

# Miniscrew - Assisted Rapid Palatal Expander (Marpe): A Efficient Alternative Treatment of axillary Transverse Deficiency

**Peer review status:**

No

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**Article ID:** WMC005360

**Article Type:** Systematic Review

**Submitted on:** 03-Nov-2017, 07:32:10 PM GMT **Published on:** 08-Nov-2017, 05:48:38 AM GMT

**Article URL:** [http://www.webmedcentral.com/article\\_view/5360](http://www.webmedcentral.com/article_view/5360)

**Subject Categories:** ORTHODONTICS

**Keywords:**

MINISCREW, ASSISTED, RAPID, PALATAL, EXPANDER, ALTERNATIVE, TREATMENT, MAXILLARY, TRANSVERSE, DEFICIENCY

**How to cite the article:** Di Luzio C, Bellisario A, Squillace F, Favale M, Caputo M. Miniscrew - Assisted Rapid Palatal Expander (Marpe): A Efficient Alternative Treatment of axillary Transverse Deficiency. WebmedCentral ORTHODONTICS 2017;8(11):WMC005360

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**Source(s) of Funding:**

No fund has been taken

**Competing Interests:**

none

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## Abstract

Maxillary deficiency is a very common problem in orthodontic patients. Various appliances and treatment protocols have been developed and used; the most common is rapid maxillary expansion (RME) performed with a tooth-anchor expander. However it has been a general perception that the predictability of orthopedic expansion is greatly reduced after 15 years of age. Due to this reason, it has been proposed the MARPE, to maximize skeletal effects in adults and to avoid surgery too.

## Introduction

The midpalatal suture represents the fusion of maxillary palatal processes. It's made up of three segments:

- The anterior segment or intermaxillary segment;
- The middle segment from the incisive foramen to the trasversal suture;
- The posterior segment after the trasversal suture.

It is possible to compare osteogenic process in the midpalatal suture to the growth and bone remodeling provided by the periosteum in other bone surfaces. It fulfills the requirements of adjacent tissues by means of external stimuli as known as functional demands. The midpalatal suture is not a center of maxillary bone growth, but it responds to osteogenic stimuli. Infact, the cross-sectional growth of the jaw occurs with sutural way at the midpalatal suture and with appositional way on the outer surface at the level of maxillary sinus.

The ossification of this suture starts at the posterior region with mineralized bridges formed from posteriorly to anteriorly. In 1991, Mann et al identified a sequence of ossification analyzing the skeletal age of the palatal sutures of 186 human skulls. It starts with the incisive suture and it is followed by the posterior segment of the midpalatal suture and then by the trasverse palatine suture. At the end this process is followed by the middle segment of the midpalatal

suture.

We can say that ossification's suture is a limiting factor for rapid palatal expansion and it seems to be a consensus that starts at the posterior segment.

The biological principle of rapid palate expansion under which is possibile to correct maxillary width deficiency, lies in the presence of palatal suture at synfibrosis stage up to adulthood (12-14 years old in females and 14-16 years old in males) and in traction on sutural fibers by applying orthopedic forces. In orthodontics, the use of intense forces causes the formation of extensive hyaline areas in the buccal periodontum. These areas are able to stop tooth's movement for a while and let to obtain a suture separation. If the suture is a synfibrosis this space will be filled with fibrous connective tissue that will be replaced with bone.

It has been reported that 9.4% of whole populations and nearly 30% of adult orthodontic patients have a maxillary transverse deficiency related to a posterior crossbite. Rapid palatal expansion (RPE) is a reliable treatment modality in prepubertal patients, but there are several controversies about nonsurgical expansion in adults. Surgically assisted RPE (SARPE) has been the treatment of choice to overcome the decreased elasticity of bone and increased resistance of interdigitated midpalatal suture in adults.

However, even though nonsurgical palatal expansion is feasible in patients in growth or in young adults, is important to explain that orthopedic expansion of the basal bone is essential to prevent detrimental periodontal effects rather than dentoalveolar tipping. These effects could be: bony dehiscence and undesirable tooth movement , root resorption and lack of firm anchorage to retain sutural long-term expansion.

A rigid element that delivers the expansion force directly to the basal bone could be a solution for the problems described above. For this purpose, a miniscrew-assisted rapid palatal expander (MARPE) has been designed.

In 2010, Lee et al treated a 20-years-old patient with severe transverse discrepancy and mandibular prognathism. Before orthognathic surgery the patient

used an expansion appliance with miniscrews to avoid another surgeon to approach transverse problem. Expansion was achieved with minimal damage to teeth and periodontum and with stable outcomes confirmed by clinical and radiographic examinations.

Recently on the basis of Lee's studies, Park and Hwang, Moon and MacGinnis developed the maxillary skeletal expander (MSE) with four miniscrews installed parallel to the midpalatal suture and to itself.

## Materials and Method

A lot of works have been published on international literature about maxillary expansion. In the last years the expansion performed with the help of temporary anchorage devices (TAD), commonly known as miniscrews or micro-implants, is become object of large scientific interest. The review of literature has been performed on the principal medical databases: Pubmed (Medline), Embase and Scopus.

The keywords used were: midpalatal suture, maxillary expansion AND miniscrews, rapid maxillary expansion. No restriction of time have been fixed.

## Review

Conventional rapid palatal expanders (tooth-borne or tooth-and-tissue borne) cause questionable effects on the basal bone after 15 years old, with undesirable effects about anchoring tooth elements.

MARPE is a simple modification of the conventional RPE appliance; the main difference is the incorporation of several miniscrews to ensure expansion of the underlying basal bone and maintain the separated bones during the consolidation period. An impression is made with the bands on the first premolars and first molars and a conventional hyrax expander is constructed on the cast. Four rigid connectors of stainless steel wire with helical hooks are soldered on the base of hyrax screw body. Two anterior hooks are positioned on the rugae region and the other two posterior hooks are placed on the parasagittal area. Orthodontics miniscrews are placed in the center of the helical hooks. This is a tooth-borne and a bone-borne expander.

However there are different designs of bone-borne palatal expanders using micro-implants: one with miniscrews placed lateral to midpalatal suture (type 1), the second with miniscrews placed at the palatal slope (type 2) and the third with miniscrews as in type 1 but with additional conventional Hyrax arms (type 3).

Several studies have been conducted to analyze stress distribution in these different appliances.

Type 1 shows that stress was concentrated around the miniscrews and the midpalatal suture with a maximum value of 0.362 Gpa. No stresses were observed around the roots. On the other hand type 2 demonstrated low stresses distributed evenly around the microimplants. Stresses in the midpalatal suture were less than those in type 1 with a maximum value of 0.046 Gpa. In type 3 there was a large amount of stress located in the midpalatal suture and around microimplants and roots of the anchor teeth. Maximum stress concentration (0.368 Gpa) was shown around the roots of the first premolar in the cross section.

The placement of miniscrews is rather simple from a surgical point of view. First at all is required to the patient to rinse with chlorhexadine and this is followed by local anesthesia infiltration of the palatal mucosa. Patients are prescribed oral antibiotics and chlorhexidine rinse for 5 days to prevent infections. After this an healing period of one week is generally allowed before activation of the expander.

The activation protocol may be different depending on the degree of expansion sought. Anyway the protocol provides for a period (3-6 months) of passive stabilization after active expansion to allow bone formation in the separated palatal suture, ensuring in this way stable results.

## Conclusions

The miniscrew-assisted rapid palatal expander (MARPE) is characterized by a decrease in the excessive load performed by conventional appliances on the buccal periodontal ligament of teeth to which they are anchored, thus resulting in multiple resorption on their roots. There is also a considerable decrease in accidental movement of anchoring teeth, given that, with the use of MARPE, the support for palatal expansion is no longer dental, but osseus.

Moreover MARPE represents a valid alternative to surgery in patients with complex craniofacial discrepancies and secure the safety and stability of the transverse correction. To avoid multiple surgeries, nonsurgical maxillary expansion can be performed to achieve both skeletal and dentoalveolar expansion for transverse correction.

Of all types proposed, type 2 seems to be the most efficient bone-anchored maxillary expander because the stress is distributed widely throughout the palate. Moreover the stress around the microimplants decrease and results in dentoalveolar expansion.

without buccal inclination of the dentition, because the expander is not connected to teeth.

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