

Mini-Implant Assisted Rapid Palatal Expansion-The Quest for Optimum Kalyani J Papalkar*, Pratiksha Lakhe, Rizwan A Gilani

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ABSTRACT

Maxillary deficiency is a common problem in orthodontic patients. A possibility to increase the skeletal effects of Class III treatment on the maxilla is the Alternative Rapid Maxillary Expansion and Constriction (Alt-RAMEC) method introduced by Liou, that progresses maxilla's effectiveness in relation to the adjacent sutures and its enhancement. Likewise, MARPE has become gradually popular in the management of transverse discrepancies compared to the traditional expansion approach, due to its amplified skeletal effects. The present article aims at reviewing the existing literature on the Alt-RAMEC protocol and Maxillary skeletal expansion, or Mini-screw-assisted rapid palatal expansion (MARPE) Appliance, and at evidencing relevant differences between them. The results obtained indicate that MARPE is a valid substitute to surgery in patients with multifaceted craniofacial discrepancies, while securing the stability and safety of the transverse correction. To avoid surgery, nonsurgical maxillary developments can be done to accomplish both dentoalveolar as well as skeletal expansion for transverse correction..

Key words: Maxillary deficiency, MARPE, Skeletal expansion, palatal expansion

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INTRODUCTION

Patients receiving orthodontic treatment may have a condition known as maxillary transverse deficit (MTD). According to reports, MTD associated to posterior cross bite affects 9.4% of the general population, roughly 21% of children, and 30% of adult orthodontic patients. A deep and narrow palate, crowding, excessive vertical alveolar growth, extensive buccal corridors, dental attrition, periodontal disease, and facial muscle imbalance are all linked to a disparity between the maxillary and mandibular arches. It is critical to create a proper transverse skeletal relationship in order to achieve a stable occlusion and avoid these negative consequences.

Rapid palatal expansion (RPE) has been used to treat transverse skeletal jaw disharmony in patients in their adolescent years since the mid-1960s, and it has proven to be a viable therapy technique. However, in mature patients, it has little to no effect on the skeletal system. There are, however, a number of dental adverse effects that could be detrimental to periodontal health. To

overcome the maxillary interdigitation sutures that are resistant to extension, surgical-assisted RPE (SARPE) has been the recommended way of treatment for adult maxillary skeletal expansion.

Chronology of midpalatal sutures by age group

Persson et al. [1] in 1977 did the study to evaluate the ossification of the human mid palatal suture microscopically in 24 people, ranging age from 15 to 60 years old. It was observed that suture ossification begins in the posterior area by mineralized bridges produced from posteriorly and proceeds to the front. Under the influence of bone maturation, the growth stage and facial development are also influenced. Mann et al. [2] al studied the palatal sutures of 186 human skulls to see how old they were, the following ossification sequence was observed in 1991:

The incisive suture is the first step.

The posterior section of the midpalatal suture comes next.

The transverse palatine suture is then applied.

It is then followed by the centre section of

The suture between the palatal bones is called the midpalatal suture. Suture ossification has been considered as a constraint to fast palatal growth, and there appears to be agreement that it begins at the top [3] posterior segment.

In occlusal radiographs or tomographic slices, imaging diagnosis of closure or ossification of the midpalatal suture is limited especially when we consider that the

small bridges created are microscopically detected but do not always result in visible images. Imaging examinations cannot detect little bone length and/or thickness, especially if calibration is not used. The resolution of modern appliances is taken into account.

MARPE and rapid palatal expansion

In 1860, Angel [4] invented the first palatal expansion device. The technique was different back then as it was not incorporated into the orthodontic practise Angell's colleagues, who were influenced by rhinologists' anxieties, thought it was inappropriate. The approach was revived by European orthodontists who were Maxillary Orthopaedics enthusiasts. Derischsweiler's et al. [5] works (1960). In the United States, American Orthodontics grew interested in When Haas et al. [6] performed the surgery in 1961, Pigs were used to demonstrate the presence of tiny events.

Rapid Palatal Expansion (RPE) in children and young adolescents is an effective treatment for transverse maxillary insufficiency. The RPE-hyrax device delivers bilateral forces from the expansion screw to the palatal bone via the first upper molars and premolars, causing the midpalatal suture to separate.

The optimal timing for RPE is considered below the age of 15, as with older age the midpalatal suture and adjacent articulations start to fuse and become more rigid, leading to a higher resistance to expansion forces. Besides the pursued maxillary expansion, this may cause undesired effects such as buccal crown tipping, root resorption, gingival recession, alveolar bone dehiscence, reduction in buccal bone thickness, marginal bone loss, pain, limited skeletal expansion or failure and post-expansion relapse.

In late adolescents and adults, more force is required to open the mid palatal suture due to its increased degree of inter digitation. Treatment with a conventional RPE could lead to unwanted dental side effects. Therefore, from the age of 16 onwards, surgically-assisted RPE (SARPE) is commonly applied to overcome these limitations by surgically releasing the inter digitated suture prior to maxillary expansion with an RPE device, such as a hyrax or a Trans-Palatal Distractor (TPD). However, the inherent risks of a surgical operation, together with the cost, the hospitalization and attendant morbidity may pose a constraint for patients to undergo this procedure.

MARPE is either a tooth-bone-borne or a solely bone-borne RPE device with a rigid element that connects to miniscrew inserted into the palate, delivering the expansion force directly to the basal bone of the maxilla. It was designed to maximize skeletal effects and to minimize dentoalveolar effects of expansion, based on the findings of previous histological studies revealing that the midpalatal suture does not fully ossify in humans even at an elderly age, possibly due to the constant mechanical stress that it undergoes. MARPE has received widespread attention in recent years and several researchers have studied the efficacy of MARPE.

MARPE appliance

Dr. Won Moon proposed the initial MARPE design, which was bound to the molars and put in the centre of the palate. Dr. Kee Joon Lee later changed the design by banding the first premolars and first molars together. This provides a strong foundation for adaptation for proper separation of the midpalatal suture on the topography of the palate. Conventional the Maxillary Skeletal Expanders were created by modifying the Hyrax Rapid Palatal Expander. Carlson et al. developed miniscrew-assisted fast palatal expanders by incorporating miniscrews into the design [7]. They stated that their design resulted in more parallel maxillary bone development and minimal dental tilting.

MARPE appliance clinical presentation

Mac Ginnis et al. [8] created the maxillary skeletal expander (MSE) with four miniscrews inserted parallel to the midpalatal suture based on Lee's research.

There were two parts to the device. Two front screws, each with a diameter of 1.5-1.8mm and a length of 11-13mm that can be adjusted depending on the anatomical thickness of the patient's palate, and two posterior screws, each with a length of 9mm [9]. MSE has changed the screw design-Hex head miniscrew (Medusa, Fav Anchor TMSAS, India) are smoother and less bulky for a more secure and precise insertion, and are thus more comfortable.

Activation of the appliance

MSE pintype activation key with four 90° activation turns per cycle and 0.2mm separation per turn, and spanner type activation key with six 60° activation turns per cycle and 0.33mm separation [10,11]. Various design types are based on the position of miniscrew and stress distribution.

Consideration of the insertion factor

Placement of the appliance

In the region of the first permanent molar, immediately anterior to the soft palate. As a result of the resistance provided by the material, the orthopaedic effect is enhanced by pterygoid plates.

Insertion of the Appliance: The placement of a Temporary Anchorage Device (TAD) can be difficult at times due to a lack of experience with an engine attached or to drive the implant into hard palatal bone with torque and directional control a straight driver in the traditional sense. A palatal driver (L'il One, Fav Anchor TMSAS, In) with a unique design (L'il One, Fav Anchor TMSAS, In)

The flat palatal but thinner bone surface in the middle of the second premolar region.

In the region of the first permanent molar, immediately anterior to the soft palate, to maximize the likelihood of bi-cortical penetration while promoting a close contact area with the jack-screw. The orthopaedic effect is improved because to the resistance given by the material pterygoid plates.

Instructions for installation

When making imprints, silicon-based impression material is preferable for acquiring exact details, which is critical during the digital workflow process. Miniscrew must be used with care inserted prior to the luting cement hardening. It is necessary to adhere to the appliance. On the OPG, the root status of the supporting teeth must be determined. Before putting on the band, double-check everything.

Activation of the appliance

The activation protocol is different depending on the therapeutic goal and the patient's biotype. For optimum treatment outcomes, follow the activation schedule requirements. Per rotation, 0.2mm of separation is achieved on average. When the lingual cusps of the maxillary first molars and the buccal cusps make edge to edge contact, the activation stops. The mandibular first molar cusps Activation limits – The expander loses if the activations surpass the permitted limits. It loses its stiffness and deforms.

Post expansion effects

Skeletal and dental effects

The overall expansion is the result of a combination of skeletal (orthopaedic) and muscular expansion. Dentoalveolar (orthodontic) expansion entails the bending of the alveolar bone and the placement of dental implants tipping. The maxilla's centre of rotation is substantially higher in traditional hybrid bone-borne RPE prosthetics which is higher than the location of the miniscrew, resulting in torque creation in two maxillae.

As a result, the alveolar bone bends [12]. Dental tipping was seen due to alveolar bone bending, even though the relative position of attached teeth did not alter. A higher lateral expansion force is achieved by exerting the expansion pressures closer to the maxilla's centre of resistance. Dental tipping was seen owing to alveolar bone bending, even though the relative position of attached teeth did not alter. A higher lateral expansion force is achieved by applying the expansion pressures closer to the maxilla's centre of resistance. Reduced dental tipping might allow the complicated to be translated. The pterygomaxillary complex provides the most resistance to sutural opening; hence The MARPE's body should be placed towards the confluence of the hard and soft palates. If adequate pressures are applied to the maxilla's centre of resistance.

The force system becomes micro implant placement utilising bespoke MARPE equipment more advantageous, which would be feasible. Due to uniform force dissipation on the posterior teeth, inclined forces are virtually eliminated, allowing for more parallel midpalatal sutural opening coronally. With MARPE, pterygoid plate separation results in a parallel expansion of the pterygoid plate. In contrast to SARPE, which results in a "V" expansion due to the lack of a pterygoid plate [13].

At the mid-palatal suture, there is a separation. The resistance of maxillary growth to bony expansion

would be pterygomaxillary and zygomatico maxillary sutures are less common in children and teenagers are not fully matured. A significant quantity of bone resistance is offered in adult patients due to the larger bony resistance offered. The anchor teeth will also be subjected to orthopaedic force, causing in dental tipping. The zygomatic bone has shifted forward and to the side. The overall displacement is modest, whereas the lateral displacement is closer to the centre, it gradually decreases near the temporal process of the zygomatico maxillary suture. The frontozygomatic suture connects the zygomatic bone (zygomatic arch) to the frontozygomatic suture. The zygoma rotates with the zygomatico maxillary complex in general. The fulcrum is the frontozygomatic suture.

Effects on the respiratory system and the airway

According to studies, addressing the nasomaxillary insufficiency with orthopaedic expansion also changes the aberrant breathing pattern. Patients who have undergone MARPE have a higher proclivity for As a result of nasal inhalation, the tongue position and muscular dynamics are likely to change. Expiratory peak flow is improved by indirectly enlarging the nasopharyngeal airway. An indication of nasal and oral obstruction, nasal inspiratory peak flow, might be raised [14]. Immediately after expansion, with continued stability for up to 5 months. The zygomatic arch expands to a lesser extent than the nasal cavity, indicating that enhanced nasal airflow is beneficial to respiratory performance and muscle strength. An increase in airway volume was seen. RME is more powerful than traditional RME. Treatment with MARPE results in a significant increase in nasal volume.

The restricted airway and upper airway resistance are also improved by increasing cavity volume. Assisting in the correction of the malocclusion's long-term stability. Separation occurs in the nasal area, resulting in a significant increase in airflow. By removing the impediment that causes nasal air resistance, mouth breathers can breathe easier.

Advantages of MARPE

When opposed to conventional expansion, which takes 2-6 months, treatment time is quite short, ranging from one to four weeks of active expansion. MARPE independence of any anchor tooth units allows for a fixed orthodontic therapy and a removable orthodontic appliance to be used at the same time. As a bonus, you'll be able to expand your business. It is possible to obtain maximum skeletal displacement. The effects of dental tipping are minor. Because the maxillary is more stable after therapy, in contrast to traditional expansion treatments, the rear teeth are not as pointed buccally.

Indications of MARPE

MARPE has an impact on respiration as well as occlusion. In the majority of cases, separate assessments of both respiration and occlusion revealed that both were mutually supporting one another, for example,

buccal cross bite is linked to increased nasal resistance as well as mouth breathing. Occlusion is based on Cases of maxillary deficit are classified as Class III. MARPE is useful in the treatment of Class III malocclusions. Having a flattened profile in the middle region of the mouth and maxillary insufficiency face, maxillary arch crowding, and cross bite, which can be unilateral or bilateral, the teeth are frequently buccally inclined. Class I patients with bilateral or severe unilateral expansion: Orthodontic treatment in its traditional form Correction takes a long time, and relapse is common after treatment. Rapid expansion with MARPE corrects the buccal segment connection in three weeks without forcing the teeth into an unfavourable position. It's possible that the upper body will migrate forward. These teeth and incisors should not be included in the appliances. This gives them the ability to during the stabilisation stage, the lower teeth relapsed into their proper relationship. Certain examples of Class 2 div 1 malocclusion, in which the pupil is extremely, narrowed A unilateral or bilateral cross bite is related with the upper arch. Discrepancies in arch length in a few cases: Good case on the out skirtspatterns on the face True maxillary deficiency cases are those in which the mandible is normal but the maxilla is underdeveloped and has a straight profile in the midface region, as well as a crossbite. A case of relative maxillary deficit occurs when a larger mandible is combined with a smaller jaw. Skeletal response during MARPE guides the growing posterior teeth into proper occlusion and corrects asymmetries of condylar functional shifts, resulting in a normal maxilla. Temporomandibular joint dysfunction is also a possibility.

Concha literally fills the nasal opening in Class II cases with mouth breathing. In these patients, a deviated nasal septum is common; increasing the internasal capacity to nasal respiration is made easier. Skeletal response during MARPE guides the growing posterior teeth into proper occlusion and corrects asymmetries of condylar functional shifts, resulting in a normal maxilla. Temporomandibular joint dysfunction is also a possibility.

Limitations of MARPE

Higher likelihood of MI deformation when forces are applied from a greater distance to the bone or implant contact. Variability in the pattern of MPS calcification and craniofacial morphology is unpredictable (greater resistance) are factors that contribute to MARPE failure. Incorporation of missing/compromised anchor units in traditional MARPE design. Implementation is a stumbling block.

MARPE causes dizziness and tension by distributing stress across the anchor teeth and the zygomaticomaxillary process, which extends along the orbit's exterior wall. The bridge of the nose, the eyes, and the majority of the face is affected. Individuals with severe sutural interdigitation and bone density growth might consider surgically assisted expansion. Sutural abnormalities are frequently associated with several congenitally missing

teeth. Because of the loss of anchorage, expansion is difficult. Endosseous implants are used as abutments. Sutural enlargement would prevent undesirable tooth movement and could even allow non-surgical treatment. In circumstances where a patient's dental health is in jeopardy, therapy is recommended.

Medical Indications

As a preparatory procedure to septoplasty. Nocturnal enuresis: A sleep lab confirms that nocturnal enuresis is caused by Obstruction, which is mainly caused by adenoidal hypertrophy, disrupts sleep patterns or an anterior nasal stenosis, which is less prevalent. Taking MARPE as an example of a highly effective programme method in early adult dentition, maxillary growth in young people with nocturnal enuresis Adults can get rid of their adenoids in a matter of months.

Contraindications

MARPE is contraindicated in anyone who has soft tissue disease in pressure-bearing areas. Patient having a severe gingival expansion tendency, such as Dilantoinhyperplasia. A patient who has had a cover bite (maxillary teeth completely outside themandible) In lateralaspect, the patient has a normal buccal occlusion. Patients that refuse to cooperate with the doctor. Patients with significant anteroposterior and vertical skeletal imbalances. Single-tooth cross bite, anterior open bite, steep mandibularplanes, and convexprofiles. A patient with maxilla or mandible skeletal asymmetry.

CONCLUSION

MARPE has been shown to be a safe and successful technique for the correction of transverse maxillary deficit, with a high success rate and long-term stability. MARPE stands for claimed to be more effective than traditional RPE, and claimed to have conquered SARPE as a result. In certain instances, this is a viable and cost-effective alternative.

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