

Expansion in Orthodontics: A Review

¹Dr. Chakka C V N S Satyadev, BDS, Leaside Orthodontic Centre, Toronto

²Dr. Anjali Mahendrasinh Gohil, BDS, Hawthorne Village Dental Care, Milton, BSMT, 7381 Doverwood Drive, Mississauga, L5N 6N4

³Dr. Ritu Jhankar, Postgraduate student, Department of Orthodontics, Uttaranchal Dental & Medical Research Institute, Dehradun

⁴Dr. Milind Rajan, Postgraduate student, Department of Pedodontics and Preventive Dentistry, Coorg Institute of Dental Sciences, Virajpet, Karnataka

⁵Dr. Sai Kiran Tomar, Assistant Professor, MDS, Orthodontics & Dentofacial Orthopaedics, Veer Chandra Singh Garhwali Government Institute of Medical Science and Research, Srinagar Garhwal, Uttarakhand

⁶Dr. Sanmati S Varne, Postgraduate student, Department of Prosthodontics and Implantology, Coorg Institute of Dental Sciences, Virajpet, Karnataka

Corresponding Author: Dr. Chakka C V N S Satyadev, BDS, Leaside Orthodontic Centre, Toronto

How to citation this article: Dr. Chakka C V N S Satyadev, Dr. Anjali Mahendrasinh Gohil, Dr. Ritu Jhankar, Dr. Milind Rajan, Dr. Sai Kiran Tomar, Dr. Sanmati S Varne, “Expansion in Orthodontics: A Review”, IJMACR- January – February - 2022, Vol – 5, Issue - 1, P. No. 187 – 192.

Copyright: © 2022, Dr. Chakka C V N S Satyadev, et al. This is an open access journal and article distributed under the terms of the creative commons attribution noncommercial License 4.0. Which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

Type of Publication: Review Article

Conflicts of Interest: Nil

Abstract

Maxillary expansion treatments have been used for more than a century to correct maxillary transverse deficiency. Three expansion treatment modalities are used today: rapid maxillary expansion (RME), slow maxillary expansion (SME) and surgically assisted maxillary expansion. The clinical conditions indicating maxillary expansion include crossbites, distal molar movement, functional appliance treatment, surgical cases for instance arch coordination or bone grafts, to aid maxillary protraction and mild crowding. This article

focuses on the various appliances that can be used for the expansion of maxillary arch.

Keywords: Maxillary expansion, SME, RME

Introduction: Malocclusions can manifest in all the three planes that is sagittal, transverse and vertical. Transverse maxillary deficiency is frequently observed in patients who seek orthodontic treatment and is often characterised by unilateral or bilateral crossbite as well as anterior crowding. There are different treatment approaches depending on the skeletal maturity, the amount of desired expansion and the presence of a concomitant sagittal or vertical problem.¹

Maxillary expansion treatments have been used for more than a century to correct maxillary transverse deficiency. Orthopedic expansion of the maxillary arch has been accomplished for more than a century. This procedure originated in New York with Emerson c. Angell in 1860. He placed a screw appliance between the maxillary premolars of a girl aged 14 ½ years and widened her arch one quarter inch in 2 weeks. But this could not be supported with radiographs as x rays were still to be discovered.² The work was discredited at the time, but the technique is now generally accepted as a relatively simple and predictable orthodontic therapy. Correction of the transverse discrepancy usually requires expansion of the palate by a combination of orthopedic and orthodontic tooth movements.^{3,4} This article focuses on the various appliances that can be used for the expansion of maxillary arch.

Type of maxillary expansion: There are three modalities of expansions used

- Slow maxillary expansion
- Rapid maxillary expansion
- Surgically assisted maxillary expansion

Slow maxillary expansion (SME): SME procedures produce less tissue resistance around the circum-maxillary structures and, therefore improve bone formation in the inter-maxillary suture, which theoretically should eliminate or reduce the limitations of RME. Slow expansion has been found to promote greater post-expansion stability, if given an adequate retention period. It delivers a constant physiologic force until the required expansion is obtained. The appliance is light and comfortable enough to be kept in place for sufficient retention of the expansion.⁵ For SME, 10 to 20 newtons of force should be applied to the maxillary region only 450 to 900 gm of force is generated, which

may be insufficient to separate a progressively maturing suture. Maxillary arch-width increases ranged from 3.8 to 8.7 mm with slow expansion of as much as 1 mm per week using 900 gm of force.⁶

Appliance used for SME⁷

Slow maxillary appliances can be broadly classified as follows:

Removable

- Coffin spring
- Y plate
- Shwartz appliance
- Active plate

Fixed

- Niti palatal expander
- Quad helix
- Minnie expander
- Spring loaded expander
- W arch
- Spring jet

Indication	Contraindication
<ul style="list-style-type: none"> • Unilateral or bilateral crossbites • To correct minimal crowding by gaining spaces • To correct dental crossbite in permanent dentition • To correct mild maxillary deficiency in cleft lip and palate patients by providing slow continuous forces 	<ul style="list-style-type: none"> • Adult patients who have completed their growth.

Advantage	Disadvantage
<ul style="list-style-type: none"> • It delivers a constant physiologic force until the required expansion is obtained. • There is minimum tipping of anterior teeth. • Least strain is exerted on anchored teeth. • The appliance is light and comfortable to the patient. • It can be used for sufficient retention after the expansion. • Relapse tendencies are less. • Time required for retention is less. • Maintenance of sutural integrity and the reduced stress loads within the tissues • Less pain and discomfort due to light forces. 	<ul style="list-style-type: none"> • Longer treatment duration compared to rapid palatal expansion

Effects of SME on mid-palatal sutures: Ekstrom et al in 1977 proved that with SME there is less traumatic disruption, a greater reparatory reaction, and greater sutural stability than rapid expansion of sutures.⁸ According to Bell et al in 1982 the rate of midpalatal suture separation by slow expansion systems apparently allows a more physiologically tolerable response by the sutural elements than the disruptive nature of rapidly expanded maxillary segments.⁹ Moyers et al in 1974

mentioned that slow expansion procedures increase the percentage of orthodontic movements as the tensile strength of the suture elements is not overwhelmed.¹⁰ Zachrisson et al in 1982 did a comparative study on slow and rapid palatal expansion and concluded that periodontal breakdown on the buccal aspects of the posterior teeth occurred in both the groups however the groups which were treated with rapid palatal expansion the occurrence of attachment loss was higher.

Rapid maxillary expansion (RME): RME is a dentofacial orthopedic procedure that involves the separation of midpalatal suture and movement of the maxillary shelves away from each other. It provide skeletal type of expansion. Advocates of rapid maxillary expansion believe that it results in minimum dental movement (tipping) and maximum skeletal movement.¹¹ An increase in maxillary arch width upto 10 mm can be achieved by RME. The rate of expansion is about 0.2-0.5 mm per day. When the force delivered by the appliance exceeds the limit needed for orthodontic tooth movement and sutural resistance, the sutures open up while the teeth move only minimally relative to their supporting bone.¹²

Types of RME

Tooth & Tissue borne: They consist of expansion screw with acrylic abutting alveolar ridge.

- **Derichweiler:** The first premolar and molars are banded. Wire tags are soldered to these bands and then inserted to the split palatal acrylic, which contains the screw.
- **Hass:** The rapid palatal expander as described by Haas is a rigid appliance designed for maximum dental anchorage that uses a jackscrew to produce expansion in 10 to 14 days

Tooth borne: They consists only band and wires without any acrylic covering.

- **Isaacson:** It is a tooth borne appliance without any palatal covering. This expander makes use of a spring loaded screw called Minne expander (developed by university of Minnesota, dental school), which is soldered directly to the bands on first premolar and molars.
- **Hyrax:** It is a tooth borne appliance, which was introduced by William Biederman in 1968. The Hyrax Expander is essentially a nonspring loaded jackscrew with an all wire frame. The screws have heavy gauge wire extensions that are adapted to follow the palatal contours and soldered to bands on premolar and molar. The main advantage of this expander is that it does not irritate the palatal mucosa and is easy to keep clean. Each activation of the screw produces approximately 0.2 mm of lateral expansion and it is activated from front to back.

Indication	Contraindication
<ul style="list-style-type: none"> • Severe maxillary constriction (narrow maxillary base or wide mandible). • Unilateral or bilateral posterior crossbites. • Anteroposterior discrepancies. • Patients with Class III malocclusions and borderline skeletal and 	<ul style="list-style-type: none"> • Uncooperative individuals. • Single tooth cross bite. • Anterior open bite. • Steep mandibular plane angle and convex profile. • Skeletal asymmetry of the maxilla or mandible.\

pseudo Class III problems. <ul style="list-style-type: none"> • Cleft lip and palate patients with collapsed maxillae • To gain arch length in patients who have moderate maxillary crowding 	<ul style="list-style-type: none"> • Adults with server anteroposterior and vertical skeletal discrepancies
--	--

Effect of RME on mid-palatal suture: Rapid maxillary expansion occurs when the force applied to the teeth and the maxillary alveolar processes exceed the limits needed for orthodontic tooth movement. The appliance compresses the periodontal ligament, bends the alveolar processes, tips the anchor teeth, and gradually opens the mid-palatal suture.¹³

Advantage of RME: Rapid maxillary expansion and fixed appliance can easily correct tooth-size/arch-size discrepancies of mild-to-moderate degree. Rapid maxillary expansion may be particularly helpful in patients who have a narrow in association with an accentuated curve of Wilson, signs of maxillary deficiency syndrome.¹⁴

Disadvantage of RME: The disadvantages of using rapid palatal expanders include discomfort due to heavy forces used, traumatic separation of the midpalatal suture, inability to correct rotated molars, requirement of patient or parent cooperation in activation of the appliance, bite opening, relapse, microtrauma of the temporomandibular joint and midpalatal suture, root resorption, tissue impingement, pain and laborintensive procedure in fabrication of the appliance.^{4,15}

Surgically assisted rapid palatal expansion (SARPE): Transverse maxillary discrepancies are routinely corrected in growing patients with appliances that

separate the median palatal and associated maxillary sutures. This type of rapid palatal expansion (RPE) is not feasible in adults, however, because of the increasing resistance of the sutures. Surgically assisted RPE is an alternative method that reduces the resistance of the closed midpalatal suture to correct maxillary constriction in an adult. It allows clinicians to achieve effective maxillary expansion in a skeletally mature patient.¹⁶

Indications for surgically assisted rapid palatal expansion^{17,18}

- To increase the maxillary arch perimeter, to correct posterior crossbite, and when no additional surgical jaw movements are planned
- To widen the maxillary arch as a preliminary procedure, even if further orthognathic surgery is planned. This is to avoid increased risks, inaccuracy, and instability associated with segmental maxillary osteotomy
- To provide space for a crowded maxillary dentition when extractions are not indicated,
- To widen maxillary hypoplasia associated with clefts of the palate
- To reduce wide black buccal corridors when smiling

Limitation of SARPE: SARPE procedures have conventionally been reported to have low morbidity, especially when compared with other orthognathic surgical procedures. Palatal tissue irritation is a frequent complication of SARPE. This can be either due to impingement from the appliance or associated with a rapid rate of expansion.^{19,20}

Other complications include hemorrhage, gingival recession, root resorption, injury to the branches of the maxillary nerve infection, pain, devitalization of the teeth and altered pulpal blood flow, periodontal

breakdown, sinus infection, extrusion of teeth attached to the appliance, relapse, and unilateral expansion.^{21,22}

Conclusion

Previously tooth extraction was considered as an ideal method of gaining space. However since centuries the debate on the stability of dentition and surrounding structures after tooth extraction have been questioned. Arch expansion is considered one of the safe and ideal means of gaining space. Expansion of the maxilla and the maxillary dentition may be accomplished in numerous ways. The type of skeletal and dental pattern greatly influences the type of expansion chosen and the type of expansion selected can greatly facilitate the overall treatment objectives

References

1. McNamara JA, Maxillary transverse deficiency, Am J Orthod Dentofacial Orthop 2000;117:567-70.
2. Timms DJ. The dawn of rapid maxillary expansion. Angle Orthod 1999 Jun;69(3):247-250.
3. Ficarelli JP. A brief review of maxillary expansion. J Pedod 1978 Fall;3(1):29-35.
4. Agarwal A, Mathur R. Maxillary Expansion. Int J Clin Pediatr Dent. 2010 Sep-Dec;3(3):139-46. doi: 10.5005/jp-journals-10005-1069. Epub 2010 Sep 15. PMID: 27616835; PMCID: PMC4993819.
5. Cleall JF, Bayne DI, Posen JM, Subtelny JD. Expansion of the midpalatal suture in the monkey. The Angle Orthodontist. 1965 Jan;35(1):23-35.
6. Hicks EP. Slow maxillary expansion: a clinical study of the skeletal versus dental response to low-magnitude force. American journal of orthodontics. 1978 Feb 1;73(2):121-41.
7. https://www.researchgate.net/publication/338990577_slow_palatal_expansion_a_novel_method_of_arch_expansion

8. Ekstrom, C. et al.: Mineralization in the midpalatal suture after orthodontic expansion, *Am. J. Orthod.* 71:449-455, 1977
9. Bell, R.A. and LeCompte, E.J.: The effects of maxillary expansion using a quad-helix appliance during the deciduous and mixed dentitions, *Am. J. Orthod.* 79:152-161, 1981.
10. Moyers, R.E.; van der Linden, F.P.G.M.; and Riolo, M.L.: Standards of Human Occlusal Development, Monograph 5, Craniofacial Growth Series, Center for Human Growth and Development, University of Michigan, Ann Arbor, 1976
11. Bell RA. A review of maxillary expansion in relation to rate of expansion and patient's age. *Am J Orthod.* 1982;81(1):32-37.
12. Haas AJ. The treatment of maxillary deficiency by opening the midpalatal suture. *Angle Orthod.* 1965;35:200-217.
13. S. Arvind Kumar, Deepa Gurunathan, Muruganandham, Shivangi Sharma. Rapid Maxillary Expansion: A Unique Treatment Modality in Dentistry *Journal of Clinical and Diagnostic Research.* 2011;5(4): 906-911.
14. Srivastava SC, Mahida K, Agarwal C, et al. Longitudinal Stability of Rapid and Slow Maxillary Expansion: A Systematic Review. *J Contemp Dent Pract* 2020;21(9):1068–1072.
15. Isaacson RJ, Wood JL, Ingram AH. Forces produced by rapid maxillary expansion. Part II Forces present during treatment. *Angle Orthod.* 1964;34:261–269.
16. Maheshwari RK, Harani H, Joshi S, Tiwari A. Surgically assisted rapid palatal expansion: A way to treat transverse maxillary deficiency. *Int J Orthod Rehabil* 2018;9:107-12
17. Woods M, Wiesenfeld D, Probert T. Surgically-assisted maxillary expansion. *Aust Dent J* 1997;42:38-42.
18. Koudstaal MJ, Poort LJ, van der Wal KG, Wolvius EB, Prah-Andersen B, Schulten AJ, et al. Surgically assisted rapid maxillary expansion (SARME): A review of the literature. *Int J Oral Maxillofac Surg* 2005;34:709-14.
19. Carmen M, Marcella P, Giuseppe C, Roberto A. Periodontal evaluation in patients undergoing maxillary expansion. *J Craniofac Surg* 2000;11:491-4.
20. Vardimon AD, Graber TM, Pitaru S. Repair process of external root resorption subsequent to palatal expansion treatment. *Am J Orthod Dentofacial Orthop* 1993;103:120-30.
21. Oztürk M, Doruk C, Ozeç I, Polat S, Babacan H, Biçakci AA, et al. Pulpal blood flow: Effects of corticotomy and midline osteotomy in surgically assisted rapid palatal expansion. *J Craniomaxillofac Surg* 2003;31:97-100.
22. Harada K, Sato M, Omura K. Blood-flow change and recovery of sensibility in the maxillary dental pulp during and after maxillary distraction: A pilot study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2004;98:528-32.