cycle of expansion and constriction needed 2 weeks to be done (1 week of expansion and 1 week of constriction), for a total amount of 6 weeks. We gave instructions to patients' parents to activate and deactivate the device: they had to activate the screw twice a day (0.50 mm) for 1 week and then to deactivate the screw twice a day for 1 week, repeating this protocol three times. After this period, we decided to expand for another 10 days to correct posterior crossbite and to gain an adequate palatal transverse diameter (2 activations of the screw a day).

During all this period, we checked weekly the patient to evaluate the opening of the suture (that was confirmed by the immediate opening of interincisal diastema after few days of expansion) (Fig. 3), the stability of the device, and the status of symptoms.

The patient complained of little pain to the area of the nose and the palate and to the upper molars during the first phase of the

Alt-RAMEC period; however, it was not necessary to take medicines to alleviate symptoms. Subsequently, he did not have any ache probably because the sutures were almost distracted.

Just after the Alt-RAMEC protocol, we adapted the Delaire mask on the patient's face to make it more comfortable on the chin and the lips; then, we gave the patient the mask and instructions about how to wear it. We recommended to use it all the night and as much as possible during the day (Fig. 4).

After 11 months of active treatment, the patient had a class II molar relationship and positive overjet (Fig. 5).

We removed the rapid maxillary expansion (RME) and took a cephalogram to compare with the T0 radiograph. Comparison between cephalometric analysis at T0 and T1 showed that the correction of the skeletal class III malocclusion was obtained (Fig. 6); the profile changed from flat to concave due to the advancement of the maxilla, becoming more harmonious in the medium and the lower third with respect to the E line.

Interestingly, the gingival recession on the lower central incisor that appeared because of the edge-to-edge contact and poor oral hygiene went to spontaneous resolution after overjet correction (Fig. 7).

CONCLUSION

By using the Alt-RAMEC protocol before the traction with the face mask, it is possible to open the circummaxillary sutures without overexpanding the maxilla. Moreover, three cycles of alternate palatal expansions and constrictions seem to be more effective than two cycles to obtain an adequate distraction of sutures and to protract the midface complex in class III preadolescent patients.

Therefore, we suggest to use this protocol whenever there is a necessity to treat a class III patient who is next to the pubertal growth spurt.

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