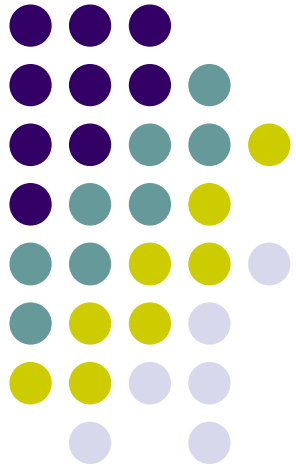
ARCH EXPANSION

Dr Rahul Trivedi



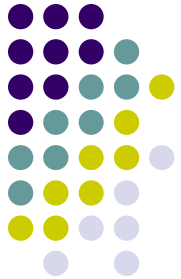
CONTENTS

- INTRODUCTION
- HISTORICAL BACKGROUND
- CLASSIFICATION
- ANATOMY
- ETIOLOGY OF NARROW MAXILLA & DIAGNOSIS
- DIFFERENCE BETWEEN ORTHOPEDIC & ORTHODONTIC EXPANSION
- SLOW EXPANSION DEVICES
- INDICATION & CONTRA INDICATION OF R.M.E
- EFFECT OF R.M.E ON THE MAXILLARY AND MANDIBULAR COMPLEX
- EFFECT OF AGE & R.M.E

CONTENTS

- APPLIANCE DESIGN & CONSTRUCTION
- SCREW USED IN R.M.E
- JACK SCREW SCHEDULES
- HOW MUCH TO EXPAND
- FORCE APPLICATION
- S.A.M.E
- HAZARDS OF R.M.E
- CLINICAL ADVICES FOR R.M.E PATIENTS
- CONCLUSION

INTRODUCTION



- The dentition erupts in to an environment, completely dominated by a musculature system which dictates individual tooth position.
- If crowding or protrusion occur in the permanent dentition, three basic treatment strategies are used to solve this problem: extraction, interproximal reduction, and expansion.

HISTORICAL BACKGROUND

- The narrow maxilla has been recognized for thousands of years but for obvious scientific reasons, no effective treatment was possible
- A number of slow expansion techniques were employed by early dental practitioners like Fauchard (1728) Bourdet (1757), Fox (1803), Delabarre (1819), Robinson (1846), White (1859).

HISTORICAL BACKGROUND

- The procedure probably originated in United State with Angell in (1860) who placed a screw appliance between maxillary premolars of a girl age 14.5 years and widened her arch one quarter inch in two weeks.
- In the year 1889, the president of the American Dental Association J. H. McQyillen protestation against Angell. Such protestations was responsible for Angell's future silence

HISTORICAL BACKGROUND

- Farrar (1888) – Mid palatal suture
- The first work in RME published by Lands Berger in (1908) and later a paper (1909)
- Ziebe (1930), Experimental study
- Angle, Case, Ketcham, and Dewey
- Nance (1947), Tweed (1945)

HISTORICAL BACKGROUND

- Barnes (1956), with 20 years experience in treatment observed that most successful results of expansion were achieved in deciduous arches when treatment was started between 4-7 years of age
- Wertz (1967), confirmed the advantage of RPE in improving nasal air flow
- Timms (1973),
- Lehman and Hass (1984),
- Glassman et al (1984),
- Morton S. Wintener (1991), Wendell V. Arndt (1993), introduced the Nickel titanium palatal expander

CLASSIFICATION

- **Expansion**

  Expansion can be divided into various arbitrary categories including orthodontic, passive, and orthopedic.

CLASSIFICATION

- **Orthodontic Expansion:**

  It is well known that expansion of the dental arches can be produced by a variety of orthodontic treatments, including those that employee fixed appliances.

CLASSIFICATION

- **Passive Expansion**

  When the occlusion is shielded from the forces of the buccal and labial musculature, a widening of the dental arches often occurs. This expansion is not produced through the application of extrinsic biomechanical forces, but rather by intrinsic forces such as those produced by the tongue. Example as passive expansion are the dimensional changes in the dental arches produced by such vestibular shield appliances as the FR-2 of Frankel.

CLASSIFICATION

- **Orthopedic Expansion:**

  Rapid maxillary expansion (RME) appliances are the best examples of true orthopedic expansion in that changes are produced primarily in the underlying skeletal structures rather than by the movement of teeth through alveolar bone

ANATOMY

- Each maxilla has a body and zygomatic, frontal, alveolar and palatine process.
- Body of the maxilla articulates with the following bones :
- Cranially :

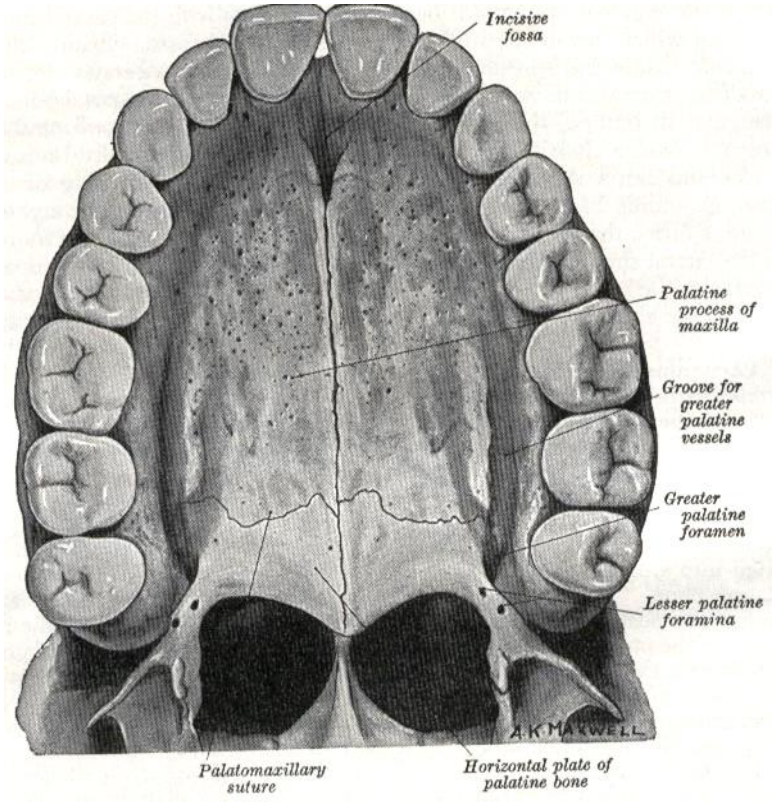
  1) Frontal, 2) Ethmoid
- Facially :

  1) Nasal, 2) Lacrimal, 3) Inferior nasal conchae,

  4) Vomer, 5) Zygomatic and 6) Palatine

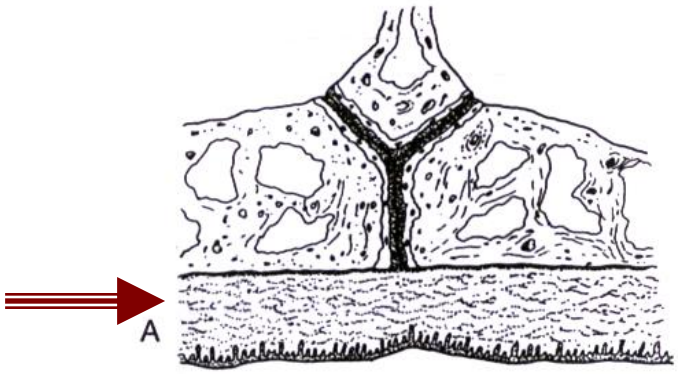
  Most of these bones bind the maxilla posteriorly and superiorly by sutural joints leaving the anterior and inferior aspect free.

ANATOMY



- In theory this suture is formed by the junction of the three opposing pairs of bones namely premaxillae, maxillae and the palatines but often for practical purposes they will be treated as single entity called as a Midpalatal suture.

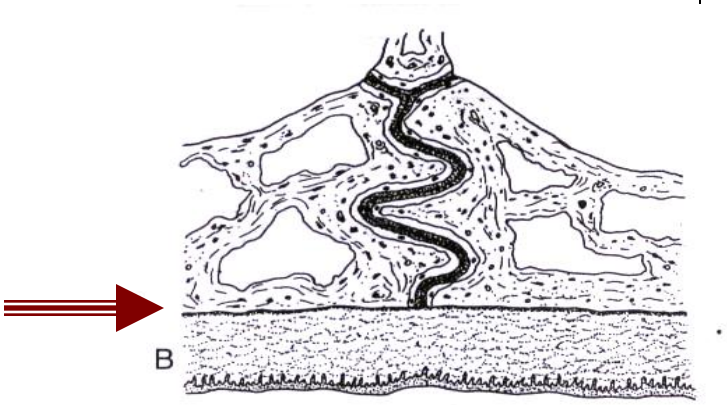
ANATOMY



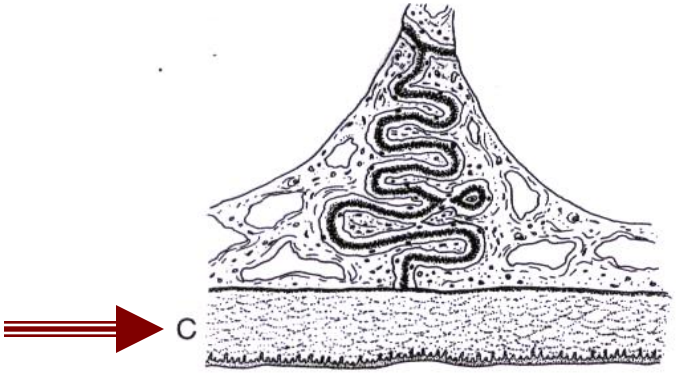
- The morphology of the mid palatal suture has been studied by MELSEN (1975).
- Stages of development used by Bjork and Helm
- First stage : Covering the infantile period. The suture is very broad and Y shaped with the vomerine bone placed in a V shaped groove between the two halves of the maxilla.

ANATOMY

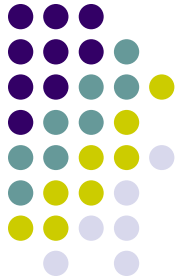
- Second stage : Juvenile period, the suture is found to be more wavy.



- Third stage : Adolescent period, the suture is characterized by a more tortuous course with increasing inter digitations



ETIOLOGY OF THE NARROW MAXILLA AND ITS DIAGNOSIS



- The causes of buccolingual discrepancies could be either genetic or environmental.
- Graber, and Harvold - abnormal function.
- Cleft palate
- Asymmetrical growth

Diagnosis:

Ashley howe's analysis, Pont's index and Korkhaus proposed index

DIFFERENCE BETWEEN ORTHOPEDIC AND ORTHODONTIC EXPANSION

ORTHODONTIC FORCE

By use of this force the teeth alone are supposed to move .

Adaptive changes in specific alveolar bone adjacent to moving teeth.

ORTHOPEDIC FORCE

Result in major change occurring in basal structures of mandible & maxillae.

Involves interaction between basal bone & alveolar bone.

SLOW EXPANSION

- Slow expanders like Quad Helix & W-Spring can transmit forces
- ranging from several ounces to 2 pounds.
- They can separate maxillae, particularly in the deciduous & mixed dentitions.
- 0.4 / 1.1 mm / week
- Intermolar width – 8mm
- 2 – 6 months
- Skeletal changes –

  16 – 30%

RAPID EXPANSION

- R.M.E.
- 0.2 / 1.5 mm / day
- Intermolar width – 10mm
- Skeletal changes – 50%
- 1 – 4 weeks.

SLOW EXPANSION DEVICES

- Active plate. This serves as a base in which screws or springs are embedded and to which clasps are attached.
- Most screws open 1mm per complete revolution, so that a single quarter turn produces 0.25mm of tooth movement

SLOW EXPANSION DEVICES

- Quad Helix Appliance:

  History:

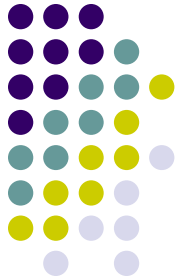
  Farrar & Coffin – 1875 .

  To treat Cleft palate

  Nance button – 1947.

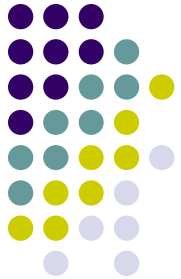
In order the widen the range and yield more flexibility , helix loops were introduced.

Quad Helix Appliance:

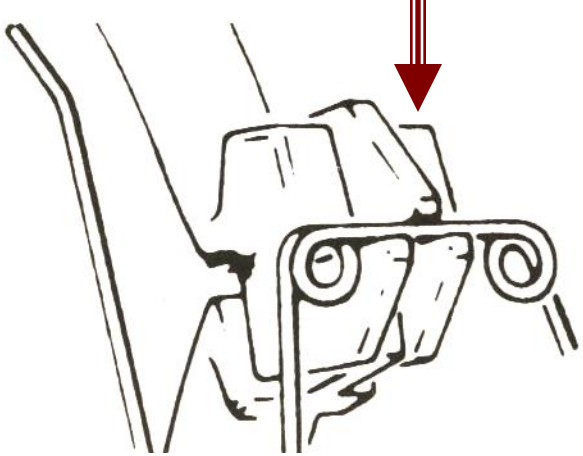


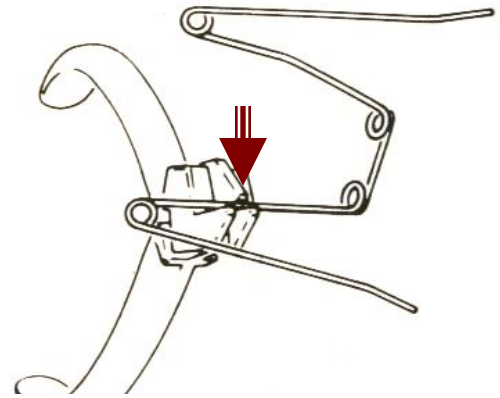
- Basically, the appliance is constructed of 0.038 inch wire and soldered to bands which are cemented to either the maxillary first permanent molar or the deciduous second molars, depending on the age of the patient.

Quad Helix Appliance:



- All cross- bites in which the upper arch needs to be widened
- Mild expansion in the mixed dentition which frequently exhibit lack of space for the upper laterals and in which the long range growth forecast is favorable.
- Class III – Expansion needed
- Class II cases
- Thumb sucking or Tongue thrusting cases
- Cleft palate conditions either unilateral or bilateral.



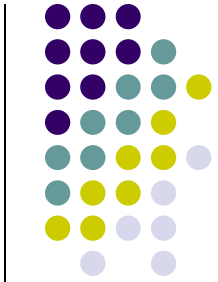


- An initial expansion of 8mm will produce approximately 14 ounces of force.

VARIATIONS

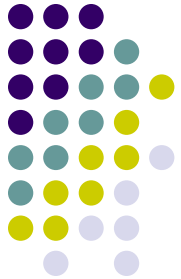
- Habit – breaking appliance.
- Finger spring.

R.M.E



- In subjects, demonstrating severe maxillary construction,
- RME is an appliance of choice for expansion of maxillary halves when maxillary bases are constricted.
- RME causes a relative reduction in the nasal airway resistance by disarticulating the maxilla from other bone particularly septal and palatine bone

INDICATION & CONTRAINDICATION OF R.M.E



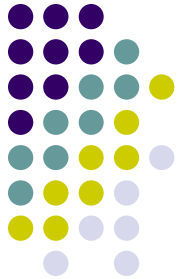
- REDUCTION OF NASAL AIRWAY RESISTANCE

  The extent of which RME will change the mode of respiration is complex owing to wide variations in both NAR (nasal airway resistance) reduction and the point at which an individual subject will switch from nasal to oronasal breathing.
- Nilnimmar et al 1980
- Study by Dale

  The recommendation of RME for purely respiratory reasons can not be advocated on a risk/benefit Basis.

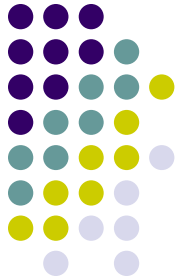
- TREATMENT OF MATURE CLEFT LIP & PALATE
- TREATMENT OF NOCTURNAL ENURESIS: (BED WETTING).

CONTRA INDICATIONS FOR RME



- Patients who do not cooperate with the clinician.
- Patients who have single tooth in cross bite probably do not need RME.
- Patients who have anterior open bite.
- Patients with steep mandibular plane and convex profits are generally not suited for RME.
- Patients who have skeletal asymmetry of the maxilla or mandible.
- Adults with server anteroposterior and vertical skeletal discrepancies are not good candidates for RME.

EFFECT OF R.M.E. ON THE MAXILLARY AND MANDIBULAR COMPLEX

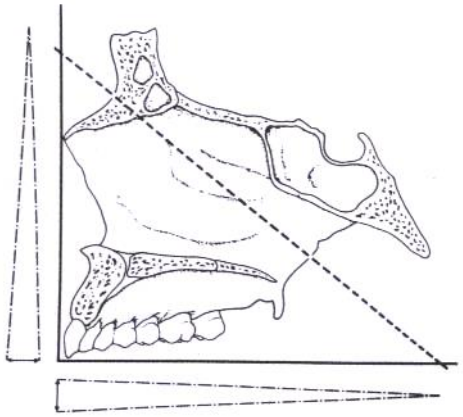


- Rapid maxillary expansion occurs when the force applied to the teeth and the maxillary alveolar processes exceeds the limits needed for orthodontic tooth movement. The applied pressure acts as an orthopaedic force that opens the midpalatal suture. The appliance compresses the periodontal ligament, bends the alveolar processes, tips the anchor teeth, and gradually opens the midpalatal suture.

- Alveolar processes. Because bone is resilient, lateral bending of the alveolar processes occurs early during RME. Most of the applied forces tend to dissipate within 5 to 6 weeks. After stabilization is terminated, any residual forces in the displaced tissues will act on the alveolar processes causing them to rebound
- Maxillary anterior teeth. From the patient's point of view, one of the most spectacular changes accompanying RME is the opening of a diastema between the maxillary central incisors.

- Maxillary posterior teeth. With the initial alveolar bending and compression of the peridontal ligament, there is a definite change in the long axis of the posterior teeth. Hicks found that the angulation between the right and left molars increased from 10 to 24^0 during expansion. Not all of the change, however, is caused by alveolar bending, but is partly due to tipping of the teeth in the alveolar bone. This tipping is usually accompanied by some extrusion.

- In the frontal plane, the fulcrum of rotation for each of the maxillae is said to be approximately at the frontomaxillary suture. Using implants, the maxillae were found to tip anywhere between – 1 and + 8 relative to each other.



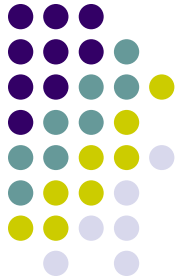
- **Fulcrum of rotation for the maxillary bony complex producing a triangular opening**

- Effects of RME on the mandible.
  - It is generally agreed that with RME there is a concomitant tendency for the mandible to swing downward and backward.

Effects of RME on adjacent facial structures

1)all craniofacial bones directly articulating with the maxilla were displaced except the sphenoid bone. (2) the cranial base angle remained constant, (3) displacement of the maxillary halves was asymmetric

EFFECTS OF AGE & R.M.E



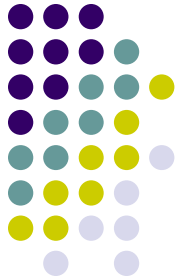
- Growth at the midpalatal suture was thought to cease at the age of 3 years. By means of implants, Bjork and Skiellent found that growth at the suture might be occurring as late as 13 years of age

- Wertz

  He divided his sample into 3 age groups: under 12, 12 to 18, and over 18 years. He found that after expansion and during fixed retention there was little relapse in any of the three groups (-0.5, -0.6 and 0.5mm, respectively). On the other hand, each age group behaved differently from the time of appliance removal to the end of retention. The group under 12 years of age had a further increase of approximately 10%, and the over 18 years group had a relapse of approximately 63%.

The optimal age for expansion is, therefore, before 13 to 15 years of age.

APPLIANCE DESIGN & CONSTRUCTION



- Rigidity
- Number of teeth included in appliance
- Load distribution
- Appliance retention
- Expansion
- Economy
- Material
- Hygiene

COMMON APPLIANCES

- Deririch Sweiler type
- Hass type
- Issacson type
- Bidermann type
- John L. Spolyar (1984)
- Vel ivanovski (1985)
- Patrick k. Turley (1988)
- R.J. Radlanski w. Walloschek (1989)
- DAVID M. SAVER et al (1989)
- STEPHEN WILSON (1990)
- HILGERS (1991)
- WENDELL V. ARNDT (1993)
- DAVID W. WARREN (1993)

SCREWS

- Skeleton type in this category we have three types.

  Maximum (Maxi)

  Medium

  Minimum (Mini)
- Hyrax expansion screw:

  For mid palatal suture separation by means of fixed appliance without the need for acrylic plates. Metal frame work used in combination with performed band which are soldered to the retention arm

- Trapezoidal expansion screw:

  This skeleton type is used mainly for narrow maxilla
- Fan type expansion screw:

  For sectional expansion of maxillary anteriors. Plate sections are opened up fan wise. It is used in cleft palate patients also.

- Telescopic or spring loaded screws:

  Telescopic stainless steel expansion screw with rectangular guide pin for lateral expansion.
- Telescopic stainless steel expansion screw with rectangular guide pin for lateral expansion.
- Telescopic expansion screw are available in minimum – medium and maximum size.

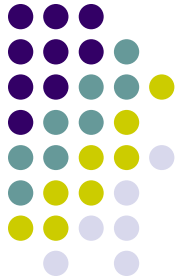
- Two stage expansion screw :
  - Widening of the maxillary arch by palatal expansion technique often necessitates using, two different expansion screw appliance an initial one, small enough to fit in an extremely narrow arch and produce, preliminary expansion and a subsequent larger appliance with which to achieve desired arch width

JACKSCREW TURN SCHEDULES

Zimmring and Isaacson recommend the following turn schedules:

- Young growing patients two turns each day for the first 4 to 5 days, one turn each day for the remainder of RME treatment:
- Adult (non growing) patient – because of increased skeletal resistance, two turns each day for the first 2 days, one turn each day for the next 5 to 7 days, and one turn every other day for the remainder of RME treatment

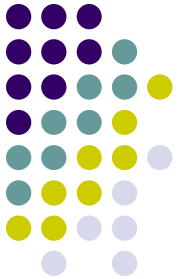
HOW MUCH TO EXPAND



- Studies by Kerbs (1964) Stockfisch (1976) and Linder Aronson et al (1979) show that between one third to one half of the expansion was lost before stability eventually was reached. Out of one thousand patients who were treated by RME there were only two in whom no relapse occurred, and the extent of this relapse is largely unpredictable. A general guide line about how much to expand dictates a stop when the maxillary palatal cusps are level with the buccal cusps of the mandibular teeth.

- A general guide line about how much to expand dictates a stop when the maxillary palatal cusps are level with the buccal cusps of the mandibular teeth.

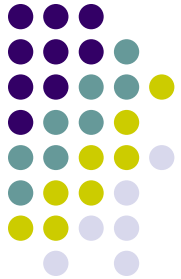
Stalley Rn Peterson Lc (1985)



- Measure the distance between the most gingival extension of the buccal grooves on the mandibular first molars or, when the grooves have no distinct terminus on the buccal surface, between points on the grooves located at the middle of the buccal surfaces.
- Measure the distance between the tips of the mesiobuccal cusps of the maxillary 1st molars.
- Subtract the mandibular measurement from the maxillary measurement

- The average differences in Persons with normal occlusion are 1.6mm for males and 1.2mm for females

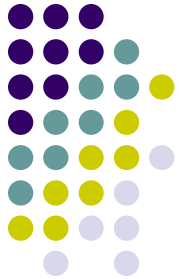
RAPID MAXILLARY EXPANSION OF CLEFT LIP & PALATE



- Complete unilateral or bilateral cleft of the osseous premaxilla destroy the continuity of the dental arches, the alveolar arch and the basal maxillary bone. When this type of congenital malformation occurs in combination with a cleft of the secondary palate the buccal segment on the affected side appears clinically rigid.

- The cleft palate subjects manifests a normal lateral relationship at the most posterior teeth and an anterior collapse. Character of the collapse is not parallel but an inward rotation of the maxilla about fulcrum in the pterygoid regions. The maxillary collapse is usually stopped by the turbinate bone coming in contact with the nasal septum.

DESIGN OF APPLIANCE FOR CLEFT PALATE PATIENTS



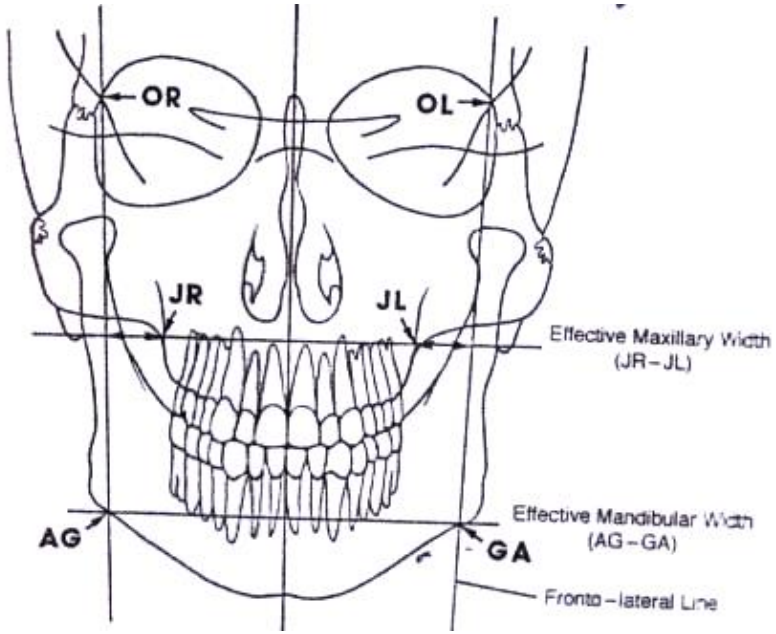
- In general, the anatomy of the repaired cleft palate differs from the normal in way which has an important bearing on appliance design. Although the basic design principles of normal subjects can be applied equally to cleft patients but a parallel or a near parallel expansion is undesirable

- Experience has shown that over expansion with some controlled relapse is a good way of managing RME, but with many cases of cleft patients, there is little room for expansion at the posterior end of the arch and differential expansion puts considerable strain on the screw. If exceeded this will result in fracture of the screw and or displacement of the applianc

- Another problem which arises a mismatch between the required size of screw and the available space. The greater the collapse, the less space is available for the screw
- Manufacturers are now marketing screw with longer threads up to 18mm expansion. As the palate in cleft patients is usually flat, the screw can be mounted near the level of the crowns or screw can be soldered to the occlusal surface of the splints.

- Matthew and Grossman 1964 described the advantage of RME in moving entire segments of bone and recommended the use of a bone graft to stabilize the expansion.

SURGICAL ASSITED MAXILLARY EXPANSION



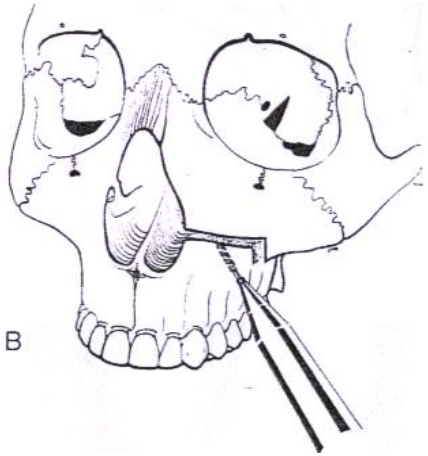
Indications

- A skeletal maxillomandibular transverse discrepancy greater than 5mm
- Significant transverse maxillary deficiency associated with a narrow maxilla and wide mandible
- Failed orthodontic expansion;

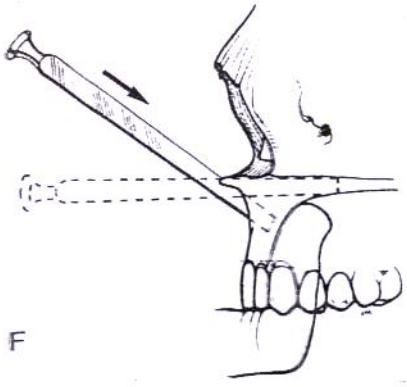
4. Necessity for a large amount (>7mm) of expansion, or preference to avoid the potential increased risk of segmental osteotomies

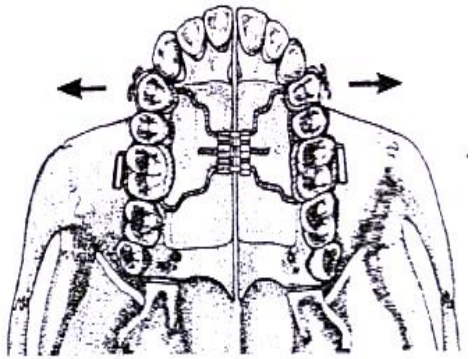
5. Extremely thin, delicate gingival tissue or presence of significant buccal gingival recession in the canine-bicuspid region of the maxilla; and

6. significant nasal stenosis.


B

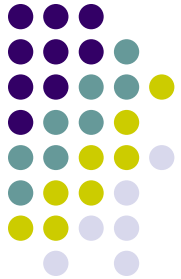

D


F


O

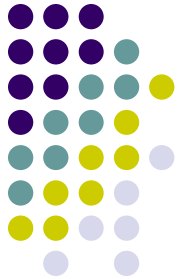

I

HAZARDS OF RME



- Tissue damage
- Root resorption
- Failure of suture to open

METHOD OF RETENTION AND RELAPSE TENDENCIES

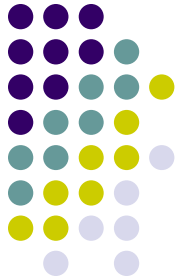


- The aim of retention is to hold the expansion while all the forces generated by expansion appliance is removed. Hicks observed that the amount of relapse is related to the method of retention after expansion. He observed with no retention, the relapse can amount to 45%, as compared with 10% to 23% with fixed retention and 22% to 25% with removable retention.

- Bell concluded that slow expansion is less disruptive to the sutural systems. Slow expansion that maintained tissue integrity apparently needs 1 to 3 months of retention, which is significantly shorter than the 3 to 6 months recommended for rapid expansion, Mew advocates a total retention period of 1 ½ to 4 years depending on the extent of expansion.

- Then the first removable retention plate is made on the ‘while you wait basis’ and consists of a fully fitting base plate of cold curing acrylic with 4 Adams cribs in the mixed dentition stage, A retention plate with only two Adam’s cribs (First permanent molar) is fitted and the fixed retention phase is longer, up to six months, when using an all metal expansion appliance

Buccolingual pressure

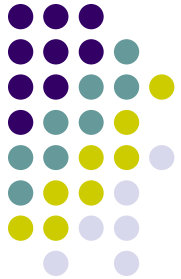


- The structural changes with RME are considerable and include areas of muscle involvement such as the pterygoid hamulus. These anatomical changes and concomitant functional changes could produce a new pattern of pressure in hormony with a wider maxilla.

Timm’s

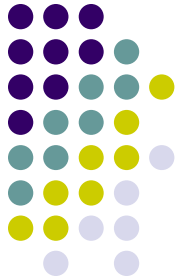
- First three months
- Resistance to deformation from circum maxillary sutures

CLINICAL ADVISE FOR RME PATIENTS



- Postpone extraction of 1st premolars until palatal expansion is completed because these teeth, together with the 1st molars are often used as abutment teeth for anchoring the appliance. If premolars have not erupted, second deciduous molars with adequate root structure can be used. Howe suggested a bonded appliance that would incorporate deciduous teeth.
- When possible avoid orthodontic movement of the maxillary posterior teeth prior to RME. Mobile teeth may tip faster during expansion.
- The vertical positioning of the expansion screw is a function of the width of the palate and the size of the screw. For patients comfort and for mechanical advantage, position the screws as superiorly as possible in the palatal vault.

- Start turning jack screw 30 minutes after the appliance is inserted to allow sufficient setting time for cementing medium. Each turn of the screw open the appliance 1/4mm. Provide the patient with an instruction sheet listing the turn schedule and possible symptoms that might accompany RME.
- Tie a string or dental floss to the turn key to prevent it from being swallowed. Solder the key handle to avoid slippage of the floss.
- See the patient at regular – intervals during the expansion phase of treatment, measure the distance between the two halves of the expansion screw to determine how much the screw has been turned. Discuss discrepancies between this measurement and the turn schedule with the patients.

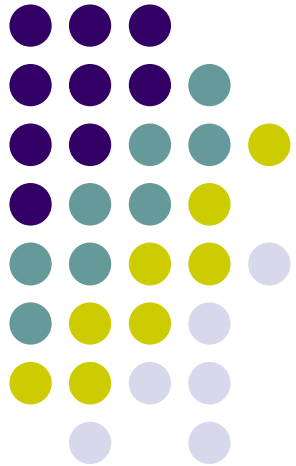


- Monitor the midpalatal suture with weekly maxillary occlusal films. The suture will open within 7 to 10 days in most patients. If the suture does not split within 2 weeks, the lack of the skeletal response may result in tipping of the teeth and possible fracture of alveolar plates.
- After the expansion is completed and the screw is immobilized, the appliance acts as a fixed retainer for a period of 3 to 6 months to allow the tissues to reorganize in their new positions and also allow the forces created by the expanding appliance to dissipate. The greater the magnitude of expansion, the longer the period of fixed retention.
- After removing the RME appliance, place a transpalatal arch between the maxillary first molars to minimize relapse tendencies.

- At the end of the expansion stage and during fixation the maxillary posterior segment are usually over expanded. During the orthodontic treatment phase incorporate some expansion in maxillary arch wire to avoid lingual crown torque of the maxillary molars and/or buccal crown torque of the mandibular molars because such forces may reintroduce the crossbite problem.

- In a patient with a severely constricted palate, the clinician might consider some of the following options.
- Expand the palate in two phases
- Initiate expansion as early as possible
- Prolong the period of fixed retention
- Consider extraction of teeth in one or both jaws to facilitate constriction of the dental arches
- Over expand the maxillary arch.
- Use an expander that will maximize skeletal movements for patients with narrow palate.

Thank you



1. Possible immediate effect of premature appliance removal include dizziness and a feeling of heavy pressure at the bridge of the nose, under the eyes, and generally throughout the face. Balancing of the soft tissue overlying these areas and balancing between the central incisors have been reported. Some of these symptoms continued over a period of 19hours during which the appliance was out of the mouth in that period. The measured relapse is only 1.5mm in transpalatal dimension. Similar symptoms occur if the appliance is removed for repair or recementation during the expansion phase or if the force is deactivated rapidly.