International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Alternative Rapid Maxillary Expansion and Constriction Vs Conventional Rapid Maxillary Expansion Protocol in Protraction Facemask Therapy: A Comprehensive Literature Review

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Abstract

The aim of this review article is to highlight the increasing popularity of Alt-RAMEC or Alternative Rapid Maxillary Expansion and Constriction procedure. It is a protocol used to correct the transverse maxillary discrepancy. In conjunction with facemask therapy, it can be used to correct the sagittal maxillary discrepancy in Class III malocclusion with a retrusive maxilla.

Alt-RAMEC procedure was introduced by Liou in 2005 with the conclusion that the maxilla can be protracted more effectively through a repetitive weekly protocol of alternate expansion and constriction than with a single course of rapid maxillary expansion (RME).

The article highlights the comparison of Alt-RAMEC maxillary expansion protocol with conventional RME protocol.

This review will discuss the studies which include successful treatments by applying this protocol and differences with other methods.

Keywords: Alt-RAMEC, Maxillary Expansion, Alternate Expansion and Constriction

1. Introduction

The use of rapid maxillary expansion to correct the transverse maxillary arch discrepancy is very common amongst the orthodontic practitioners. Applying a lateral force against the posterior maxillary dentition produces a separation of the midpalatal suture and results in an orthopaedic expansion.

Generally, RME appliances are fixed and generate 3-10 pounds of force. After activation, RME produces a net increase in the transverse width of the maxillary basal bone, thereby correcting the crossbites. [1]

RME is also used for protracting the maxilla with face mask (FM) therapy to correct skeletal Class III an-

omalies with maxillary deficiency. [2] Prior to facemask therapy, RME has been recommended as it stimulates maxillary movement by opening the circummaxillary sutures.[3]

Various modifications of maxillary expansion appliances have been introduced. Haas proposed a design to increase the orthopaedic effect and reduce the dental side effects. He introduced the acrylic Haas-type expansion appliance that covered both the dental and the palatal tissues. It provided a support for the transfer of expansive forces directly to the maxillary skeletal base. [4]

A lot of literature supports that modifying tooth and tissue supported expansion appliances can prevent molar tipping and maintain vertical control.

Spolyar designed an expansion appliance covering the buccal segments with acrylic while leaving the palatal side open for better hygiene. [5]

The more commonly used type of RME appliance is the Hyrax-type expander, the design of which has been credited to Biederman. This type of expander is made entirely of stainless steel. It does not include any palatal acrylic and thus, has been considered a more hygienic appliance by many practitioners. [6]

In 2005, Liou et al. introduced a novel maxillary expansion method known as the "alternate rapid maxillary expansions and constrictions (Alt-RAMEC)", a recurrent weekly expansion and constriction protocol of 9 weeks using a double hinged expander.

2. The Alt- RAMEC Protocol

In 2005 Liou et al [8] tested a hypothesis by comparing the cephalometric results in two groups of patients treated either with a single course of RME or a repetitive weekly protocol of Alt-RAMEC.

According to him, the goal of rapid maxillary expansion in face mask therapy is to disarticulate the circumaxillary sutures to facilitate its forward positioning. To disarticulate the circumaxillary sutures without overexpansion of the maxilla, a repetitive weekly protocol of Alternate Rapid Maxillary Expansions and Constrictions (Alt-RAMEC) may be followed. He compared the effects of the protocol to simple tooth extraction, in which the tooth is repeatedly rocked buccally and lingually until it is disarticulated from the alveolar socket. It was postulated that the repetitive weekly protocol of Alt-RAMEC displaces the maxilla more effectively than a single course of RME.

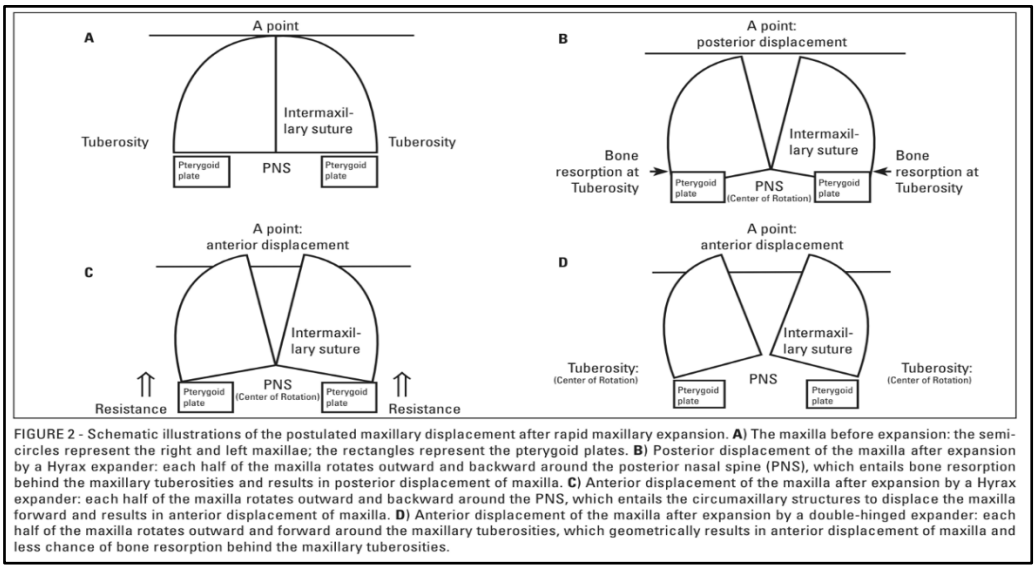

FIGURE 2 - Schematic illustrations of the postulated maxillary displacement after rapid maxillary expansion. **A)** The maxilla before expansion: the semi-circles represent the right and left maxillae; the rectangles represent the pterygoid plates. **B)** Posterior displacement of the maxilla after expansion by a Hyrax expander: each half of the maxilla rotates outward and backward around the posterior nasal spine (PNS), which entails bone resorption behind the maxillary tuberosities and results in posterior displacement of maxilla. **C)** Anterior displacement of the maxilla after expansion by a Hyrax expander: each half of the maxilla rotates outward and backward around the PNS, which entails the circumaxillary structures to displace the maxilla forward and results in anterior displacement of maxilla. **D)** Anterior displacement of the maxilla after expansion by a double-hinged expander: each half of the maxilla rotates outward and forward around the maxillary tuberosities, which geometrically results in anterior displacement of maxilla and less chance of bone resorption behind the maxillary tuberosities.

Figure 1 : Schematic Illustration of the Postulated Maxillary Displacement After Rapid Maxillary Expansion. [8]

3. Comparison of ALT-RAMEC Protocol vs RME

Face mask therapy following the conventional RME protocol and that following the Alt-RAMEC protocol in different procedures have been compared in various studies.

Greater forward movement of point A was seen in the Alt-RAMEC protocol as compared to conventional RME protocol, except in two studies. [14,15]

In a study by Liou et al [8] in 2005, 26 patients with a unilateral cleft lip and palate and hypoplastic maxillae (SNA < 82 degrees) were divided into two groups. Their age ranged from 9 to 12 years. The RME group included the first 16 patients (eight boys and eight girls). The Alt-RAMEC group included the next 10 patients (four boys and six girls). A two hinged expander was used.

The treatment protocol in the RME group was 1 week of RME followed by 5 months and 3 weeks of maxillary protraction. The total treatment time for expansion and protraction was 6 months. The treatment protocol in the Alt-RAMEC group was 9 weeks of Alt-RAMEC followed by 3 months and 3 weeks of maxillary protraction. The total treatment time was again 6 months. The weekly sequence of Alt-RAMEC was four pairings of expansion and constriction, followed by a final expansion. Each expansion or constriction course was 7 days and 1 mm per day.

The study concluded that more protraction was obtained in the Alt-RAMEC group (A point, 5.8±2.3 mm) than in the RME group (A point, 2.6±1.5 mm). [8]

Wang et al [9] in 2009 quantitatively analysed the opening of the circumaxillary suture after alternate rapid maxillary expansions and constrictions (Alt-RAMEC). Twelve inbred cats were grouped into two groups for 1 week of rapid maxillary expansion (RME) (1 mm/day) or 5 weeks of Alt-RAMEC (1 mm/day). Following the expansion, the craniofacial skeleton of each cat was studied for opening of the circumaxillary suture using a 0.5 mm periodontal probe. It was concluded that Alt-RAMEC protocol opens up both the sagittally and the coronally running circumaxillary sutures quantitatively more than the conventional RME protocol.

Isci et al [10] in 2010 compared the dentofacial effects of rapid palatal expansion (RPE) and Alt- RAMEC protocols with reverse headgear. The study was conducted on two groups of 15 subjects each. In the RPE group (seven males and eight females, 11.94 ± 1.62 years), Hyrax screws were activated every 12 hours for 1 week. At the end of this period, RPE was stopped and the patients were instructed to wear the reverse headgear. In the Alt-RAMEC group (seven males and eight females, 11.34 ± 1.81 years), the screws were activated every 12 hours for 1 week. Subsequently, the screws were deactivated every 12 hours for 1 week followed by activation and deactivation for the next 2 weeks. After this protocol, the patients were instructed to use the reverse headgear.

The anterior movement of point A (4.13 mm) for the Alt-RAMEC group was approximately twice that of the RPE group (2.33 mm; $P < 0.001$). The pronounced anterior movement of point A demonstrates that the Alt-RAMEC procedure positively affected the maxillary protraction. [10]

Masucci et al [11] in 2014 assessed the effects of alternate rapid maxillary expansion and constriction (Alt-RAMEC) protocol in combination with facemask (FM) therapy in Class III growing patients. 31 Class III patients (17 males, 14 females) were treated with Alt-RAMEC/FM protocol. They were compared to a sample of 31 Class III patients (16 males and 15 females) treated with conventional rapid maxillary expansion and facemask (RME/FM); and to a control group of 21 subjects with untreated Class III malocclusion. All patients were evaluated and compared at the beginning and at the end of the orthopaedic therapy. Both the Alt-RAMEC/FM and the RME/FM protocols showed significant favourable effects of correction of the Class III malocclusion.

The Alt-RAMEC/FM protocol produced a more effective advancement of the maxilla (SNA +1.2°) and greater intermaxillary changes (ANB +1.7°) as compared to the RME/FM protocol.

Wilmes et al [12] in 2014 reported that face mask therapy with the Alt-RAMEC protocol provides a longer-lasting "RPE effect" for increased maxillary protraction following an 8 week Alt-RAMEC protocol with hybrid hyrax RME in two patients with Class III malocclusion.

Liu et al [13] in 2015 investigated the effects of facemask protraction combined with alternating rapid palatal expansion and constriction (Alt-RAMEC) vs rapid palatal expansion (RPE) in 44 patients (age 7 to 13 year old) with a retrusive maxilla. Hyrax palatal expanders and facemask maxillary protraction were used in all patients. Patients in the RPE group were treated with rapid palatal expansion for 1 week. Patients in the Alt-RAMEC group were treated for 7 weeks. The expansion or constriction rate was 1 mm per day. The pretreatment and the posttreatment cephalometric radiographs were compared. The average protraction time in the RPE group was 10.84 months while it was 9.06 months in Alt-RAMEC group.

Maxillary forward movement increased by 3.04 mm in the Alt-RAMEC group, which was greater than that in the RPE group (2.11 mm). Hence, Facemask maxillary protraction with RPE/C positively affected the forward movement of the maxilla compared to that with RPE alone in the early treatment of maxillary retrusive patients.

However, two studies found no significant difference between the Alt-RAMEC protocol and conventional RME protocol. [14,15]

Viera et al[14] in 2009 evaluated the amount of maxillary protraction achieved with face mask therapy in complete unilateral cleft lip and palate patients using two types of rapid maxillary expansion (RME) protocols. The sample consisted of 20 individuals (nine boys and 11 girls; with mean age of 10 years) with unilateral complete cleft lip and palate who had a constricted maxilla in the vertical and transverse dimensions and were divided into 2 groups. Ten patients underwent 1 week of RME, followed by 23 weeks of maxillary protraction. The other group consisted of 10 patients who underwent 7 weeks of alternate rapid maxillary expansion and constriction, followed by 17 weeks of maxillary protraction. Both the groups were treated for 6 months. It was concluded that there was no significant difference between the groups using these different protocols.

Do-delatour et al [15] in 2009 evaluated the difference in the extent of maxillary protraction clinically when combined with either 7 weeks of Alt-RAMEC or 1 week of rapid maxillary expansion. Eighteen patients with Class III malocclusion were treated with either Alt-RAMEC/protraction or with rapid maxillary expansion/protraction. Lateral cephalometric radiographs were used to evaluate the skeletal and dental changes. After taking the growth changes into consideration, significant differences between the two expansion protocols were found only with respect to the position of the lower molars. The data suggested that Alt-RAMEC alone does not increase the amount of forward movement of the maxilla. Other factors such as patient age, the duration the facemask worn and treatment duration affected the treatment outcome.

4. Conclusion

When the Alt-RAMEC protocol was first introduced, it was applied with a double-hinged hyrax screw as developed by Liou. In the studies conducted in the following years, this protocol was successfully applied using with standard hyrax screws.

Based on the literature review, the following conclusions have been made:

- Alt-RAMEC protocol before maxillary protraction is an effective method for early treatment of patients with Class III malocclusion.

- In most of the studies, the Alt-RAMEC protocol appears to be more effective than the RME.
- Further long-term studies on the Alt-RAMEC protocol are required.

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