

## Maxillary Expansion

Harshikkumar A Parekh<sup>1\*</sup><sup>1</sup>Assistant Professor, Department of Orthodontics, Government Dental College and Hospital, Ahmedabad 380016, Gujarat, IndiaDOI: [10.36347/sasjm.2021.v07i11.006](https://doi.org/10.36347/sasjm.2021.v07i11.006)

| Received: 14.10.2021 | Accepted: 18.11.2021 | Published: 25.11.2021

\*Corresponding author: Dr. Harshikkumar A Parekh

### Abstract

### Review Article

Maxillary transverse insufficiency usually requires expansion of palate with a combination of orthopedic and orthodontic tooth movements. Four different types of maxillary expansion procedures are used: slow maxillary expansion (SME), rapid maxillary expansion (RME), miniscrew assisted rapid maxillary expansion (MARME), surgically assisted maxillary expansion (SARME). This article aims to review the maxillary expansion by all the rapid maxillary expansion modalities and a brief discussion on commonly used appliances.

**Keywords:** Maxillary expansion, Rapid maxillary expansion, miniscrew assisted rapid maxillary expansion, surgically assisted maxillary expansion.

**Copyright © 2021 The Author(s):** This is an open-access article distributed under the terms of the Creative Commons Attribution **4.0 International License (CC BY-NC 4.0)** which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

## INTRODUCTION

Maxillary expansion has been used for more than a century for the correction of maxillary transverse insufficiency. One of the earlier reports available in Dental Cosmos for maxillary expansion was performed by Emerson C. Angell in the 19th century [1]. The technique was not widely accepted at that time and was later accepted as a relatively simple and predictable orthodontic technique in the 20th century. The management of the transverse maxillary insufficiency requires the transverse movement of the right and left palatal halves of maxilla by a combination of skeletal which is orthopedic and dental which is orthodontic movements. Currently, four different types of maxillary expansion procedures are used: slow maxillary expansion (SME), rapid maxillary expansion (RME), miniscrew assisted rapid maxillary expansion (MARME), surgically assisted maxillary expansion (SARME) [2-5]. Each treatment modality has its advantages and disadvantages and therefore, it is important to understand the situations for the use of each. Clinical practitioners select the treatment appliances based on their personal skills, experience, age of patient, type of malocclusion, skeletal maturity [4, 6, 7].

The normal growth for palate is nearing the end when patient reaches the age of 6 to 9 years. As the growth of palate nears the completion, there is increased interdigitation of the palatal suture and this makes it difficult to separate the two halves during the

time of puberty [4, 8-13]. During the orthodontic treatment, transverse forces will lead to tipping of the segments buccally and also bodily movement of the segments depending on the appliance design [14-18]. If the transverse force is high enough, then the separation will occur at the palatal suture. The conditions requiring expansion are maxillary posterior crossbite, distalization of molar, functional appliances, correction of arch width discrepancies by surgery or bone grafts, help in protraction of maxillary arch, and mild crowding. This article will provide a review of the maxillary expansion procedure and the commonly used appliances.

### Rapid Maxillary Expansion (RME)

The main objective of RME procedure is to achieve correction of the narrow maxillary arch. But its effects are not only related to maxilla but also to 10 other bones in the face which are connected to maxilla by circum-maxillary sutures [19]. When maxillary expansion is undertaken, a combination of dental movement that is buccal tipping and skeletal movement that is translation of palatal halves takes place [7]. With opening of the maxillary expanders, the forces are transferred to the maxillary sutures [20]. The sutures open up in response to this force, when the forces of maxillary expansion overpower the resistance of the sutures. Therefore, in young children with less interdigitation of the sutures, it is easier to open the palatal suture as less force is required to overpower the resistance. Whereas in older children and adults, the

suture is more interdigitated and therefore requires more expansion force to overpower the suture. When the expansion process is undertaken, the transverse forces compress the periodontal ligament of the teeth, bend the alveolar bone, tip the molar teeth buccally, and gradually open the midpalatal and other circum-maxillary sutures [21].

### **Appliances for RME**

The appliances used for rapid maxillary expansion are bonded RME and Banded RME. In the banded RME, the bands are placed on the maxillary molars and premolars and the appliance is attached to these bands. These are banded and bonded appliances. The banded appliances are attached to teeth with bands on the maxillary first molar and first premolars [4]. The banded RME appliances are of two types: i) Tooth and tissue borne, which have the appliance attached to bands and acrylic coverage on the palate and ii) tooth borne, which have appliance attached to the bands and no acrylic coverage on the palate [22]. The tooth borne appliances are more hygienic as there is no acrylic on the palate, which helps in keeping in clean after eating food. Bonded RME appliance on the other hand are attached to the teeth with an acrylic cap on the posterior teeth, which is bonded directly on the teeth. As it is observed from previous report that with expansion, there is molar extrusion which can lead to vertical changes of the mandible [4]. The bonded appliance can be used in patients with increased vertical dimensions to reduce the molar extrusion effects.

### ***Tooth Borne RME appliance***

There are two kinds of tooth borne appliance. Hyrax expander and Issacson appliance. Hyrax expander uses a special screw known as HYRAX (Hygienic Rapid Expander). The Hyrax screw is a non-spring-loaded jackscrew with an all wire frame without any acrylic coverage [4]. The screw consist of a heavy gauge wire extension that are adapted to follow the contours of palate and soldered to premolar and molar. Each activation of screw produces 0.25 mm of lateral expansion.

### ***Tooth and Tissue borne RME appliance***

This appliance consists of an expansion screw with acrylic abutting on the alveolar ridges. The acrylic on the palate is designed to obtain additional anchorage from the palatal aspects of maxilla.[12] However, the design is not as hygienic as food particles can get stuck below the acrylic and is difficult to clean for the patient.

### ***Miniscrew assisted rapid maxillary expansion (MARME)***

Miniscrew assisted rapid maxillary expansion appliance is used to perform non-surgical expansion for patients with posterior crossbite. Miniscrews in the palate help to transfer the forces to palatal bone and decrease the side effects on the teeth. 23 The miniscrews inserted in palatal region have a high

success rate [24] and this enhances the dependability of MARME appliance. MARME appliance can also be increased with of circum-maxillary sutures and therefore be useful in correcting associated malocclusions [25]. For example, in cases with Class III malocclusion, MARME appliance can be combined with elastics and skeletal anchorage [26]. The skeletal anchorage preparation can be done with mini plates in the mandibular anterior region and maxillary posterior region to allow the Class III vector with elastics [26]. The type of MARME appliance can be either two miniscrew in the palate [27], four miniscrews in palate [28, 29]. When the MARME appliance is not connected to teeth it is known as pure skeletally anchored expansion appliance [27]. When MARME appliance is connected to teeth, it is known as hybrid skeletal and tooth anchored expansion appliance [30]. When the miniscrews are inserted on only one side of the palatal half for the correction of unilateral crossbite, it is known as U-MARPE [31].

### ***Surgically assisted maxillary expansion (SARME)***

The technique of SARME as described by Brown *et al.* [32] involves splitting of midpalatal suture. The midline splitting has been recommended in the anterior maxilla as well. The midpalatal suture has been thought of as the area of increased resistance to expansion in the past but now it is considered that the maxillary articulations with other bones are a major area of resistance [33]. It was also observed by Wertz that the zygomatic arch prevents parallel opening of midpalate suture and is the major area of resistance [34]. SARME technique releases these areas of resistance of maxilla with surgery and thus allows easier expansion of maxilla. However, SARME can lead to complications associated with surgery such as epistaxis, cerebrovascular accident, nerve damage, orbital compartment syndrome, palatal tissue irritation, deviation of nasal septum, etc [35-37]. Due to such complications and increased expense, patients do not prefer SARME technique. The MARME technique has shown good results in the recent studies. The first long term effects of MARME technique were shown by Mehta *et al.* and found that MARME can increase skeletal width and intermolar width of maxilla significantly compared to controls [27]. Therefore, MARME technique is used as an alternative to SARME in most cases in contemporary orthodontic practice. In certain situations, with increased resistance of midpalatal suture, osteoperforations can be performed on the palatal region as a minimally invasive surgery in combination with MARME as an alternative to SARME [38, 39].

All types of rapid maxillary expansion can lead to appearance of space between the upper incisors. This is known as midline diastema and is self-correcting. It is important that patients be informed about such effects.

## CONCLUSIONS

The expansion of maxillary arch and maxillary teeth can be achieved in numerous ways. The type of skeletal and dental pattern of expansion is greatly influenced by the expansion appliance and the type of expansion selected can facilitate the overall treatment objectives. The conventional rapid maxillary expansion can be used to achieve the desired effects in young age. Both tooth-anchored and tooth and tissue-anchored expansion appliances can be used for conventional design. With miniscrew assisted rapid maxillary expansion, the design can be influenced by the number of miniscrews, location so miniscrews, and connection of expansion appliance to teeth or bone. Surgically assisted maxillary expansion involves surgery to reduce the resistance of the maxillary structures during expansion.

## REFERENCES

1. Timms, D.J. (1999). The dawn of rapid maxillary expansion. *Angle Orthod*, 69(3); 247-250.
2. Pereira, J. D. S., Jacob, H. B., Locks, A., Brunetto, M., & Ribeiro, G. L. (2017). Evaluation of the rapid and slow maxillary expansion using cone-beam computed tomography: a randomized clinical trial. *Dental press journal of orthodontics*, 22, 61-68.
3. Sayar, G., & Kılınc, D. D. (2019). Rapid maxillary expansion outcomes according to midpalatal suture maturation levels. *Progress in orthodontics*, 20(1), 1-7.
4. Mehta, S., Chen, P. J., Vich, M. L., Upadhyay, M., Tadinada, A., & Yadav, S. (2021). Bone-anchored versus tooth-anchored expansion appliances: Long-term effects on the condyle–fossa relationship. *Journal of the World federation of orthodontists*.
5. Suri, L., & Taneja, P. (2008). Surgically assisted rapid palatal expansion: a literature review. *American journal of orthodontics and dentofacial orthopedics*, 133(2), 290-302.
6. Ficarelli, J.P. (1978). A brief review of maxillary expansion. *J Pedod*, 3(1); 29-35.
7. Bell, R. A. (1982). A review of maxillary expansion in relation to rate of expansion and patient's age. *American journal of orthodontics*, 81(1), 32-37.
8. Persson, M., & Thilander, B. (1977). Palatal suture closure in man from 15 to 35 years of age. *American journal of orthodontics*, 72(1), 42-52.
9. Handelman, C. S. (1997). Nonsurgical rapid maxillary alveolar expansion in adults: a clinical evaluation. *The Angle Orthodontist*, 67(4), 291-308.
10. Isaacson, R. J., & Ingram, A. H. (1964). Forces produced by rapid maxillary expansion: II. Forces present during treatment. *The Angle Orthodontist*, 34(4), 261-270.
11. Stambach, K. H. (1964). Cleall<sup>^</sup> JF: The effects of splitting the midpalatal suture on the sur rounding suture. *Am. J. Orthod*, 50, 923.
12. Haas, A. J. (1965). The treatment of maxillary deficiency by opening the midpalatal suture. *The Angle Orthodontist*, 35(3), 200-217.
13. Hicks, E. P. (1978). Slow maxillary expansion: a clinical study of the skeletal versus dental response to low-magnitude force. *American journal of orthodontics*, 73(2), 121-141.
14. Majourau, A., & Nanda, R. (1994). Biomechanical basis of vertical dimension control during rapid palatal expansion therapy. *American Journal of Orthodontics and Dentofacial Orthopedics*, 106(3), 322-328.
15. Cleall, J. F., Bayne, D. I., Posen, J. M., & Subtelny, J. D. (1965). Expansion of the midpalatal suture in the monkey. *The Angle Orthodontist*, 35(1), 23-35.
16. Starnbach, H., Bayne, D., Cleall, J., & Subtelny, J. D. (1966). Facioskeletal and dental changes resulting from rapid maxillary expansion. *The Angle Orthodontist*, 36(2), 152-164.
17. Murray, J. M. G., & Cleall, J. F. (1971). Early tissue response to rapid maxillary expansion in the midpalatal suture of the rhesus monkey. *Journal of dental research*, 50(6), 1654-1660.
18. Storey, E. (1973). Tissue response to the movement of bones. *American journal of orthodontics*, 64(3), 229-247.
19. Ceylan, Í., Oktay, H., & Demirci, M. (1996). The effect of rapid maxillary expansion on conductive hearing loss. *The Angle Orthodontist*, 66(4), 301-308.
20. Angelieri, F., Cevidanes, L. H., Franchi, L., Gonçalves, J. R., Benavides, E., & McNamara Jr, J. A. (2013). Midpalatal suture maturation: classification method for individual assessment before rapid maxillary expansion. *American Journal of Orthodontics and Dentofacial Orthopedics*, 144(5), 759-769.
21. Bishara, S. E., & Staley, R. N. (1987). Maxillary expansion: clinical implications. *American journal of orthodontics and dentofacial orthopedics*, 91(1), 3-14.
22. Façanha, A. J. D. O., Lara, T. S., Garib, D. G., & Silva, O. G. D. (2014). Transverse effect of Haas and Hyrax appliances on the upper dental arch in patients with unilateral complete cleft lip and palate: a comparative study. *Dental press journal of orthodontics*, 19, 39-45.
23. Pimentel, A. C., Manzi, M. R., Barbosa, A. J. P., Cotrim-Ferreira, F. A., Carvalho, P. E. G., de Lima, G. F., & Deboni, M. C. Z. (2016). Mini-Implant Screws for Bone-Borne Anchorage: A Biomechanical In Vitro Study Comparing Three Diameters. *International Journal of Oral & Maxillofacial Implants*, 31(5).
24. Arqub, S. A., Gandhi, V., Mehta, S., Palo, L., Upadhyay, M., & Yadav, S. (2021). Survival

- estimates and risk factors for failure of palatal and buccal mini-implants. *The Angle Orthodontist*.
25. Cantarella, D., Dominguez-Mompell, R., Mallya, S. M., Moschik, C., Pan, H. C., Miller, J., & Moon, W. (2017). Changes in the midpalatal and pterygopalatine sutures induced by micro-implant-supported skeletal expander, analyzed with a novel 3D method based on CBCT imaging. *Progress in orthodontics*, 18(1), 1-12.
  26. Mehta, S., Chen, P. J., Upadhyay, M., & Yadav, S. (2021). Intermaxillary elastics on skeletal anchorage and MARPE to treat a class III maxillary retrognathic open bite adolescent: A case report. *International orthodontics*.
  27. Mehta, S., Wang, D., Kuo, C. L., Mu, J., Vich, M. L., Allareddy, V., ... & Yadav, S. (2021). Long-term effects of mini-screw-assisted rapid palatal expansion on airway: A three-dimensional cone-beam computed tomography study. *The Angle Orthodontist*, 91(2), 195-205.
  28. Nojima, L. I., Nojima, M. D. C. G., Cunha, A. C. D., Guss, N. O., & Sant'Anna, E. F. (2018). Mini-implant selection protocol applied to MARPE. *Dental press journal of orthodontics*, 23, 93-101.
  29. Bhargava, T. (2021). Selection and Application of Mini implants for MARPE. *International Journal of Dental Science and Innovative Research*, 4(3); 257-262.
  30. Arqub, S. A., Mehta, S., Iverson, M. G., Yadav, S., Upadhyay, M., & Almuzian, M. (2021). Does Mini Screw Assisted Rapid Palatal Expansion (MARPE) have an influence on airway and breathing in middle-aged children and adolescents? A systematic review. *International Orthodontics*.
  31. Dzingle, J., Mehta, S., Chen, P. J., & Yadav, S. (2020). Correction of Unilateral Posterior Crossbite with U-MARPE. *Turkish Journal of Orthodontics*, 33(3), 192.
  32. Brown, G.V.I. (1938). *The Surgery of Oral and Facial Diseases and Malformation*. 4<sup>th</sup> edn. London: Kimpton; 507.
  33. Isaacson, R. J., & Ingram, A. H. (1964). Forces produced by rapid maxillary expansion: II. Forces present during treatment. *The Angle Orthodontist*, 34(4), 261-270.
  34. Wertz, R. A. (1970). Skeletal and dental changes accompanying rapid midpalatal suture opening. *American journal of orthodontics*, 58(1), 41-66.
  35. Kraut, R. A. (1984). Surgically assisted rapid maxillary expansion by opening the midpalatal suture. *Journal of oral and maxillofacial surgery*, 42(10), 651-655.
  36. Messer, E. J., Bollinger, T. E., & Keller, J. J. (1979). Surgical-mechanical maxillary expansion. *Quintessence international, dental digest*, 10(8), 13-16.
  37. Pearson, A. I., Davies, S. J., & Sandler, P. J. (1996). Surgically assisted rapid palatal expansion: a modified approach in a patient with a missing lateral incisor. *The International journal of adult orthodontics and orthognathic surgery*, 11(3), 235-238.
  38. Mehta, S., Chen, P. J., Kalajzic, Z., Ahmida, A., & Yadav, S. (2021). Acceleration of orthodontic tooth movement and root resorption with near and distant surgical insults: An in-vivo study on a rat model. *International Orthodontics*.
  39. Santana, L. G., & Marques, L. S. (2021). Do adjunctive interventions in patients undergoing rapid maxillary expansion increase the treatment effectiveness? A systematic review. *The Angle Orthodontist*, 91(1), 119-128.