WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 14, Issue 5, 130-143. Review Article ISSN 2277–7105

MAXILLARY EXPANSION AND ITS EFFECTS ON IRCUMMAXILLARY STRUCTURES

Rathnapriya S. K.[1]* and Dr. Beeularajakumari[2]

[1]Intern Adhiparasakthi Dental College and Hospital, Melmaruvathur.

[2]Lecturer Adhiparasakthi Dental College and Hospital, Melmaruvathur.

Article Received on
12 January 2025,

Revised on 02 Feb. 2025,
Accepted on 22 Feb. 2025

DOI: 10.20959/wjpr20255-35615

***Corresponding Author**
Rathnapriya S. K.
Intern Adhiparasakthi Dental College and Hospital, Melmaruvathur.

ABSTRACT

Orthopedic expansion involves widening the upper jaw by applying outward pressure to the back teeth in the upper jaw, causing separation of the mid-palatal suture. Lateral discrepancies in the maxilla are among the most common issues encountered, with a narrowed maxillary arch frequently presenting as a problem for orthodontists used to treat teens and adults. Maxillary expansion is a technique that increases the width of the upper jaw by applying targeted forces. , Most commonly used in pediatric patients addressing a narrow maxillary arch requires orthopedic and orthodontic interventions. Orthodontic treatment prioritizes the correction of lateral maxillary defects, which may manifest as clinical symptoms such as a narrow palate, cross-bites (unilateral or bilateral, typically in the posterior region), severe anterior crowding, and cone-shaped hypertrophy. Treatment options for maxillary narrowing include slow and rapid maxillary expansion and surgically assisted rapid maxillary expansion. Maxillary expansion affects the naso maxillary complex, altering facial structures and potentially impacting speech and hearing. This review article explores maxillary expansion in detail, focusing on its effects on the associated structures.

KEYWORDS: Rapid maxillary expansion, Slow maxillary expansion, Surgically assisted maxillary expansion, Types, Effects.

INTRODUCTION

Transverse maxillary deficiency is a prevalent issue within the dental system, with approximately 30% of patients requiring complex orthodontic or surgical interventions due to

this condition.[1] For many years, maxillary expansion has been the primary treatment for addressing lateral maxillary deficiencies. In most cases, correcting lateral maxillary imbalances involves both orthodontic and orthopedic tooth movements.

Transverse maxillary defects can be identified by the following clinical features:
Posterior cross-bites (one or both sides)
Narrow or deep palatal vault
V-shaped palate
Anterior teeth crowding.[2,3,4]

Tooth size discrepancies between upper and lower jaws.[5]

When a complete cross-bite occurs, Liptuk identified the main clinical symptoms as nasal breathing difficulties, reduced nasal volume, mouth breathing, a rigid and narrow palate, and petrous hypertrophy. The presence of at least two of the above clinical signs indicates a skeletal or dentofacial malocclusion and requires treatment aimed at expanding the transverse dimension of the maxilla.[6]

This article provides an in-depth review of maxillary expansion, covering
Types of expansion
Benefits and drawbacks
Impact on the naso-maxillary complex.

HISTORY

In 1860, Emerson Colon Angell introduced the concept of rapid maxillary expansion (RME). Farrar and Clark C. Godard (1888) pioneered the concept of lateral expansion by opening the mid-palatal suture.

Wright reported in 1912 that rapid maxillary expansion resulted in a 6.5 mm significant increase in nasal cavity width.

During the early 1970s, Haas extensively utilized rapid maxillary expansion in clinical practice.

In the late 1940s, Graber recommended RME as a treatment option for patients with cleft lip and palate.

Haas assessed the long-term stability of maxillary expansion in 1980.

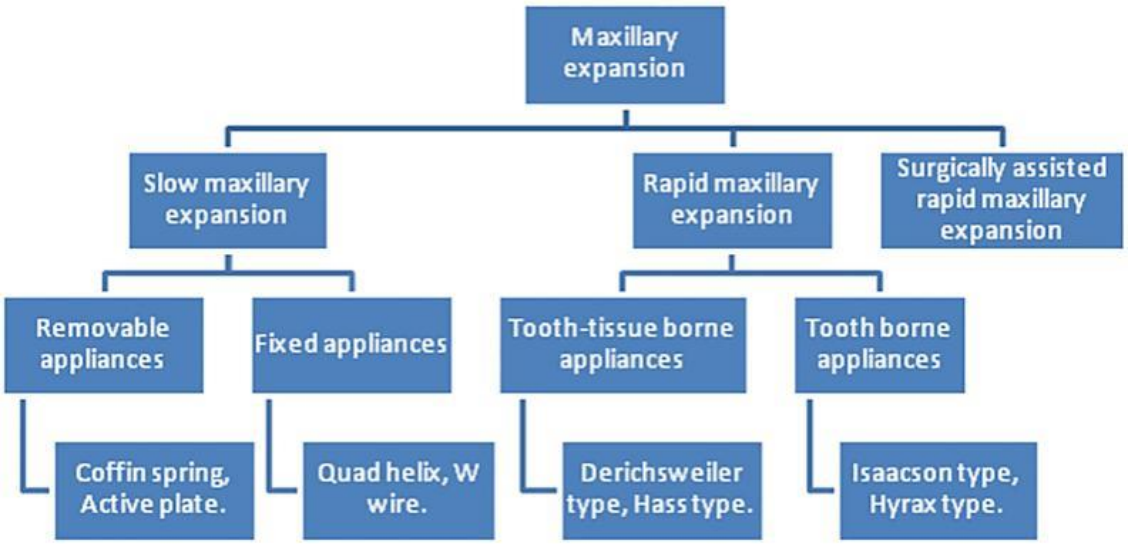
Latham suggested in 1971 that mid-palatal suture growth ceases by the age of 3 years
Björk and Skieller, in 1974, proposed that growth at the suture could continue until around 13 years.

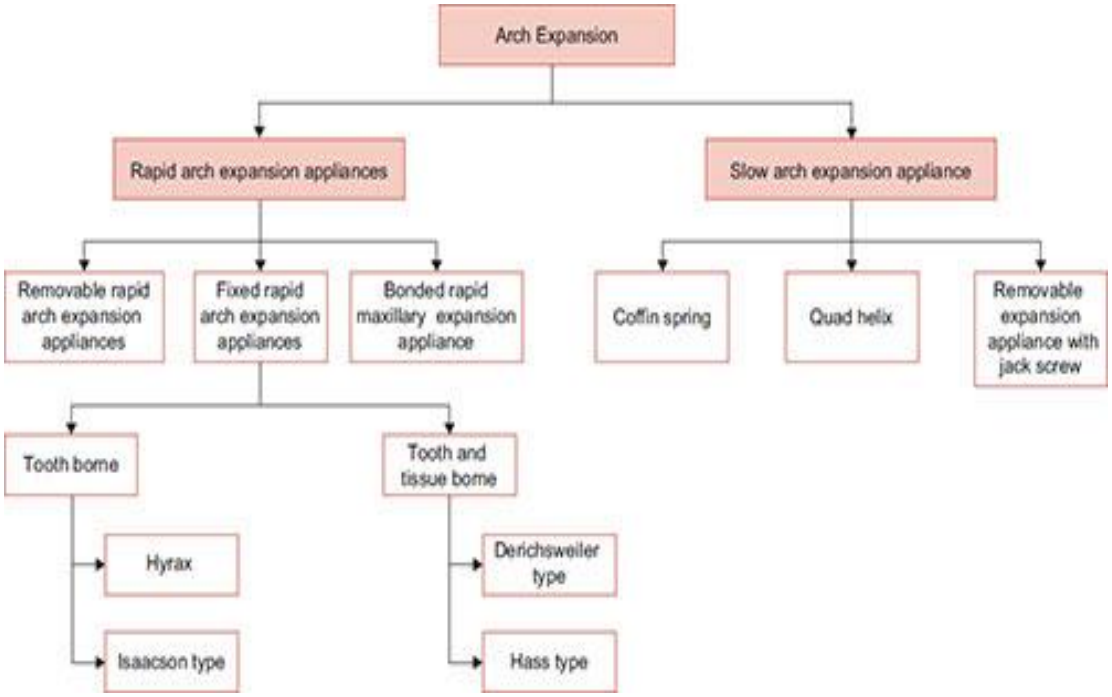
In 1977 cadaveric study, Persson and Thilander found that by the age of 25, 5% of the mid-palatal suture was no longer visible, although variations were observed. For instance, a 15-year-old cadaver had a fully ossified suture, whereas a 27-year-old cadaver still had an unossified suture.

Epker and Wolford (1980) observed that rapid maxillary expansion (RME) is more difficult in patients over 16 years old due to the fusion of craniofacial sutures, making orthopedic expansion more challenging, with the zygomatic buttress providing significant resistance to lateral movement.

Hicks, in 1978, studied slow maxillary expansion using a fixed split acrylic appliance, analyzing the results through frontal and lateral cephalogram.

CLASSIFICATION OF MAXILLARY ARCH EXPANSION





RAPID MAXILLARY EXPANSIONS

INDICATIONS OF RAPID MAXILLARY EXPANSIONS

Patients with lateral discrepancies equal to or greater than 4mm

Patients with narrow upper jaws due to skeletal, dental, or combined issues.

Those with moderate overcrowding of upper teeth.

Individuals with uneven jaw alignment (condylar asymmetry).

Front and back misalignments.

Patients with cleft lips and palates suffering from compressed maxillae.

CONTRAINDICATIONS FOR RAPID MAXILLARY EXPANSIONS

Patients who are non-compliant.

Those with open bites in the front teeth

Patients with steeply angled lower jaws and prominent facial features.

Patient who have passed growth spurts

Patients with skeletal asymmetry of the maxilla or mandible.

Adults with severe anteroposterior and vertical skeletal discrepancies.[8]

APPLIANCES OF RAPID MAXILLARY EXPANSION

These appliances are attached and linked together. Bands that wrap around the first molars and first premolars secure the permanent appliance to the upper teeth. Because there is no coverage over the palate, these bound appliances help promote cleanliness.

Banded appliances can be categorized into several types.

Tissue Tooth borne – Derichswelier and Haas

Tooth borne – Hyrax type, Isaacson type

Hyrax type

It is a dental device, William Biderman first presented it in 1968. A unique screw known as a Hyrax (Gigen Fast Expander) is used in this kind of apparatus. The Hyrax Expander is an all-wire jackscrew that isn't spring-loaded. After being adjusted to meet the palatal contours, the thick gauge wire extensions of the screws are soldered to the premolar and molar bands. This expander's primary benefits are its ease of cleaning and lack of irritation to the palatal mucosa. It is possible to separate seams of 11 mm in a precise wearing period, with distances up to 13 mm being achievable. Each actuation of the screw produces a lateral expansion of approximately 0.2 mm, actuated from one end to other.

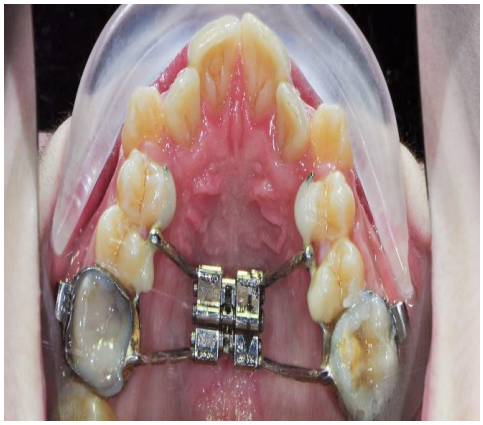
Isaacson type

This dental appliance does not have a palatal cover. It has a spring-loaded screw called the Minne expander, which was created by the University of Minnesota School of Dentistry. On the initial premolars and molars, the Minne expander is soldered straight to the bands. It

features a precisely calibrated coil spring that compresses the coil by twisting a nut, causing it to expand. The bands on the abutment teeth are soldered to two metal flanges that are orientated perpendicular to the coil. After the expansion phase is complete, the Minne expander may continue to apply expansion forces unless it is partially deactivated.[9]

Tissue tooth borne

Derichsweiler type



Initially the premolars and molars are banded. After soldering the wire ends to these bands, they are placed into split palatal acrylic that has a screw in it.

Hass type

It is similar to the banded version, aside from how it is attached to the teeth, this appliance features an acrylic cap on the back segments that is directly bonded to the teeth. The benefits of the bonded appliance have led to its growing popularity.

During the mixed dentition stage, when retaining other appliances might be less effective, It is simple to cement.

The several of visits decreases

It minimizes posterior tooth tipping and extrusion.

The buccal capping helps control molar extrusion during treatment, enhancing vertical control. This is especially beneficial in Class II cases, as molar extrusion could lead to mandible to rotate backward and downward, leading to increased facial convexity and a greater vertical dimension of the lower face.[9]

It offers a bite block effect to rectify the anterior cross-bite.[10]

SLOW MAXILLARY EXPANSION

INDICATIONS OF SLOW MAXILLARY EXPANSION

Patients who have unilateral or bilateral cross-bites

Patients with minimal crowding by gaining space.

Patients who have dental cross-bite in permanent dentition.

Patient with mild maxillary deficiency in patients with cleft lip and palate can be addressed by applying slow, continuous forces

ADVERSE CONDITION OF SLOW MAXILLARY EXPANSION

Patient who have completed their growth.[11]

APPLIANCES IN SLOW MAXILLARY EXPANSION

Slow maxillary appliances are divided into.

REMOVABLE/ ADJUSTABLE

Coffin spring

Active palate

Y- plate

Shwartz appliance

FIXED

Quad helix

Minnie expander

Spring loaded expander

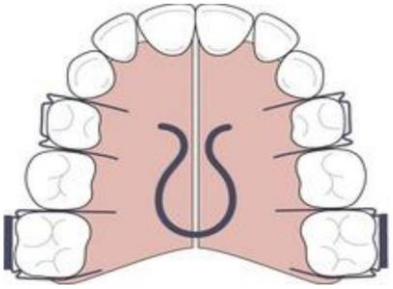
W arch

Spring jet.

REMOVABLE

Coffin spring

It is given Walter Coffin in 1875. It is a removable device that allows for slow expansion of the alveolar bone. The appliance consists of a 1.25 mm thick omega-shaped wire that is placed in the mid-palatal region. The acrylic covering the empty bevel has the free end of the omega-shaped wire implanted in it. The spring is triggered by manually extending both sides.[12]



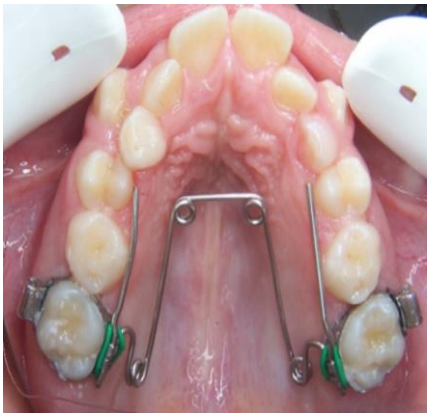
Y- plate

It is an active type removable expansion device that Bite plate with Adams clasp acting as support or restraining component. Premolar and molar area. Labial bow is placed in the anterior part. A retention lever is incorporated into the acrylic, and the acrylic plate is split. Y-shaped with two screw jacks between the anterior and posterior halves. Acrylic plate exerting force in distal direction.[13]

FIXED

Quad helix

The Quadhelix Appliance, an adaptation of the W-Coffin Spring described by Ricketts, features four helices integrated into the W spring. This design enhances flexibility, activation range, and palatal shoulder length. Depending on the teeth in a cross-bite, the appliance can be adjusted.[14]



W-arch

The "W" expansion device, first introduced by Ricketts et al. in 1975 for the treatment of cleft palate patients, features a fixed horseshoe-shaped design. It is constructed from 36-mil steel wire and attached to the molar bands on both sides. The lingual arch should remain 1–1.5 mm apart from the palatal soft tissue to avoid irritating it. This device is simple to activate, allowing adjustments by opening the upper arms into a W-shape to extend either more anteriorly or posteriorly, as required. For optimal performance, the device should be opened 3-4 mm wider than its passive width before insertion, ensuring it applies the correct level of force. A monthly expansion of 2 mm is recommended until the cross-bite is just a little bit overcorrected.

SURGICALLY ASSISTED MAXILLARY ARCH EXPANSION

As people age, the dental arch's influence on the maxillary base decreases, hence surgical expansion approaches might be taken into consideration.

Indications for surgical expansion

Arch extension

To rectify posterior cross-bite when an extensive expansion (>7 mm) is necessary to mitigate the potentially heightened risk of segmental osteotomies.

For arch expansion following maxillary collapse linked with cleft palate, particularly in in stances of exceptionally fragile and delicate gingival tissue or when notable buccal gingival r ecession exists at the site of maxillary canines and premolars; as well as in-scenario in which notable nasal stenosis is identified.[16]

The methods

Surgically assisted rapid palatal expansion (SARPE) Segmental maxillary surgery.

Surgically assisted rapid palatal expansion (SARPE) is an increasingly popular treatment option for correcting transverse maxillary deficiencies (TMD), Health professionals can attainpotent widening of the upper jaw in patients who have reached skeletal maturity. Transv erse dilatation can be carried out during the Le Fort 1 osteotomy by making an additional surgical incision at the mid palatal seam using segmental maxillary surgery.

The sections of the maxilla are then isolated and secured in their new alignment. The compar ative rigidity of the palatal mucoperiosteal tissue restricts the degree of expansion that can be accomplished.

Preoperative orthodontic intervention may expand the upper front tooth to enhance surgical access to the site of the osteotomy. This technique selects a patient who needs expansion surgery and has variations in Yagut and/or vertical discrepancies.

EFFECT OF EXPANSION ON CIRCUMMAXILLARY STRUCTURES

Maxillary skeletal influences

Inoue discovered on occlusal examination inception of the mid- palatal suture was trigonal and unbalanced, accompanied by largest entry in the front teeth area and little by little diminished toward the backside of the palatal region.

In frontal view

The suture of upper jaw divides uninformed techniques in the absence of knowledge. There is a pyramid-like structure located at the bottom of the pyramid on the inner surface of the skeletal.[17]

Maxillary halves

Haas and Wertz have identified that the upper arch often moves downwards and forwards.

Palatine vault

In Haas's research, a lateral shift of the maxillary segments led to a descended palatine structure.

Alveolar process

On the account of elasticity of skeletal, a curvature of the alveolar process develops in the early stages of EMR, but will eventually revert back to its normal state a little while.[18]

Maxillary anterior teeth

In patient's view, a notable transformation introduced by EMR is the visibility of the upper front teeth. It has been calculated that, while the expansion screw is opened, upper front teeth move about half the distance from its position,[19] but the gap between the central incisors should not be used to measure the suture separation. It corrects itself because of the elastic recoil of the transseptal fibres.[20]

Maxillary molars

Buccal inclination and upper molars proclination are observed. The posterior part of the maxillary is not much able to expand due to resistance offered by the thickening of the buccal bone and the pterygoid plate.

RECENT ADVANCES

MARPE models upheld by four mini screws may likewise have extra dental help, for example, a palatal bar interfacing the left and right first molars in the maxilla. The expansion of a trans palatal bar unavoidably changes the machine plan into a blend of dental and bone expander. In a review where unadulterated bone MARPE (upheld by just four mini screws) was contrasted and consolidated dental and bone MARPE (four mini screws and a palatal bar between the primary molars), 100 percent achievement was accomplished in isolating the mid-palatal stitch. However, compared to the combined maxillary skeletal expander appliance, the bone-to-bone appliance provided greater increases in skeletal width, less dental side effects, and less buccal loss.[21]

CONCLUSION

Maxillary expansion is a cornerstone in orthodontic and orthopedic treatments for transverse deficiencies. Its effects extend beyond dental correction, influencing the circummaxillary sutures, nasal cavity, and facial structures. Continued research and advancements in technology will further refine these techniques, improving patient outcomes and expanding clinical applications.

REFERENCES

1. Patil GV, Lakhe P, Niranjane P. Maxillary expansion and its effects on circummaxillary structures: A review. Cureus, 2023 Jan; 15(1).

2. Ramieri GA, Spada MC, Austa M, Bianchi SD, Berrone S. Transverse maxillary distraction with a bone-anchored appliance: dento-periodontal effects and clinical and radiological results. International journal of oral and maxillofacial surgery, 2005 Jun 1; 34(4): 357-63.
3. Pinto PX, Mommaerts MY, Wreakes G, Jacobs WV. Immediate post-expansion changes following the use of the transpalatal distractor. Journal of oral and maxillofacial surgery, 2001 Sep 1; 59(9): 994-1000.
4. Posterior transpalatal distraction with pterygoid disjunction: a short-term model study. Matteini C, Mommaerts MY. *Am J Orthod Dentofacial Orthop,* 2001; 120: 498–502.
5. Jadhav VV, Vasudevan SD, Kamble R, Tiwari MM. Comparison of Bolton's ratio for evaluation of tooth size discrepancy between maxillary and mandibular arches in Vidarbha population. Journal of Evolution of Medical and Dental Sciences, 2020 May 25; 9(21): 1659-63.
6. Laptook T. Conductive hearing loss and rapid maxillary expansion: report of a case. American journal of orthodontics, 1981 Sep 1; 80(3): 325-31.
7. Angell EE. Treatment of irregularity of the permanent or adult teeth. Dent Cosmos, 1860; 1: 540-4.
8. Gogna N, Johal AS. The stability of surgically assisted rapid maxillary expansion (SARME): a systematic review. Journal of Cranio-Maxillofacial Surgery, 2020 Sep 1; 48(9): 845-52.
9. Sarver DM, Johnston MW. Skeletal changes in vertical and anterior displacement of the maxilla with bonded rapid palatal expansion appliances. American Journal of Orthodontics and Dentofacial Orthopedics, 1989 Jun 1; 95(6): 462-6.
10. .Bishara SE, Staley RN. Maxillary expansion: clinical implications. American journal of orthodontics and dentofacial orthopaedics, 1987 Jan 1; 91(1): 3-14.
11. McNamara Jr JA. An orthopedic approach to the treatment of Class III malocclusion in young patients. Journal of clinical orthodontics: JCO, 1987 Sep 1; 21(9): 598-608.
12. Naidu S, Suresh A. Slow Palatal Expansion a Novel Method of Arch Expansion. Guident, 2019 Jan 1; 12(2): 46-50.
13. Bell RA. A review of maxillary expansion in relation to rate of expansion and patient's age. American journal of orthodontics, 1982 Jan 1; 81(1): 32-7.
14. Naidu S, Suresh A. Slow Palatal Expansion a Novel Method of Arch Expansion. Guident, 2019 Jan 1; 12(2): 46-50.
15. RICKETTS R. Rocky mountain orthodontics. Bioprogressive Therapy, Book, 1.

16. Suri L, Taneja P. Surgically assisted rapid palatal expansion: a literature review. American journal of orthodontics and dentofacial orthopaedics, 2008 Feb 1; 133(2): 290-302.
17. Bishara SE, Staley RN. Maxillary expansion: clinical implications. American journal of orthodontics and dentofacial orthopaedics, 1987 Jan 1; 91(1): 3-14.
18. Isaacson RJ, Wood JL, Ingram AH. Forces produced by rapid maxillary expansion: I. Design of the force measuring system. The Angle Orthodontist, 1964 Oct 1; 34(4): 256-60.
19. Haas AJ. Rapid expansion of the maxillary dental arch and nasal cavity by opening the midpalatal suture. The Angle Orthodontist, 1961 Apr 1; 31(2): 73-90.
20. Wertz RA. Skeletal and dental changes accompanying rapid midpalatal suture opening. American journal of orthodontics, 1970 Jul 1; 58(1): 41-66.
21. Sarraj M, Akyalcin S, He H, Xiang J, AlSaty G, Celenk-Koca T, DeBiase C, Martin C, AlSharif K, Ngan P. Comparison of skeletal and dentoalveolar changes between pure bone-borne and hybrid tooth-borne and bone-borne maxillary rapid palatal expanders using cone-beam computed tomography. APOS Trends Orthod., 2021 Apr; 11(1): 32-40.