

A Review on Maxillary Expansion, Alternate Maxillary Expansion and Constriction, and Maxillary Disarticulations

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Received: December 11, 2021 **Published:** December 23, 2021

Abstract:

The aim of this review is to explain the different types of expansion protocols such as rapid maxillary expansion (RME), mini-screw assisted rapid palatal expansion (MARPE), and alternate rapid maxillary expansion and constriction (Alt-RAMEC) approach used in expansion of maxilla and treatment of class III malocclusion. An important consideration of maxillary expansion is to increase the skeletal effects of expansion and increase the width of circummaxillary sutures. This causes an increase in the effects of maxillary protraction procedures such as facemask. Facemask is an extra-oral appliance and has less compliance due to unesthetic appeal. MARPE combined with intermaxillary elastics on skeletal anchorage can be used for Class III correction in place of facemask. In this review, all the different protocols for maxillary expansion and protraction will be discussed.

Keywords: RME, MARPE, Alt-RAMEC, Class III malocclusion.

Introduction

Class III malocclusions have enjoyed more focus than other types of malocclusions for ages.¹ In the current world, patients are very self aware of their external appearance and place a high importance on esthetics. Class III malocclusions can give an unesthetic appearance to the patients and adversely affect their psychosocial status. Such malocclusion are mainly caused by genetic conditions, inheritance, mandibular prognathism, maxillary retrognathism, or a combination of both.^{2,3}

There are mainly two approaches for the management of Class III anomalies depending on the growth status of the patient. In the growth and development period, orthopedic treatment can be used for management of patients. The other approach is camouflage treatment or orthognathic surgical treatment, which are used in adult patients where the growth and development has been completed.⁴

Class III treatment:

In cases where the growth and development period is not completed, mandibular treatment is used to redirect the development of mandible by using chin cap, and maxillary protraction used to treat retrusive maxilla by facemask.⁵ In the literature, there are some researchers who utilized face mask in combination with other methods for maxillary protraction.⁶ The types of facemask used are petite facemask and Delaire facemask. Facemask can result in the following effects - protraction of maxilla, proclination of maxillary teeth, clockwise rotation of mandible. When the protraction of maxilla is performed, it is advantageous to expand the maxillary arch with an expander. This procedure can loosen the maxillary sutural connections with the adjacent bones.⁷ Maxilla articulates with the opposing maxillary bone in the midline and with other facial and cranial bones with circummaxillary sutures.

Influence of Conventional Maxillary Expansion and Mini Screw Assisted Rapid Palatal Expansion on Class III treatment

When maxillary expansion is done with rapid maxillary expansion appliance such as a Hyrax or Hass appliance, it leads to stress on the sutures of the maxillary bone.⁸

This is useful in increasing the protraction of maxilla when class III correction is done with facemask.^{9,10} The Mini-screw assisted rapid maxillary expansion (MARPE) procedure uses mini-screws connected with palatal expanders to achieve maxillary expansion.¹¹ Mini-screws have been used in different areas of maxilla and mandible such as buccal shelf, mandibular ramus, maxillary buccal bone, and maxillary palate.¹²⁻¹⁵ From all the different sites, the success rates of palatal mini-screws has been found to be highest.¹⁶ The purpose of this method is to increase the efficiency of palatal expansion appliance and achieve more skeletal effects and reduce the unwanted dentoalveolar effects. Increasing the skeletal effects of expansion leads to decrease in the amount of relapse in the post-expansion period.¹⁷⁻¹⁹ In addition, increasing the skeletal effects would mean a higher loosening of the circummaxillary sutures leading to increased Class III correction with the appliances.

Alt-RAMEC approach

Alternate rapid maxillary expansion and contraction (Alt-RAMEC) approach utilizes this principle of loosening of maxillary sutures.²⁰ In the Alt-RAMEC approach, the maxillary arch is expanded by activating the expansion screw open for a week and followed by contraction in which the expansion screw is closed for a week.²¹⁻²³ Performing this sequence of expansion and contraction leads to decreasing the rigidity of the maxillary articulations with adjacent bones but without expanding the maxilla significantly.

Amount of Expansion and circummaxillary disarticulations:

The amount of expansion needed with RME to provide sutural disarticulations is important to consider while deciding which method to use for the patient. Some researchers have stated that with 5-mm of expansion, RME can result in good sutural mobilization. Whereas, other researchers have described that the amount of expansion needed with RME may be as high as 12-15 mm. Expansion of 12-15 mm may be considered as an excessive amount of expansion with RME that can cause irritated palatal mucosa.²⁴ With MARPE appliance, the amount of expansion required to achieve maxillary disarticulations is less because the amount of skeletal expansion with MARPE appliance is higher than that with RME and controls.²⁵ The Alt-RAMEC approach would utilize the expansion and constriction method to achieve the disarticulations without expanding the maxilla significantly. In the Alt-RAMEC approach, expansion procedure is undertaken for the first week by the palatal expanders with 1-mm per day of expansion as explained by Liou et al.²⁶ The screw is then closed at the same rate for the next week. This procedure is repeated for multiple times and at the end of the expansion and constriction protocol, the class III protraction force is applied to the maxilla.²⁷ Certain interventions such as osteoperforations can also be performed to achieve higher efficacy for expansion, especially in mature patients.²⁸ Osteoperforations cause an increase in the bone remodeling which results in higher number of osteoclasts.²⁹

The conventional method of expansion of maxillary arch and protraction of maxilla include the protraction facemask.³⁰ In this method, the protraction force is applied with a facemask at an angle of 15 degrees to the occlusal plane. High forces in the range of 400 grams per side are used for facemask appliance. Facemask is an extraoral appliance and therefore is not esthetic.³¹⁻³² This causes decreased compliance with facemask for orthodontic patients. The skeletal anchorage with the MARPE approach, enables the application of the intermaxillary elastics through the mini-implants or mini-screws.³³ This allows the correction of Class III malocclusion with protraction of maxilla and clockwise rotation of mandible.³³ The intermaxillary elastics used with MARPE appliance and skeletal anchorage are intraoral and therefore more esthetic than the facemask options described above. In addition, the force levels for the elastics used with this method are not as high as required for a facemask appliance. This enables higher compliance for MARPE and class III elastics with the orthodontic patients.

The method of maxillary expansion is independent of the type of orthodontic appliance used for treatment. Maxillary expansion with RME or MARPE can be followed with fixed orthodontic appliances or even with aligners.³⁴⁻³⁸ The expansion appliances provide a distinct advantage by generating high amounts of forces and working predictably in a rapid fashion. Such methods can also be used for individuals with craniofacial deformities such as cleft lip and palate to correct the maxillary discrepancy.

Conclusions

The utilization of the methods of maxillary expansion such as rapid maxillary expansion (RME), mini-screw assisted rapid palatal expansion (MARPE), or alternate rapid maxillary expansion and constriction (Alt-RAMEC) approach is an effective method for treatment of Class III malocclusions. MARPE appears to have a better skeletal expansion than RME. When MARPE approach is combined with intermaxillary Class III elastics on skeletal anchorage, protraction of maxilla can be accomplished for the correction of Class III malocclusion.

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Citation: Pappoppula LP, Tantravahi VSS. "A Review on Maxillary Expansion, Alternate Maxillary Expansion and Constriction, and Maxillary Disarticulations". *SVOA Dentistry* 3:1 (2022) Pages 21-24.

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