

MARPE in Orthodontics- A Review Article

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ABSTRACT

"Microimplant-Assisted Rapid Palatal Expansion with Cortical Bone Support." It refers to a specific technique in orthodontics that utilizes microimplants (mini-implants or temporary anchorage devices) to assist in rapid palatal expansion (RPE) without the need for surgical intervention. Here's a breakdown of what this approach involves and its significance:

1. **Microimplant-Assisted:** This indicates that the palatal expansion is facilitated or supported by the use of microimplants. These are small screws or implants placed temporarily into the bone to provide anchorage for orthodontic appliances.
2. **Rapid Palatal Expansion (RPE):** This is a technique used to widen the maxilla (upper jaw) by separating the midpalatal suture. It is typically used to correct transverse maxillary deficiency, which is a condition where the upper jaw is narrower than ideal.

Cortical Bone Support: Refers to the support provided by the cortical bone (dense outer layer of bone) during the expansion process. This is important for the stability and effectiveness of the expansion.

Keywords: MARPE, Mid-palatal sutures, Palatal Expansion, Rapid Palatal Expansion.

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Introduction

History: Maxillary expansion appliances have a long history of evolution in orthodontics.

1. **Early Concept (1860s):** The concept of maxillary expansion originated in the 1860s with Angell, who introduced the idea of using a palatal expansion appliance to laterally open the mid-palatal suture. This marked the initial steps towards correcting transverse maxillary deficiency.¹

2. **Haas Expander (1956):** In 1956, Haas introduced the Haas Expander to the United States. This appliance was revolutionary as it was

the first to document increases in nasal width and arch perimeter resulting from maxillary expansion. Haas's work significantly advanced the understanding and application of palatal expansion techniques.²

3. **Modern Developments:** Over time, various advancements and refinements in maxillary expansion techniques have occurred. These include rapid palatal expanders (RPEs) and more recently, microimplant-assisted approaches such as MARPE (Microimplant-Assisted Rapid Palatal Expansion). These modern techniques aim to achieve more controlled and stable expansion

outcomes, often without the need for surgical intervention.²

4. The introduction of Microimplant Assisted Rapid Palatal Expansion (MARPE) appliances presented a new treatment option for clinicians

and adolescent patients dealing with maxillary transverse deficiency. Three-dimensional finite element analysis demonstrated that these devices induce more skeletal and fewer dental side effects compared to traditional RME.^{3,4}

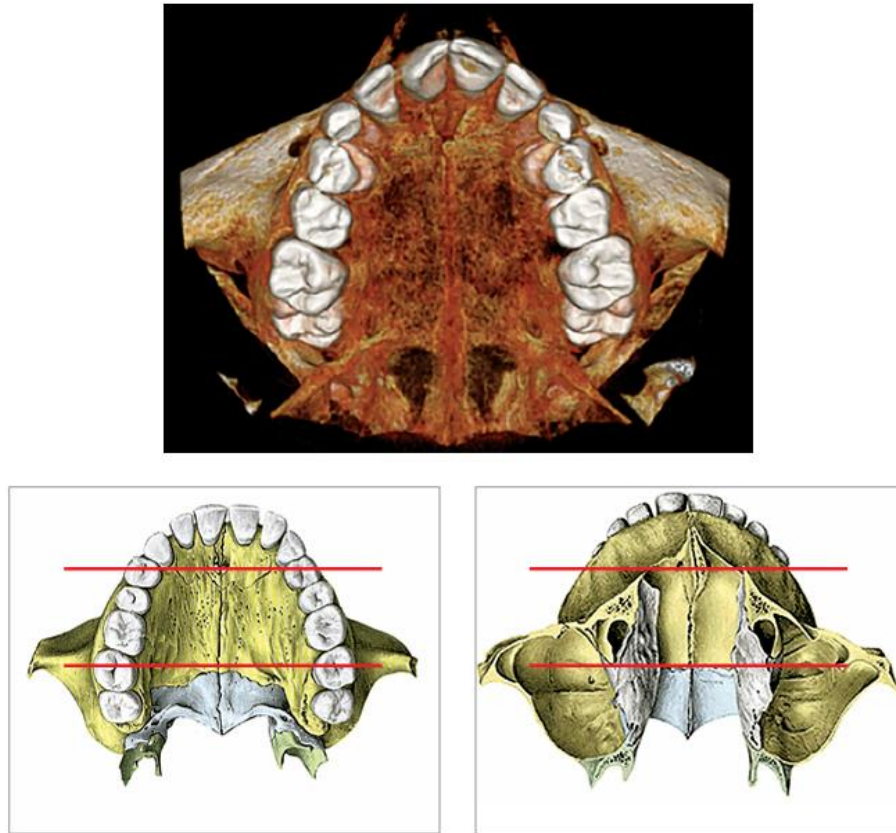


Figure 1: The midpalatal suture is a crucial anatomical feature situated along the center of the hard palate, linking the two halves of the palatine bone. It can be divided into three segments: Anterior, Middle, and Posterior Segment.

Appliance Design

The microimplants had a diameter of 1.8mm and a length of 11mm. Their extended length enabled them to engage both cortical layers of the palate and nasal floor, thereby minimizing the force transmitted to the teeth used for anchorage during expansion. Placed as posteriorly as feasible, the palatal micro implants aimed to maximize orthopedic force directed efficiently towards the pterygoid plates, ensuring it did not exceed the limits of the palatine process.⁵

Activation Protocol

Each participant commenced maxillary expansion two weeks after microimplant placement. The rate of activation varied depending on the patient's age. Expansion procedures were halted if patients reported intolerable pain, if the jackscrew became too difficult to turn, if any microimplants loosened, or if soft tissue wrapped around the microimplants or linkages, leading to noticeable local inflammation. Patients received instructions on how to activate the expansion and maintain oral hygiene by rinsing the palatal area after

meals. The number of expansion turns was documented, regular dental check-ups were mandatory, and all adverse events were promptly

reported. Expansion concluded upon achieving 2-3mm of overexpansion.

Rapid Palatal Expansion and MARPE



Figure 2: The MARPE appliance incorporates mini-screws into its structural design, with dimensions customized to fit the palatal area along the midpalatal suture. Examples include:

- A) ****MSE Expansion Appliance****: Created by Moon et al. (Biomaterial Korea, Seoul, South Korea), this device represents a type of MARPE appliance used for maxillary skeletal expansion.
- B) ****Modified MARPE Appliance by Suzuki et al.****: Suzuki et al. (Peclab, Belo Horizonte/MG, Brazil) introduced alterations to the original MARPE design in this variant.
- C) ****Post-Expansion Computed Tomography****: This imaging method demonstrates the outcomes of the expansion process as applied to the modified MARPE appliance.

The orthopedic expansion appliance, whether equipped with a screw secured to resin support adapted to the palatal mucosa or not, applies force to the supporting teeth. This process results in reduced blood flow in the buccal periodontium and the formation of extensive hyaline areas.⁶ These areas lack the necessary conditions for bone modeling units to recover, which are essential for tooth movement within the bone. Bone resorption takes place at a distance and progresses slowly, maintaining the position of the supporting teeth until the suture gives way under the resulting force.

Once the expansion is evident, indicated by the opening of a gap between the maxillary central incisors (diastema), the next step involves achieving overcorrection of the crossbite to prevent relapse. During this phase, the expansion appliance remains inactive for three months. Following this period, a retention device is installed and worn for six months.⁷

In cases where maxillary expansion cannot be successfully achieved through orthodontic

methods, surgical intervention for rapid palatal expansion may be recommended.

Potential adverse effects include discomfort in the regions of the incisors or nasal sutures, as well as ulceration or necrosis of the palatal mucosa. Swelling at the midpalatal suture may occur, particularly shortly after expansion. Ischemia and necrosis of the palatal mucosa can occur if the suture does not yield to the forces exerted by the tooth-mucosa-supported appliance.⁸

The miniscrew-assisted rapid palatal expander (MARPE) is designed to reduce the excessive load traditionally placed on the buccal periodontal ligament of anchoring teeth by conventional appliances, thereby minimizing the risk of flat, multiple root resorption. Clinically, MARPE is considered safe for patients, as it shifts the support for palatal expansion from dental to osseous structures.

Recent studies advocate for the use of MARPE in growing patients with both transverse and anteroposterior maxillary deficiencies, as well as in cases requiring maxillary protraction. By

anchoring into the basal bone of the maxilla, MARPE mini-screws enhance skeletal effects during maxillary advancement, promoting primarily orthopedic movement while reducing the impact on teeth.⁹

The results of palatal expansion can range from failure to achieving a horizontal gain of up to 4 mm. Failure has been linked to factors such as the patient's skeletal maturity, variability in the transverse measurement depending on when post-treatment data were collected, and issues with retention. In cases of retention failure, there is a risk of relapse in horizontal measurements and downward movement of the maxilla, which may result in the maxilla either remaining unchanged or returning to its original position.^{10,11,12,13}

Conclusion

Rapid palatal expansion may be recommended for patients who have reached the final stage of pubertal growth, as well as for adults with maxillary constriction. It offers a treatment option that could potentially obviate the need for surgical intervention. When combined with rapid palatal expanders, it has the potential to amplify the skeletal effects of the treatment.

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In the current market, some companies offer prefabricated MARPE (Mini-Screw Assisted Rapid Palatal Expansion) devices that enable orthodontists to create their own expanding screws. However, these devices have limitations, particularly regarding the adjustment of the height of miniscrew fixation rings. This restriction can be problematic in clinical cases involving severe maxillary atresia or palatal asymmetry, conditions that are common among patients who might benefit from MARPE. Custom-fabricated expanders, made by skilled technicians, can address these limitations by being tailored to each individual's anatomy, thereby reducing the risk of complications.

The current protocol for selecting miniscrews for MARPE emphasizes the importance of understanding the bone structure of the palatal region and the midpalatal suture prior to inserting the expanders. This knowledge aids in accurate diagnosis, planning, and predicting the outcomes of maxillary expansion, ensuring a safer application of the MARPE technique.

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