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# MINISCREW ASSISTED RAPID PALATAL EXPANDER(MARPE)- A LITERATURE REVIEW

Orthodontics

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## ABSTRACT

Sleep disorders and associated breathing difficulties have received significant attention, leading to an increased interest in the study of various maxillary expansion protocols. MARPE has become progressively popular in the management of transverse discrepancies in comparison to traditional expansion methods, due to its significant skeletal effects. Awareness of early prevention or methods to alleviate sleep related breathing disorder symptoms by possibly increasing the airway dimensions has led to an interest in the study of various maxillary expansion protocols. This article aims to review the appliance design, miniscrew placement, activation technique etc.

## KEYWORDS

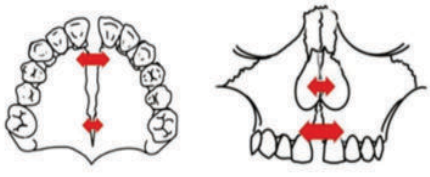
Palatal expansion, Midpalatal suture, Rapid palatal expansion, MARPE

## INTRODUCTION

Treatment of the constricted maxillary arch requires the application of orthopedic forces or a surgical intervention, for achieving expansion. Patients who have minimal or no growth remaining are often reluctant to undergo surgery, leading to attempts to correct these deficiencies without subjecting them to surgery, which formed the basis for the development of MARPE.

The MARPE appliance by Dr. Won Moon et al is an innovative modification of the RME appliance and has evolved as a breakthrough in transverse malocclusion correction[8]. It has proved to be a viable and efficient nonsurgical option for young adults.

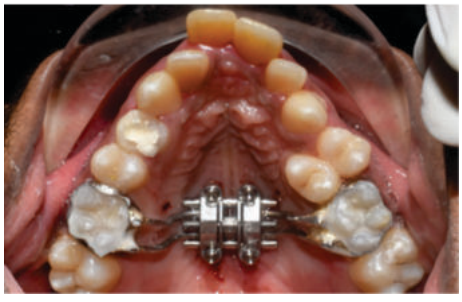
Histologically, Melson et al[3,4] examined the maturation of the mid palatal suture at different developmental stages. The suture was broad and smooth in children upto 10 yrs of age (Infantile stage), whereas in the "juvenile" stage it had developed into a more typical squamous suture with overlapping sections (Age range-10 to 13 years). Finally, during the "adolescent" stage (13 and 14 years of age) the suture was wavier with increased interdigitation. They have also included observations of the "adult" stage of the suture that noted synostoses and numerous bony bridge formations across the suture. Clinical support for the histologic findings by Melsen is derived from the results of a study by Wertz and Dreskin who noted greater and more stable orthopaedic changes in patients under the age of 12 years.[5]



The major structures that hinder maxillary expansion are the zygomatic buttress, the pterygopalatine suture, and the interdigitating Midpalatal suture. when the above structures are surgically separated then only maxilla can be split. However, sometimes with surgically assisted rapid palatal expansion (SARPE), the anterior region of the maxilla is widened significantly more than the posterior region because pterygopalatine disjunction is often not performed completely[6]

## DISCUSSION:

Microimplant-assisted RPE (MARPE) appliances are developed recently that can localize the lateral forces to the Midpalatal suture while minimally using the dentoalveolar complex. The maxillary skeletal expander (MSE) is a particular type of MARPE, first developed around 2003, which has evolved over time.[7] The MSE was specifically designed to apply expansion force more posteriorly against the zygomatic buttress bones and pterygopalatine sutures, and more superiorly against the Midpalatal suture and superiorly positioned peri-maxillary sutures.[7]The jackscrew is positioned between the maxillary first molars medial to the zygomatic buttress, unlike other miniscrew assisted RPE designs. Bicortical engagement of the palate on both the palatal and nasal cortical layers are recommended to prevent tipping of the implant within the bone and it helps in reducing the internal strain produced.[8]



The lateral force vectors generated through expansion with MSE are found to be closer to the zygomatic buttress and as the rotational fulcrum is located away, a more translational expansion is expected. Undesired effects such as lateral rotation of maxillary halves, clockwise rotation of the mandible and subsequent bite opening can be considerably minimized.[9]

### Insertion Factor Considerations:

### Appliance position:

Anteriorly-Distal to the 3rd rugae along the anterior palate increases the primary stability due to thick palatal bone, propagating the forces to the nasomaxillary complex.

Middle-on the flat palatal but thinner bone surface of second premolar region. This promotes a close contact area with the jackscrew but significantly increases the risk for Bicortical penetration.

Posteriorly- immediately anterior to the soft palate, at the region of the first permanent molar. This results in an increased orthopaedic effect due to the resistance offered by the pterygoid plates.

### Appliance Insertion:

Temporary Anchorage Device (TAD) placement is cumbersome sometimes due to lack of torque and directional control to drive the implant into hard palatal bone with an engine mounted or a

conventional straight driver. Silicon-based impression material is preferred when impressions are made for obtaining an accurate detail which is essential during the digital workflow process. Miniscrew must be placed before curing the luting cement. A diagonal sequence of miniscrew insertion into the appliance should be followed.

The root status of the supporting teeth on the OPG must be checked before band placement.

**Suggested expansion rates for different age groups[10]:**

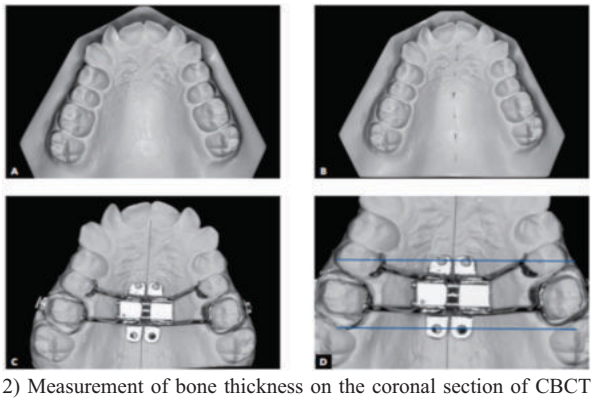
| Age of the patient | Initial expansion rate | Expansion rate after opening of the diastema |
|---|---|---|
| Early teens | 3 turns/week | 3 turns/week |
| Late teens | 1 turn/day | 1 turn/day |
| Adults | 2 turns/day | 1 turn/day |
| Older patients (>30 years) | .2 turns/day | 1 turn/day |

**Protocol For Selection Of Mini-implants Length In Marpe**

To select the length of miniscrews to be used in the MARPE technique, we suggest the following steps.

1) Achievement of dental casts the working dental cast is obtained after transfer impression with bands positioned on teeth 16 and 26. Firstly, the line referring to the Midpalatal suture is traced, which demarks the expanding screw in relation to its transverse position. The sites of miniscrew insertion are finalised with the expanding screws pre-positioned on the dental cast. In anteroposterior direction, as reference, the expanding screw may be positioned at the level of permanent first molars.

Two lines transverse to the Midpalatal suture are traced, in mesial and distal direction to the expanding screw, passing through the centre of fixation rings of miniscrews up to the occlusal surface of teeth. These lines are used as reference for the achievement of coronal tomographic slices and measurement of bone thickness at the selected anatomical regions.[9]



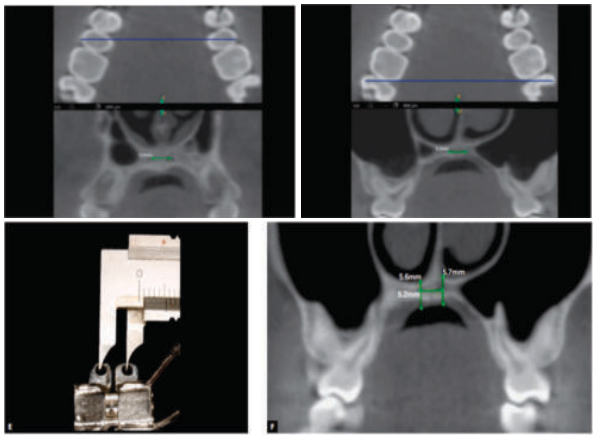
2) Measurement of bone thickness on the coronal section of CBCT images

The following step comprises selection of the coronal sections that were predetermined on the dental casts, as indicated in Figure, following the identification of reference lines transverse to the Midpalatal suture, passing through the fixation rings of miniscrews mesial and distal to the expanding screw. At the mesial region of the expanding screw, as indicated on the dental cast, a plane is delineated crossing the fixation rings of miniscrews until beyond the respective teeth.

The same position is selected on the coronal section of the CBCT image, taking as reference the teeth crossed by the plane defined on the dental cast.

The same guidelines are followed for the fixation rings of miniscrews at the distal region of the expanding screw. Following, the width between fixation rings of miniscrews located on the expanding screw is measured with a caliper. This measurement is transferred to the coronal section of the CBCT image, positioned on the central part of the bone, and equidistant to the Midpalatal suture.

The miniscrew length indicated corresponds to the bone thickness measured on the coronal sections of CBCT images. The soft tissue thickness may also be obtained at the same area of miniscrews insertion. For that purpose, the patient is instructed to avoid touching the palate with the tongue.[9]




**3) Evaluation of expander miniscrews fixation rings**

To achieve the necessary length of miniscrews in MARPE, the height of expander miniscrews fixation rings to the expanding screw should be determined, as well as their distance from the palatal soft tissue surface, besides the bone and soft tissue measurements described in the previous step.[9]

**4) Selection of miniscrew:**

The total length of the miniscrew (MI) is represented by the variables: bone thickness (o), adding 1.0 to 2.0 mm, which is necessary for the miniscrew tip to surpass the cortical plate of the nasal fossa; soft tissue thickness (m); fixation ring thickness (a), and distance from the ring to the palatal surface (d). The equation employed to calculate the total miniscrew length is described, with the value in millimeters, as: MI= o + m + a + d + (1 or 2).

The total MI length selected is related to the distance from its active tip to the base of the transmucosal collar. The evaluation of axial sections of tomographic images before and after expansion with MARPE evidences opening of the Midpalatal suture.[9]

**Advantages**

Treatment duration is very less, one to four weeks of active expansion period, when compared to other conventional expansion methods, 2-6 months of period for expansion. MARPE is independent of any anchor teeth units supports a simultaneous fixed orthodontic therapy and expansion as an added advantage. Maximal skeletal displacement can be achieved with minimal dental tipping effects. More stable on completion of treatment because the maxillary posterior teeth are not tipped buccally as much as in conventional expansion procedures.

**Limitations:**

- Forces applied from increased distance to the bone or implant interface leads to higher chances of Mini implant deformation.
- Chance of treatment success is hindered when MSE placement is attempted on a narrow high arched palate.
- Unpredictable variability in the pattern of MPS calcification and craniofacial architecture (higher resistance) are contributing factors for MARPE failure.
- Incorporation of Missing/compromised anchor units in classic design of MARPE implementation is a hindrance.
- MARPE creates stress distribution around the anchor teeth and zygomaticomaxillary process extending along the external wall of the orbit, which can cause dizziness and tension around the bridge of the nose, eyes, and mostly throughout the face. Therefore, in individuals who have very heavy sutural interdigitation and bone density expansion must resort to surgically assisted expansion.[10]
- In case of multiple congenitally missing teeth an often associated with craniofacial anomalies, sutural expansion is difficult due to loss of anchorage. The use of endosseous implants as abutments for sutural expansion would eliminate unwanted tooth movement and may allow non-surgical treatment in cases with a compromised dentition.

**Final Considerations**

Rapid palatal expansion might be recommended for patients at the final pubertal growth stage, in addition to adult patients with maxillary constriction. It represents a treatment solution that can potentially

avoid surgical intervention. When performed in association with rapid palatal expanders, it might enhance the skeletal effects of the latter.

The MARPE appliance modified by Suzuki et al, aims at making its use appropriate to the clinical practice, so that operational advantages and outcomes are rendered familiar to all.[10]

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