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Case Series

MARPE in Non-Growing Individuals

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Abstract

Introduction: One of the highly prevalent malocclusions includes transverse deficiencies of the maxilla seen in both growing individuals and adults. If maxillary constrictions are not treated on time, they can develop into more complicated malocclusions or may even cause respiratory issues associated with nasal constriction. The treatment options in pre-pubertal children are more and easier as compared to that of adults. Rapid palatal/maxillary expansion is a commonly used treatment modality in growing children. In adults, invasive procedures like Surgically assisted rapid palatal expansion (SARPE) are the alternative. However, in the recent past micro implant-assisted rapid palatal expansion (MARPE) has been gaining popularity because of its increased success rates in terms of skeletal changes and lack of need to perform osteotomies.

The Aim of Work: The study aimed to evaluate the efficiency, assess the success rate, study the dental and skeletal effects and side effects of the MARPE Technique.

Methodology: The review is a comprehensive research of PUBMED from the year 1997 to 2021.

Conclusion: In the majority of the non-growing patients, MARPE can be seen as an effective alternative to SARPE to correct a maxillary transverse deficiency. Clinically acceptable skeletal and dental changes have been seen, which makes MARPE an acceptable alternative to surgically invasive procedures. The expansion shows stable results and favorable periodontal support in clinical and radiological follow-ups. The incorporation of miniscrews to correct transverse deficiencies can be adapted as an alternative to reduce multiple surgeries in craniofacial discrepancies. Significant respiratory and occlusal improvement has also been noted in cases.

Keywords: *MARPE; Miniscrews; Midpalatal Suture; Rapid Palatal Expansion; SARPE; Transverse Discrepancies*

Introduction

Maxillary transverse deficiency accounts for 23.3% of the malocclusion seen in the primary dentition.[1] Etiology includes myofunctional disturbances due to habits like thumb sucking, genetic or hereditary factors. Thumb sucking can cause the tongue to rest in a lower position which allows the unopposed action of the buccinator to constrict the maxillary further. Maxillary constriction as a result of genetic factors is commonly seen in class III malocclusions where anterior and posterior crossbite is usually seen with mandibular prog-

nathism [1]. If the intervention of maxillary transverse deficiency with or without posterior crossbite is not done on time, it can cause varying levels of occlusal disharmony, postural changes of the tongue, periodontal problems like gingival recession or localized bone loss. Jaw-related problems like the functional shift of the mandible as a result of improper buccolingual tip of the posterior teeth, asymmetric positioning of the mandible, disturbances of the muscular function, and dental malalignment can also be seen [2]. However, the most dangerous problem associated with maxillary transverse deficiency is obstructive sleep apnea syndrome (OSAS) which occurs when the nasal cavity is narrowed (Figure 1) [1,3].

Figure 1: *Coronal view-Maxillary transverse deficiency, narrow nasal cavity, high-arched palate, ow tongue position, and anatomic disorders of the nasal cavity (turbinate hypertrophy and septal deviation) [1].*

In growing individuals, orthodontic correction of transverse maxillary deficiency can be achieved by rapid palatal expansion (RPE). RPE has been widely and successfully used where skeletal and dental changes have brought about morphological and functional correction, which leads to proper facial development [1]. In adults, calcification and interdigitation of the mid-palatal sutures are seen, which makes the procedure of RPE futile as these tooth-borne appliances cannot bring about the skeletal changes as the separation of the calcified sutures is difficult. RPE in non-growing individuals can cause undesired buccal tipping of the posterior teeth, which can further cause dehiscence of the buccal cortical bone and less orthopedic expansion [4].

Surgically-assisted rapid palatal expansion (SARPE) is an indicated alternative in such cases. SARPE can cause orthopedic expansion with predictable results. SARPE involves a LeFort 1 osteotomy with a surgical separation of the midpalatal suture. The expanders are anchored to the Molars and premolars, and the lateral forces are transmitted to them. The disadvantages of the SARPE procedure are the increased biological load and the additional financial cost of the treatment [1,5].

To overcome the disadvantages of the conventional tooth-borne (Hyrax type) or tooth and tissue borne (Haas type) expansion appliances, Lee., *et al*. in 2010 came up with an appliance design of miniscrew-assisted rapid palatal expander (MARPE), where a rigid element that can deliver the force of expansion directly to the basal bone was included [6].

An overview of the case reports published over time with MARPE will be discussed.

Case Report I

The first case report published by Lee., *et al*. was in a 20-year-old male patient with severe mandibular prognathism and bilateral buccal crossbite of the maxilla. Since the patient and doctor wanted to avoid a 2-stage surgical procedure, the idea of maxillary orthopedic expansion with the help of a miniscrew as the anchorage was formulated [6].

Treatment objectives

1. To achieve orthopedic maxillary expansion to correct the maxillary deficiency
2. To prevent unwanted effects on the periodontal tissues
3. To attain stable buccal occlusion
4. Improve the patient's profile after the orthognathic surgery [6].

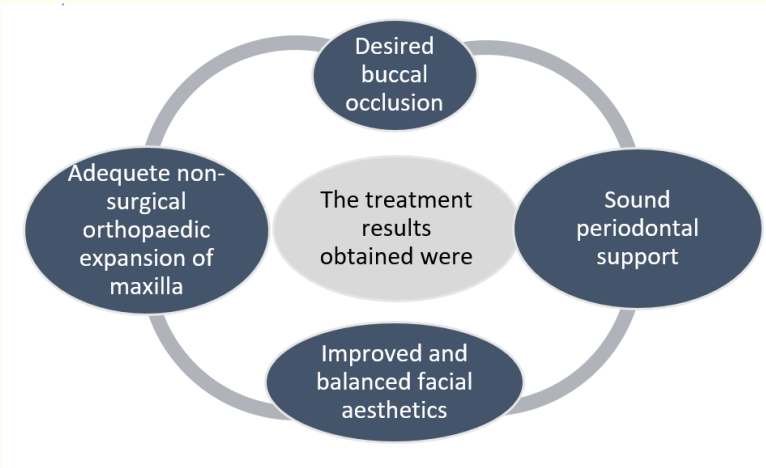
Treatment progress

- After banding the first premolars and molars, an impression was made, and a conventional type of Hyrax expander was fabricated after soldering four stainless steel rigid connectors on the base of the body of the hyrax screw.
- In the rugae region, two anterior hooks were placed and two hooks on the parasagittal area which were in passive contact with the soft tissue (Figure 2A).
- The cementation of the MARPE was done, after which four miniscrews (1.8-mm collar diameter and a 7-mm length) were placed in the helical hooks (Figure 2B) [6].
- For six weeks, one turn (90^0) was done per day, which resulted in an 8.3mm increase of the intermolar width.
- After achieving the required expansion, the MARPE was placed for an additional three months for bone formation to occur in the space created by the separation of the midpalatal suture (Figure 2C).
- It was observed that the buccolingual inclination of the molar remained unaltered after the expansion and alignment. Some amount of soft tissue inflammation around the miniscrews decreased after its removal.
- After the surgeries were performed to correct the skeletal class III problem, post-surgical orthodontics was done and completed.
- It was noted that post completion of the treatment, the posterior occlusion was stable and remained so for 18 months [6].
- The periodontal component of gingival recession and loss of attachment was minimal [6].

Figure 2A: *Fabrication of MARPE on the cast [6].*

Figure 2B: *Cementation and placement of miniscrews [6].*

Figure 2C: *After 6 weeks of MARPE [6].*



Figure

Case Report II

In 2017 a new technique for rapid palatal expansion was developed after many years of improvement by Dr. Moon., *et al*. in 2017. One of the key features of their device for maxillary skeletal expansion (MSE) was the bending of the wires of the soldered to the molar bands to follow the curvature of the palate and separated by 2 mm along with its extension (Figure 3) [1].

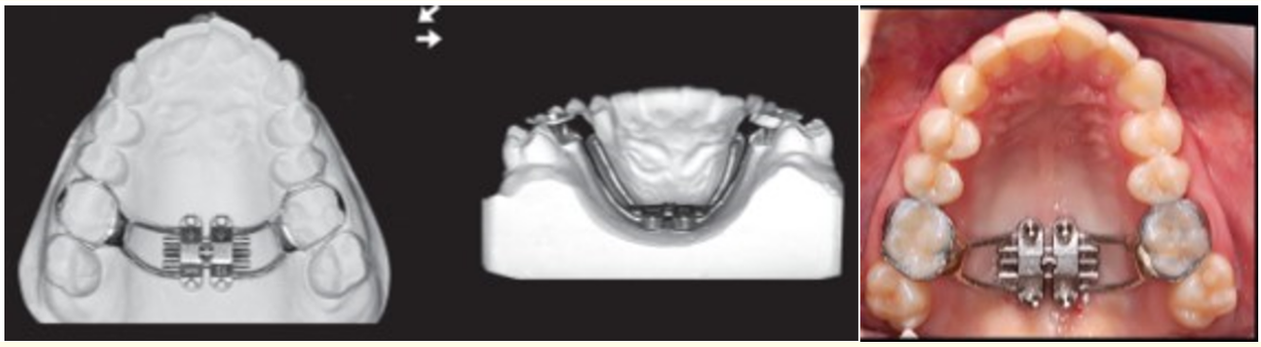


Figure 3: *Appliance wire segments bent to outline palate curvature, with at least a 2 mm gap from the mucosa [1].*

A 22-year-old female patient with difficulty during sleep and posterior crossbite wanted a non-surgical alternative to correct the same. The patient presented with a left transverse asymmetry owing to the posterior crossbite on the same side (Figure 4A). She was also diagnosed with an apnea/hypopnea index (AHI) of 7.9, which is classified as mild apnea syndrome according to the American Association of Sleep Medicine guideline [7].

A 10 mm maxillary skeletal expander (MSE) was selected with three activations (1/4 of a turn, 90 degrees each) was done immediately, after which two daily activations followed. interincisal diastema was seen during the second week (Figure 4B).

Thirty-four activations later, photographs confirmed the opening of the sutures and lack of any unwanted buccal inclination of maxillary molars (Figure 4C) [1].

Figure 4A: *Posterior cross bite (Left Side) [1].*

Figure 4B: *Interincisal diastema confirms suture opening [1].*

Figure 4C: *After34 activations (6.8 mm) [1].*

A total of 8.8 mm screw opening was seen after 44 activations. A conventional tooth-borne Hyrax expander was placed post removal of MSE. Two daily activation protocol was continued to achieve the desired buccal inclination of the left posterior teeth. After a 7 mm total expansion, the following features were observed:

- Buccal corridor space reduced
- Midline shift corrected
- Left posterior teeth showed a favorable buccolingual inclination
- Reduction of the AHI to 1.5 from 7.9.

For the purpose of suture ossification, the expander had to be held in place for at least four months. The non-surgical palatal expansion achieved in this case was satisfactory. Theoretical application of this type of expansion can be made since no studies show evidence of a complete fusion of palatal sutures at the end of facial growth. Apart from solving the transverse deficiency, the reduction of upper airway resistance was also noted [1].

Appliance follow up and removal

- After the appliance is delivered, it is important to have regular follow-up visits as the patient may find it hard to activate the appliance on their own because of the increased resistance.
- At every visit, it is important to check the stability of the miniscrew, note any inflammatory changes around it, and also the distance between the expander and the mucosa [1].
- It is important to place the expander as posteriorly possible (junction of the soft palate and hard palate) since the sutures between the maxilla and pterygoid plates have high resistance, and the expander needs to overcome this.
- The application of the forces directly to the center of resistance of the maxilla as opposed to the teeth seen in conventional methods results in a more uniform force dissipation [8]. Suture opening happens in a parallel method, and buccal tipping of the teeth is avoided as well [9].
- During removal of the expander, it can be done without a local anesthetic. The mucosal wound is usually healed in a few days [1].

The application of this technique is successfully seen in class II hyperdivergent cases that present with maxillary transverse deficiency. A true mandibular counter-clockwise rotation is the best treatment in these cases, according to Buschang., *et al* [10,11]. After expansion with the MARPE, maxillary intrusion of the molars can be done, which results in the counterclockwise rotation of the mandible, thus

improving the facial profile. The retention of the expansion is provided by the expander itself, which is used as a skeletal anchorage causing posterior maxillary intrusion [1]. It is suggested to place a micro implant in the lower arch also to avoid unnecessary extrusion of the opposing teeth [1].

Case Report III

In 2019 Minervino., *et al*. used a prototyped surgical guide placement for MARPE to correct posterior skeletal bilateral crossbite in an 18-year-old patient. Using the software NemoStudio (version 20122, 16.50.0.56), a MARPE guide was virtually planned and fabricated on laser-printed on a 3D printer MoonRay D225—SprintRay, 2014 [12]. This technique used the merging of three files which are the intraoral scan of the patient, computed tomography of the suture, and the digital file of the expander (Figure 5A and 5B) [12].

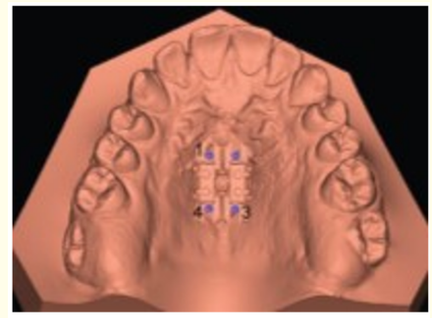


Figure 5A: *Digital model presenting planning of positioning of the MARPE expander and mini-implants [12].*

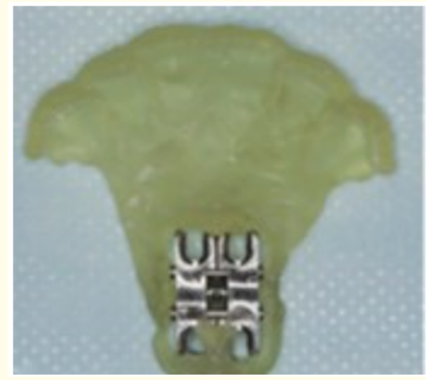


Figure 5B: *Surgical guide printed in 3D using autoclavable resin (MoonRay) [12].*

Figure 5C: *Device at surgery and without utilization of orthodontic bands [12].*

The maxillary expansion was carried out in the patient at 2/4th turns per day for a span of 12 days, which resulted in a 6 mm expansion. This device did not use molar bands in the design (Figure 5C). CBCT images were used to compare the pre and post-expansion changes, and it showed the opening of the midpalatal suture along its entire length (Figure 6A and 6B) [12].

Figure 6A and 6B: *Pre and Post expansion [12].*

Accurate, efficient, predictable, and stable results can be obtained with 3D technological planning. They can help in standardizing the technique and reducing the risk rates since all processes are prepared digitally. The use of the surgical guide helps provide better occlusal stability and improved respiratory conditions. However, the added costs and technological sensitivity of the procedures may be the disadvantages [12].

Discussion

Literature states that the medial borders of the hemimaxillae grow towards each other and are interlocked, which follows post-natal development stages such as synfibrosis, the broad distance between parallel borders, synarthrosis, narrower sinuous course; synostosis, complete interdigitation [13]. Recent histological studies show that only the anterior third of suture ossification was seen in individuals older than 70 years of age, even though radiographically evidence of complete ossification was seen [14]. The fact that some amounts of connective tissue are seen in the posterior areas of the mid palatal suture could support the theoretical success of the MARPE procedure. Post expansion, a CBCT image helps to check for the suture separation even if clinically no incisor separation is seen [1]. In 2014 Choi., *et al*. conducted a study where they did a follow-up of 69 young adults and saw no side effects after the MARPE procedure [15].

When the conventional expansion was compared to MARPE in an average age group of 18.1 ± 4.4 years, it was seen that orthopedic efficiency was better in MARPE than in the conventional method. Decreased rate of dentoalveolar side effects was also noted [16].

In a transverse type of malocclusion, the relapse rate is usually seen when the expansion achieved is orthodontic (buccal tipping of the posterior teeth). In MARPE, since the force application is directed to the bone, the changes seen are mostly skeletal and involve less tooth tipping [17].

Different types of MARPE techniques with various designs have been developed and made available. Certain expanders only have micro implant support like palatal distractors, or they could be supported both by the dentition and micro-implants [1]. It has been noted that the different types of device design can lead to different treatment results. The risk of bony dehiscence is greater with tooth-borne expanders compared to tooth and tissue borne expanders, even in prepubertal patients, which can only mean that the risks will be much greater in post-pubertal patients. In adults, the surgical osteotomies performed to aid in skeletal expansion have uncertain stability, which can, in turn, lead to relapse [6].

Several methods have been suggested for diagnostic criteria of SARPE, one of which suggested by Handelman., *et al*. states that surgically aided expansion should be done when intermolar width exceeds 8 mm [18].

A systemic review was done by Kapetanović in 2021 studies that MARPE is successful in inducing both skeletal and dental effects. The results obtained by MARPE maxillary expansion are clinically comparable to SARPE. They also found that despite the short duration of the MARPE procedure, it has a possibility to induce dental and periodontal side effects and may affect the peri-oral tissues [19].

There is no evidence of any serious side effects of MARPE reported in the literature. Hyperplasia of the soft tissues around the micro implant is usually seen because of poor hygiene around the appliance. Patients should be thoroughly explained the importance and methods to maintain the area around the device. Lack of sufficient distance between the expander or its components to the soft tissue mucosa could also result in soft tissue hyperplasia. An important limitation of MARPE would be in patients with high-arched narrow palates, which can interfere with the vertical positioning of the expander, which in turn can affect the success of treatment [15].

Conclusion

The perception of having to use SARPE After the age of 15 has been greatly decreased after the MARPE technique was developed. Current evidence indicates that non surgically assisted palatal expansion with micro-implants is attainable and predictable in young adult patients. There is a lack of tangible evidence about the complete fusion of the palatal suture at the end of facial growth, suggestive of theoretical acceptability of the MARPE procedure at any age. MARPE in correcting maxillary transverse deficiency has an effective impact on reducing the resistance of the upper airways improving respiratory function. The envelope of treatment options in different types of malocclusion can be achieved by the robust skeletal anchorage provided by this type of palatal expander.

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