International Journal Dental and Medical Sciences Research
Volume 3, Issue 6, Nov-Dec 2021 pp 195-198 www.ijdmsrjournal.com ISSN: 2582-6018

Management of Maxillary Transverse Discrepancy - Miniscrew Assisted Rapid Palatal Expansion vs Surgically Assisted Rapid Palatal Expansion

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Submitted: 10-11-2021 Revised: 25-11-2021 Accepted: 28-11-2021

ABSTRACT:This review compared the skeletal and dental changes of miniscrew assisted rapid palatal expansion (MARPE) with those produced by surgically assisted rapid palatal expansion (SARPE) and rapid paltal expansion (RPE). The studies in the literature published on the effects of RPE, MARPE, and SARPE were searched, evaluated, and compared. Cone beam computed Tomography is recorded before and after the procedure to identify the skeletal and dental effects of the appliances. MARPE leads to parallel suture opening and higher skeletal expansion. SARPE leads to triangular suture opening similar to RPE. This review will discuss the three procedures and their findings in detail.

KEYWORDS:MARPE, SARPE, RPE, suture.

I. INTRODUCTION

The management of transverse maxillary constriction with rapid palatal expansion (RPE) is mostly indicated inmixed dentition cases until the period of adolescenece.[1] The prognosis of RPE is dependent on the extent of interdigitation of the maxillary suture, and its effect is reciprocally related to the success of expansion, which means, that the higher the amount of interdigitation and the greater the synostoses at the sutures, the lesser are the changes of the splitting of the maxilla without an additional surgical procedure. The surgical procedure to expand the maxilla is known as surgically assisted rapid palatal expansion (SARPE).[2,3]

In young adults and adolescents after the pubertal growth spurt with advanced skeletal maturity, the effects of non-surgical RPE differ consideratbly.[1] It has been showed that there are higher success rates of RPE in young population and the success rates decreased with increasing age up to 18 years and 21 years.[4,5] Several complications have been shown in the literature due to the conventional tooth-borne RPE approach, such as pain, swelling, buccal root resorption of supporting teeth, buccal cortical plate and bone resorption, and bone dehiscne.[4,6-8] Some studies have also shown ischemia, and necrosis in the palatal mucosa when maxillary sutures do not positive react due to the transverse-forces with a RPE.[8]

The reason for the failure of RPE is because of the higher rigidity of the craniofacial structures in patients who are skeletally mature.[9] Therefore, SARPE procedure is used in these patients for the management of transverse maxillary deficiency. However, this treatment is unfortunately not accepted by patients many times due to its invasiveness, risks and high costs for the patient.[11] Miniscrews have been utilized lately for anchorage purposes to apply orthopedic forces.[12,13] A miniscrew assisted rapid palatal expansion (MARPE) technique has been advocated to distribute the forces optimally to the maxillary basal bone and circummaxillary structures, increase skeletal effects, and reduce dental inclination changes.[8,13,14] Therefore, because of this technique's high success rates, it could be recommended as an alternative to surgical expansion. It has been shown to preserve periodontal health.[16,17]

II. METHODS

The miniscrews can be installed manually for MARPE by using a contra-angle driver. For MARPE, the miniscrews are inserted in to the palate usually near the molar region.[18] Two mini-screws are usually used for MARPE with one mini-screw on each side of the palatal suture.[18] The activation protocol is usually 1/4th turn done two times a day which leads to opening of the screws and expansion of maxilla. The expansion is performed until the crossbite is corrected and the

International Journal Dental and Medical Sciences Research
Volume 3, Issue 6, Nov-Dec 2021 pp 195-198 www.ijdmsrjournal.com ISSN: 2582-6018

full correction is achieved. The number of mini-screws can be higher upto three, or even four depending on the design of the appliance.[19]

For SARPE, the patients have to undergo surgery such as LeFort I osteotomy which includes the lateral-wall of maxilla, pterygomaxillary suture, and palatal suture disruption.[20,21] This procedure is performed under general anesthesia at a hospital setting. A hyrax expander is used for expansion procedure after the surgery is performed. The expander is anchored to molar and premolars. The activation protocol is usually the same with 1/4th turn twice daily until the crossbite is corrected. RPE procedures use a Hyrax or Hass appliance with a similar expansion protocol but without the surgery.[22,23]

Cone beam computed Tomography (CBCT) are recorded at different time points to evaluate the effects of appliances on the maxilla and cirummaxillary structures.[24] The imaging data is recorded in DICOM (Digital Imaging and Communication in Medicine) format.[25] CBCT is advantageous over other two dimension radiographs as it has been reported that when CBCT and two dimension radiographs are compared, CBCT is not affected by head rotation while recording but the accuracy of two dimension radiographs is negatively affected with head rotation.[26]

III. RESULTS

When MARPE expansion is performed, a significant increase is found in the skeletal measurements of maxilla after MARPE expansion. The SARPE expansion shows a significant increase in the skeletal expansion as well but it fails to increase the midfacial width and posterior maxillary base width increase with MARPE.[4,6,7,8,27] A recent clinical study showed that using only miniscrews anchored expansion and not teeth in MARPE, the amount of skeletal expansion of MARPE was higher than RPE and controls (mean age: 13 years).[28] This was attributed to the parallel suture opening with MARPE compared to RPE where the suture opening is triangular.[28] MARPE shows a significantly higher expansion of the nasal cavity than SARPE. The expansion of nasal cavity may be responsible for the increase in airway with MARPE. MARPE shows a higher increase in nasopharyngeal airway than RPE and controls by over 44.3%.[28] The success rates of SARPE have been found to be lower than MARPE.[29] A reason for this is the high success rates of palatal miniscrews which are used for MARPE.[30]

IV. DISCUSSION

RPE, MARPE, and SARPE approaches are suggested for the correction of transverse maxillary issues in adult patients.[4,6,7,8] The objective with MARPE and SARPE is to increase the skeletal effects and decrease the unwanted effects with RPE. Because of the parallel expansion of palatal suture with MARPE, there is a higher chance of disarticulation of sutures with MARPE. The disarticulation of sutures play an important role in gaining more skeletal expansion.[31] These effects of disarticulation of sutures have an important implication in the treatment of Class III malocclusion in which maxillary protraction therapy is applied following MARPE expansion, decreasing the resistance of the maxillary protraction procedures and therefore better anteroposterior orthopedic outcomes.[32]

Cantarella et al. showed that MARPE appliances with miniscrews close to the palatal suture are helpful in achieving higher expansion of midface.[33] MARPE can also lead to a lateral displacement of the zygomatic arch with expansion. If the mid palatal suture is dense and highly ossified, micro-osteoperforations can be done on the palatal suture to allow for more skeletal expansion of MARPE. A recent study showed that micro-osteoperforations can allow for more effective and faster tooth movement due to the increase in inflammatory response.[35]

SARPE expansion pattern are similar to that of RPE.[23] SARPE usually leads to a triangular separation of maxilla as view from the front, with the apical point of the triangle towards the nasals cavity and the base of the triangle is at the palate. The tooth borne appliances such as hyrax in RPE also product as similar type of suture opening with more opening in the front and absence of opening on the back, specifically with pterygopalatine suture.[24]

V. CONCLUSION

This review article combined the knowledge from the recent literature on the effects of RPE, MARPE, and SARPE. MARPE shows an increase in the skeletal transverse maxillary expansion at the level of palatal and basal bone. SARPE and RPE show an increase in the expansion at alveolar process but not at the basal bone level. MARPE presents a more parallel expansion of palatal suture in frontal view and axial view. In contrast, SARPE and RPE display a more triangular expansion of the suture.

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