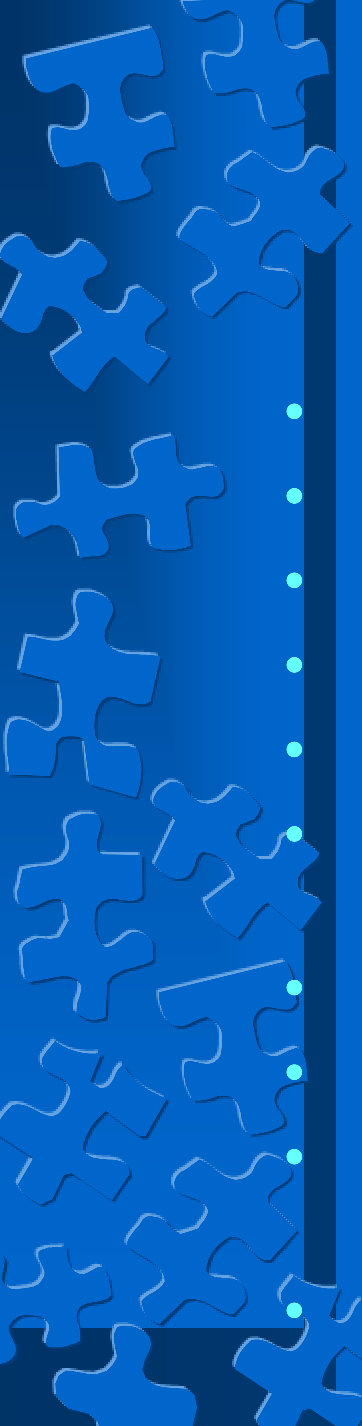
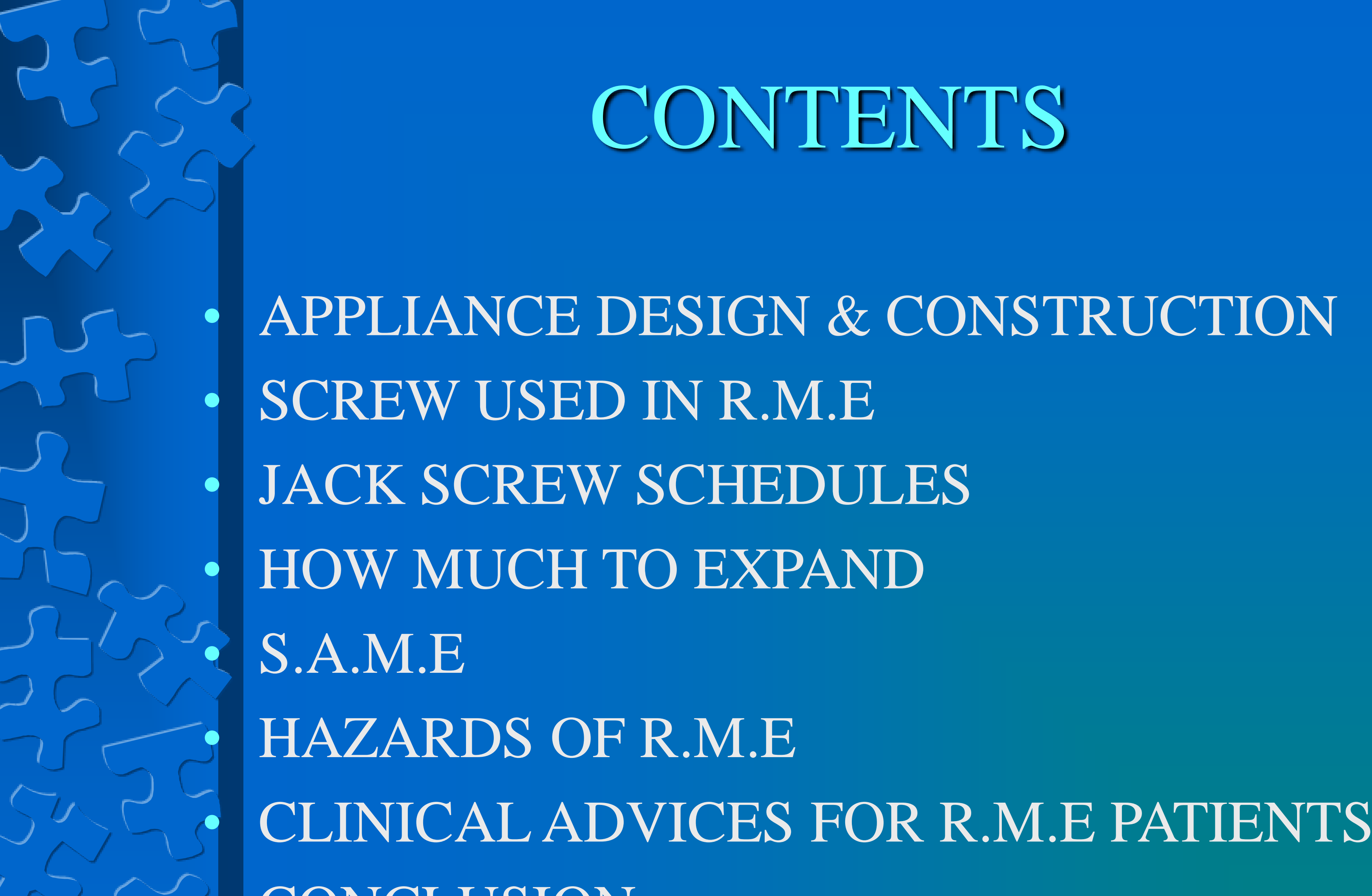


CONTENTS

- 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
S.A.M.E
HAZARDS OF R.M.E
CLINICAL ADVICES FOR R.M.E PATIENTS
CONCLUSION

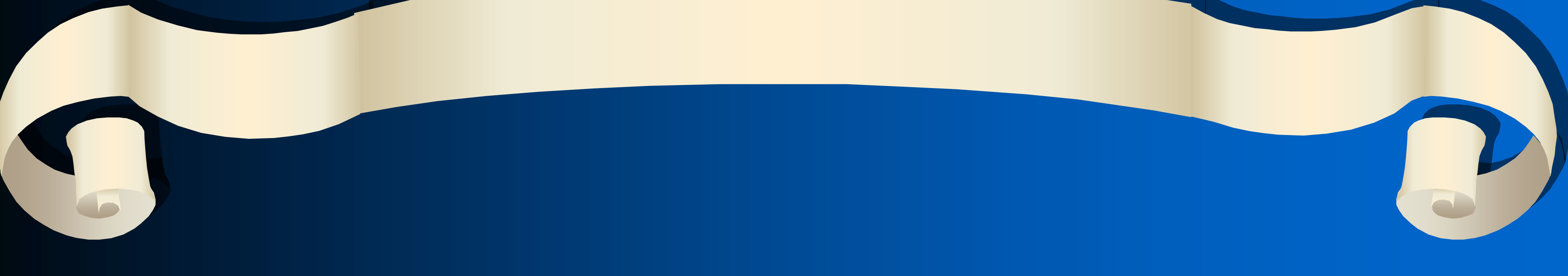
INTRODUCTION

- Growth ceases first in the transverse dimension. The constricted maxilla dentally or skeletally always poses a problem for an orthodontist . So diagnosing and treating this problem first is an integral part in orthodontics .
- The maxilla and upper teeth positions are governed by the musculature surrounding them, in patients showing constricted maxillary arch it is mandatory to deal with by applying an orthopedic forces across the maxilla to expanding it.

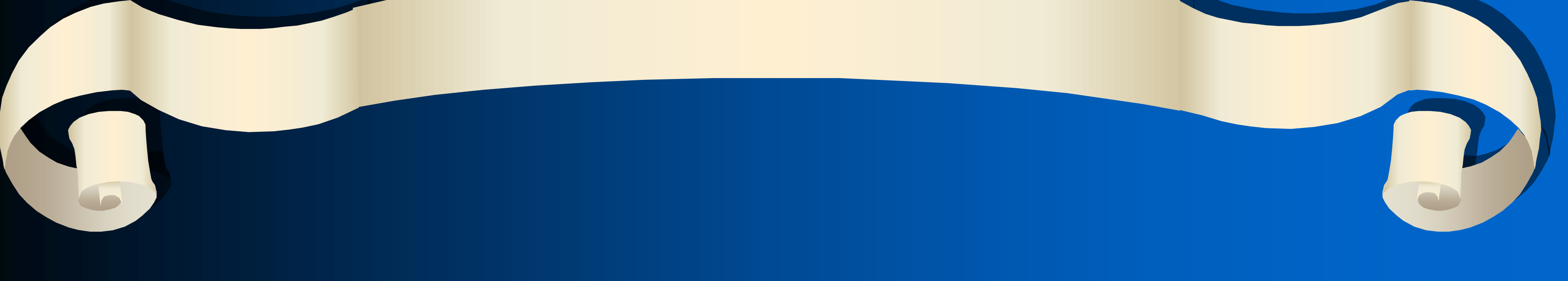
- Palatal expansion occupies a unique In dentofacial therapy. By its tooth movements and mechanics it must basically come with in the field of orthodontics ,yet its ramifications take it into such other surgical disciplines as oral ,ENT and plastic surgery

HISTORICAL BACKGROUND

- The narrow maxilla has been recognized for thousands of years by “Hippocrates”
- 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).



- The first published work 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.
- To many in field of orthodontics and Rhinology , the early 1900's are know as the "maxillary expansion years"



- At this stage in orthodontic history numerous articles pointing to the interrelations of orthodontics and Rhinologic treatment procedures appeared in the literature .
- G.V.I Brown a noted rhinologist was one of vociferous proponents of suture opening for purpose of increasing nasal permeability

- 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 .
- Lundstrom and later Brodie and associates also challanged the expansion .

Incidence

- The incidence of transverse maxillary deficency is estimated to be between 8-18 percent of patients presenting for orthodontic consultation.

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

Will and Muhl

- I)Jackscrew Appliances:

  Two types:

  Tooth borne, Hyrax appliance

  Tissue borne, Hass appliance
- II)Removable Expanders.

  Removable jack screw appliances
- III)Non screw expanders

  A)Quad Helix

  B)Transpalatal arch
- IV) Slow expansion:

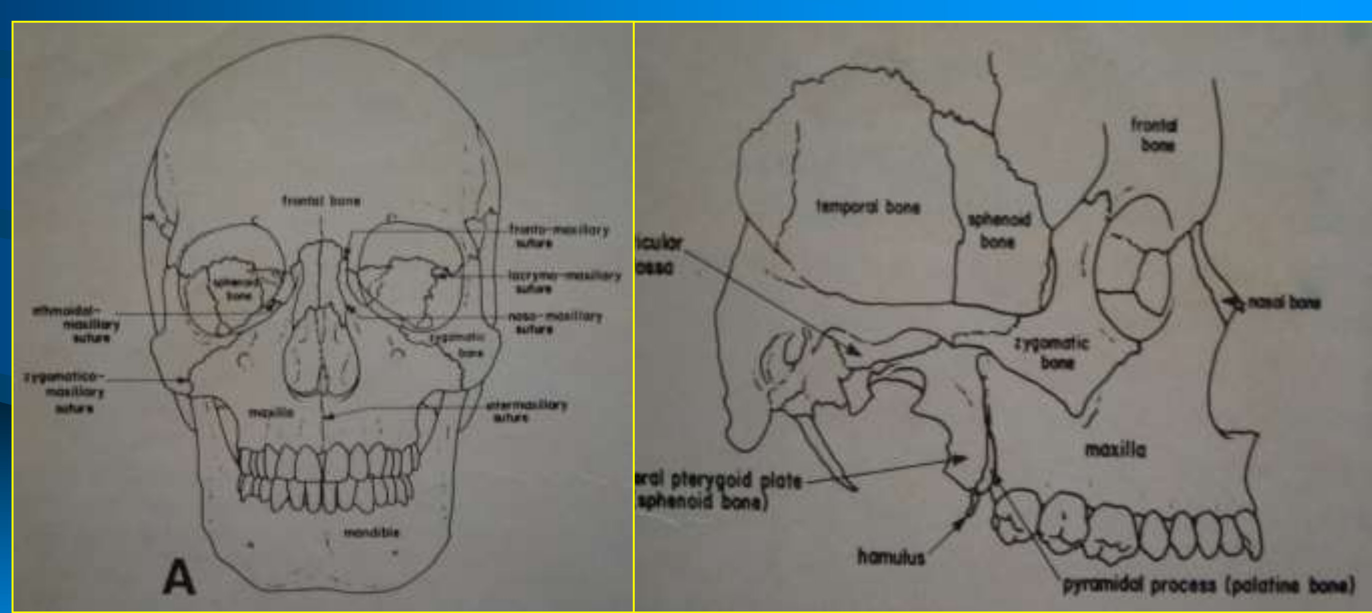
  Minnne expander
- V) Functional appliances

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,

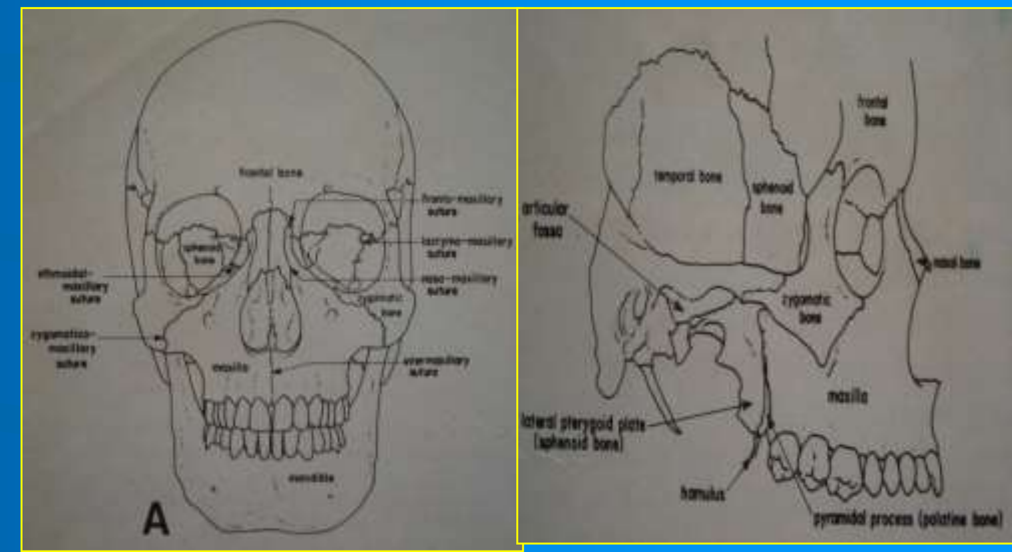
2) Lacrimal,

3) Inferior nasal conchae,

4) Vomer,

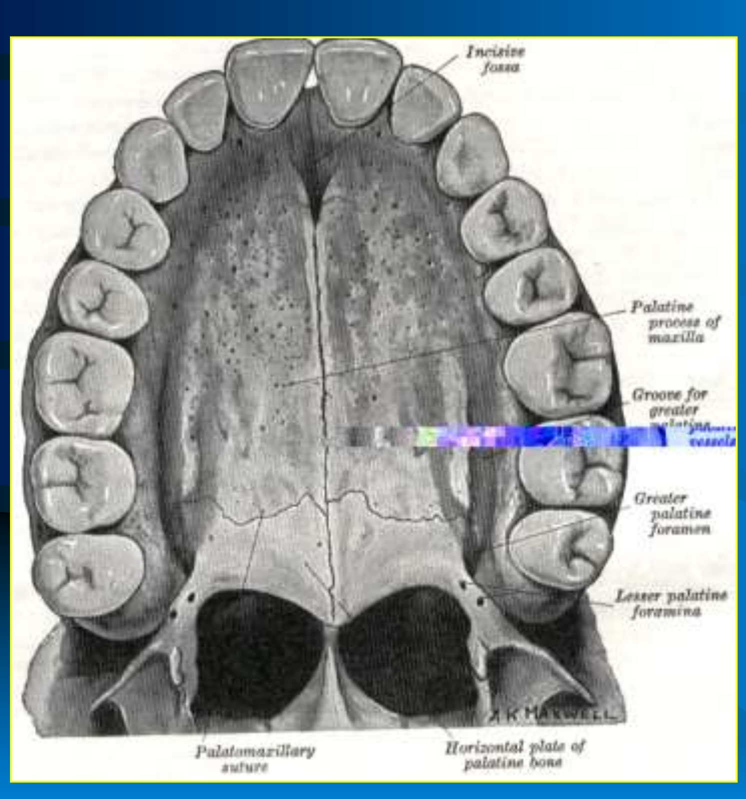
5) Zygomatic and

6) Palatine



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

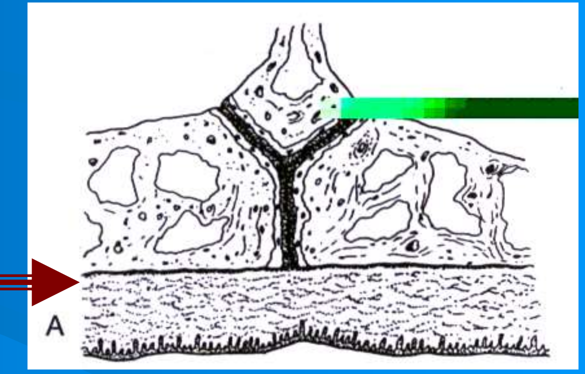
ANATOMY



- 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.

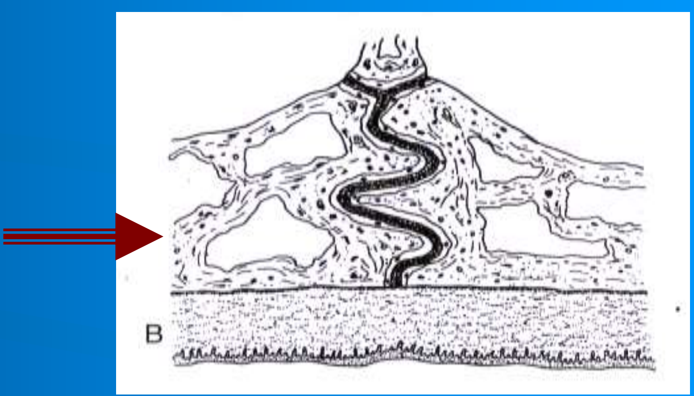
ANATOMY

- 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.

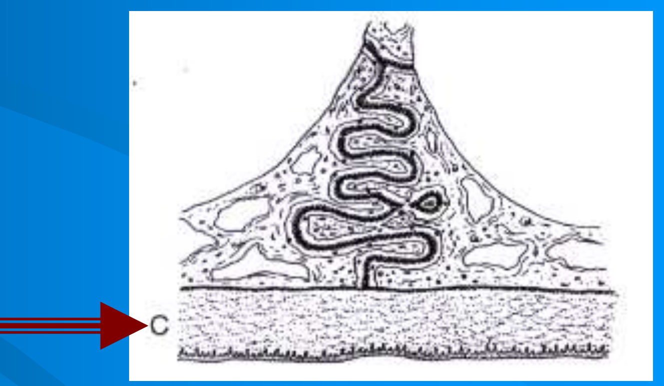


ANATOMY

- 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

- The causes of buccolingual discrepancies could be either genetic or environmental.
- According to Graber, and Harvold, Cheirici and Vargervi many constricted maxillary dental arches are the result of abnormal function.
- Harvold in his experimental work created narrow maxillary dental arches in rhesus monkeys by converting them from nasal to obligatory oral respiration.

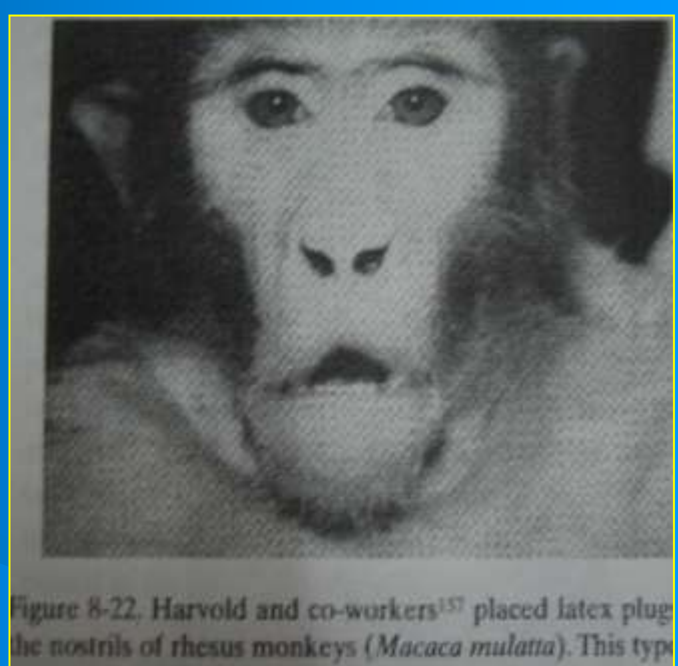


Figure 8-22. Harvold and co-workers[157] placed latex plug
the nostrils of rhesus monkeys (*Macaca mulatta*). This typ

- All patients considered for RME should be examined for nasal obstruction and, if obstruction is found, they should be referred to an otolaryngologist before orthodontic treatment

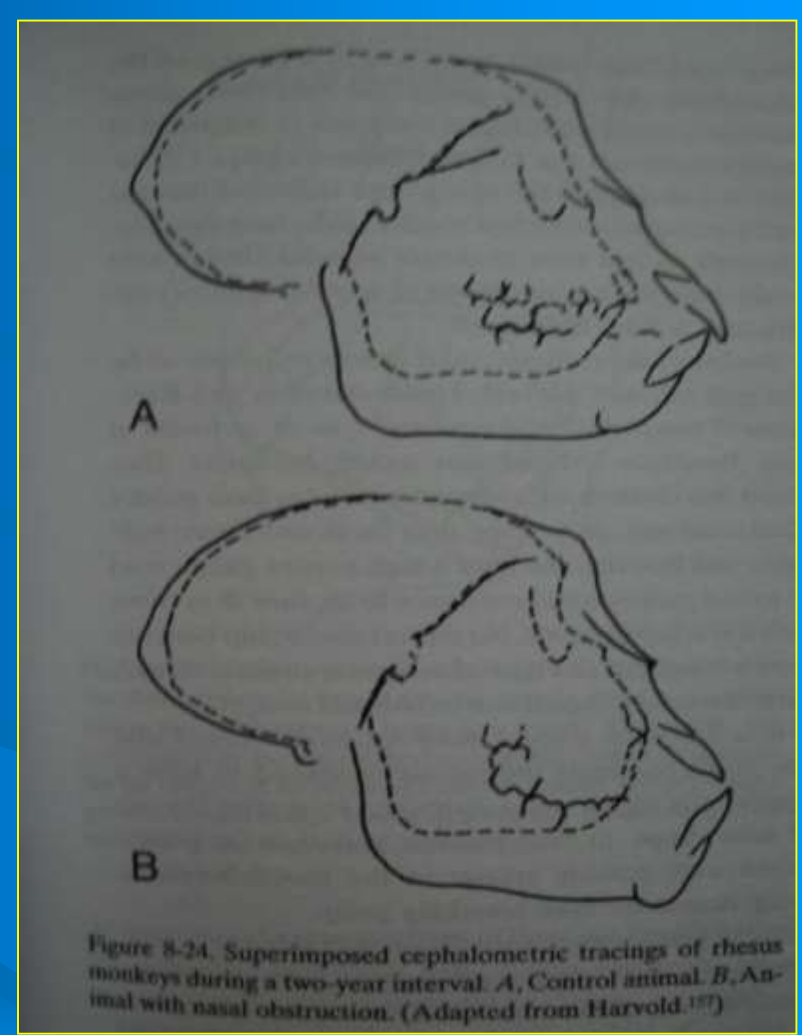


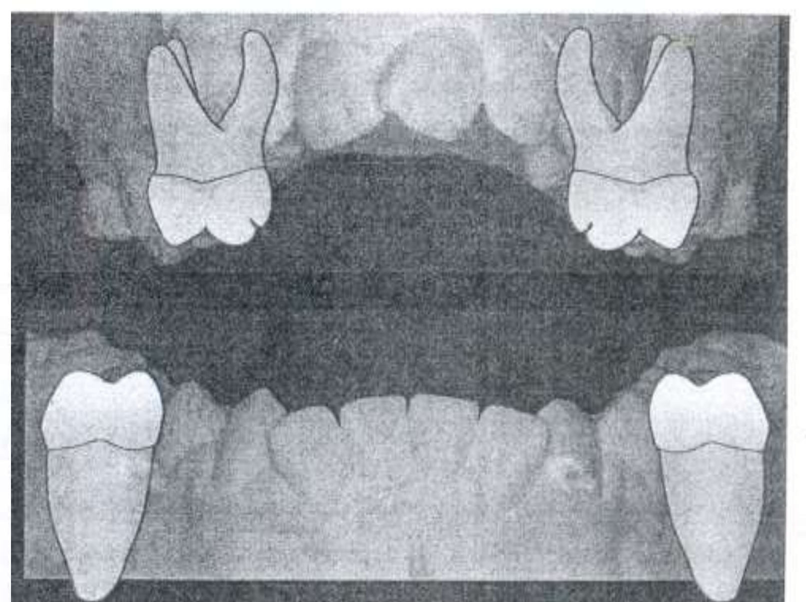
Figure 8-24. Superimposed cephalometric tracings of rhesus monkeys during a two-year interval. *A*, Control animal. *B*, Animal with nasal obstruction. (Adapted from Harvold.[157])

Diagnosis

Are posteroanterior (PA) cephalograms necessary in diagnosing transverse jaw relationships?

PA cephalograms are useful in quantifying skeletal asymmetries, but they have only very limited value in evaluating transverse discrepancies without asymmetries.

The utility of P A cephalometric analysis in quantifying skeletal asymmetries has been established. However, in the absence of overt skeletal asymmetries, PA cephalogram offer only very little in evaluating crossbites.



Semin Ortho 11:130-39

CROSS BITE

PALATAL HEIGHT INDEX

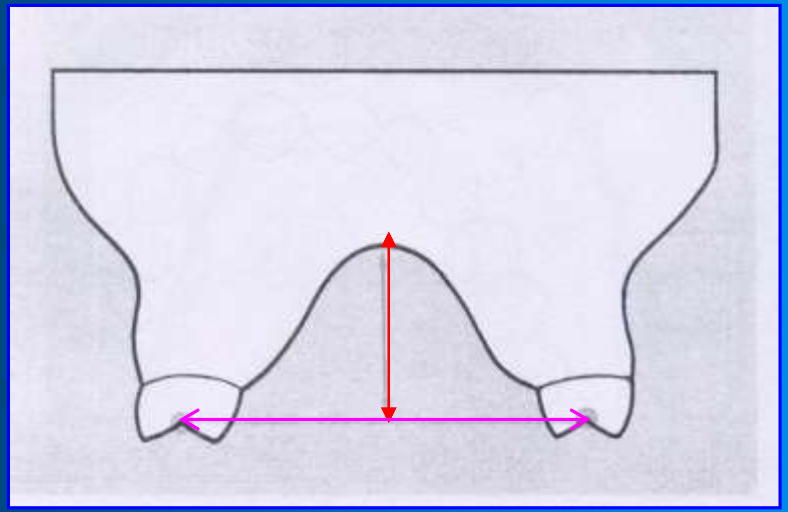
-By Korkhaus

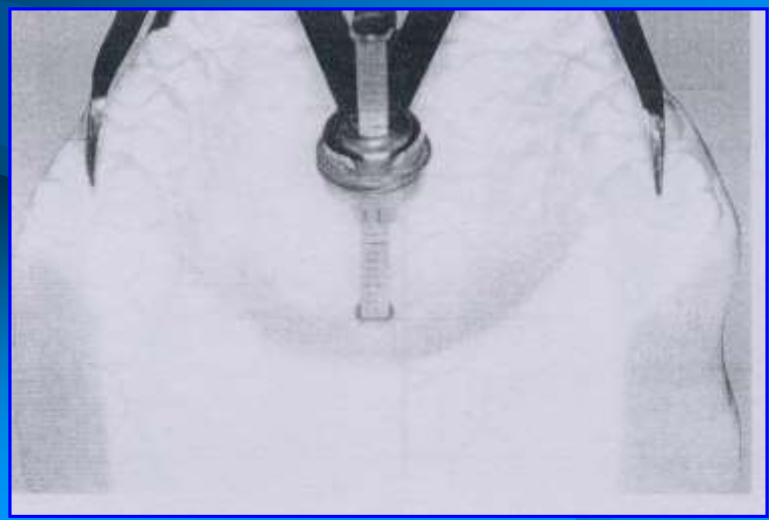
Palatal height Index

=

$$\frac{\text{Palatal height} \times 100}{\text{Posterior arch width}}$$

The average index value is 42%





ASHLEY'S HOWE ANALYSIS

$$\text{P.M.B.A.W\%} = \frac{\text{P.M.B.A.W} \times 100}{\text{T.T.M}}$$

If P.M.B.A.W is more than P.M.D then it is an indication that arch expansion is possible. If on the other hand the P.M.D is less than P.M.B.A.W, then arch expansion is not possible and might require extraction.

Frontal Cephalometrics: Practical Applications

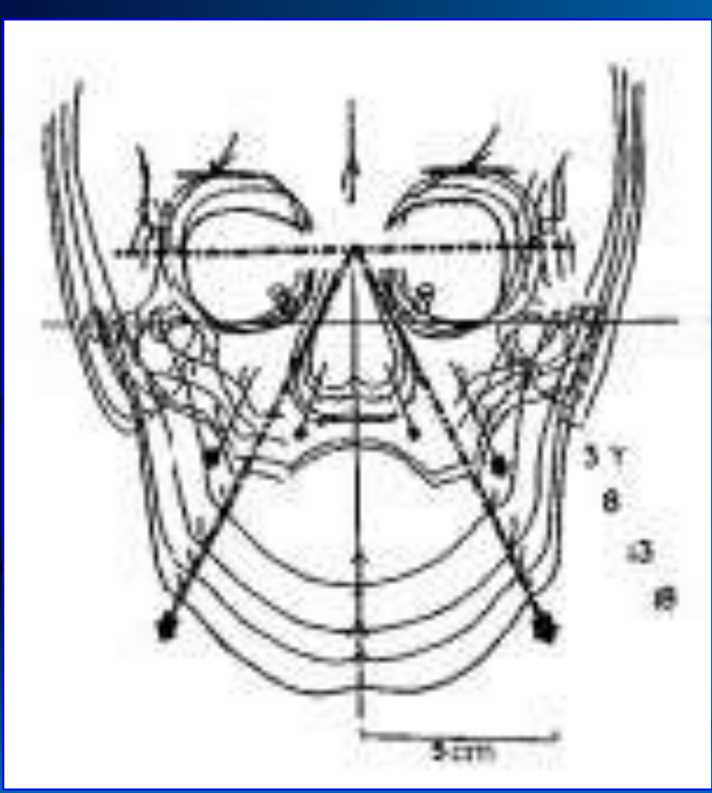


Table 1 Maxillary width (J-J′) in males

Age (y)	Width (mm)
3	55
4	56
5	57
6	58
7	59
8	60
9	61
10	62
11	63
12	64
13	65
14	66
15	67
16	68
17	69
18	70
19	71
20	72
21	73

Table 2 Mandibular width (Ag-gA) in males

Age (y)	Width (mm)
3	68.0
4	69.5
5	70.0
6	71.5
7	73.0
8	74.5
9	76.0
10	77.5
11	79.0
12	80.5
13	82.0
14	83.5
15	85.0
16	86.5
17	88.0
18	89.5
19	91.0
20	92.5
21	94.0

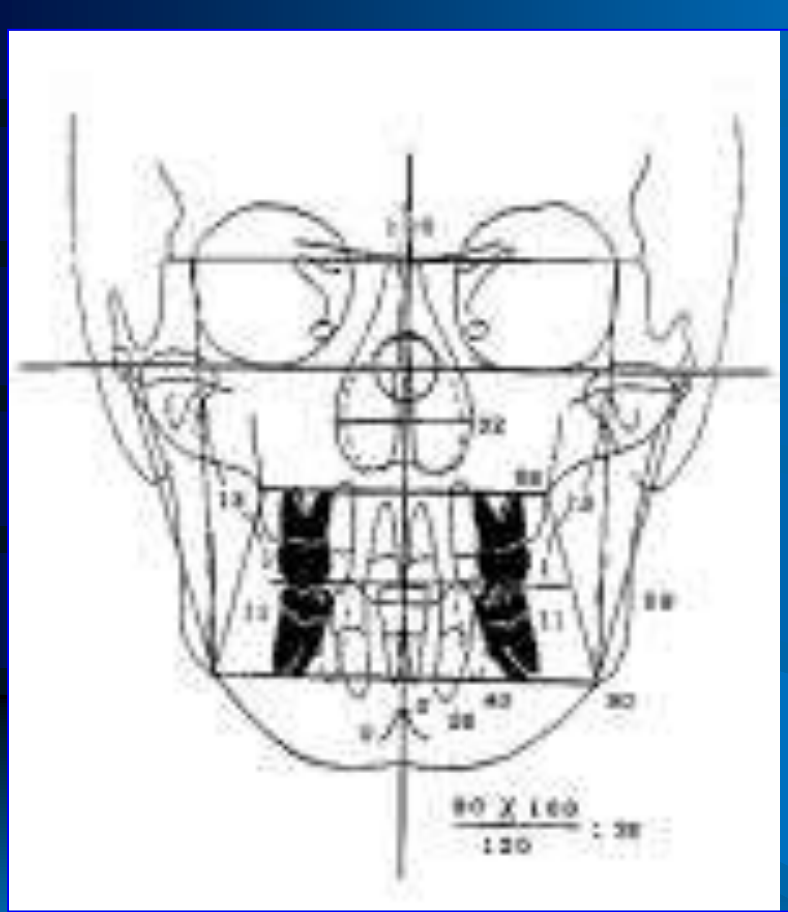


Table 3 Maxillomandibular differential and index values in males

Age (y)	Maxillary (mm)	Mandibular (mm)	M-M differential (mm)	Ratio (%)
3	55	68.0	13.0	80.0
8	60	74.5	14.5	80.5
13	65	82.0	17.0	79.27
18	70	87.5	19.5	80.0
Adult	72	92.5	20.5	78.0

Table 4 Nasal cavity and maxillary differential and index values in males

Age (y)	Nasal cavity (mm)	Maxilla (mm)	differential (mm)	Ratio (%)
3	22.0	55.0	33.0	40.0
8	24.5	60.0	65.5	41.0
13	27.0	65.0	38.0	41.5
18	29.5	70.0	40.5	42.0

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

- By use of this force the teeth alone are supposed to move
- 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.
- Rate of separation varies from 0.4 to 1.1 mm / week
- Intermolar width – 8mm
- Requires 2 – 6 mons
- Skeletal changes – 16 – 30% of total change and vary with age

RAPID EXPANSION

- Results in major change occuring in basal structures of mandible and maxilla
- More than 5 ounces
- Rate of separation varies from 0.2 to 0.5 mm / day
- Intermolar width – 10mm
- Requires 1- 4 weeks
- Skeletal changes – 50%

SLOW EXPANSION DEVICES

History:

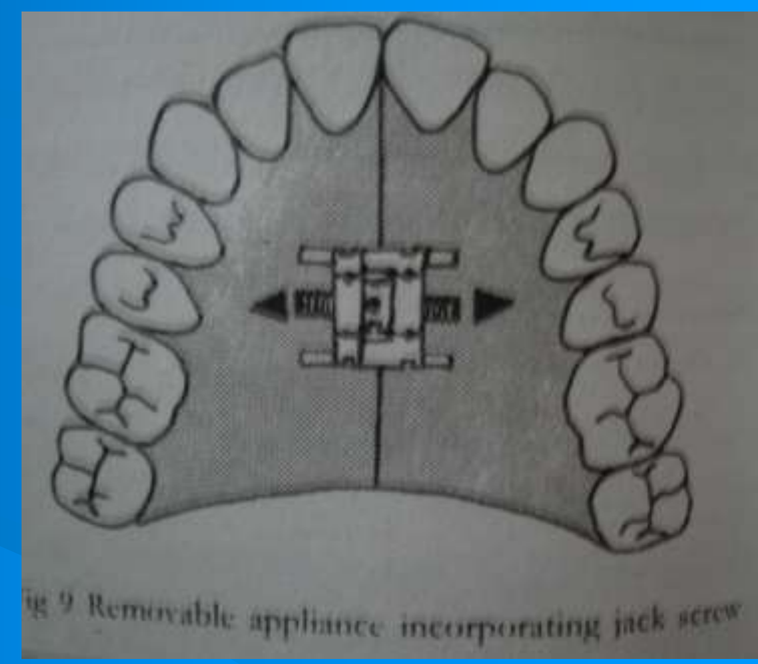
Farrar & Coffin – 1875 .

To treat Cleft palate

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

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



ig 9 Removable appliance incorporating jack screw

SLOW EXPANSION DEVICES

- Walter Coffin – 1875
- .It is a removable appliance capable of slow dento alveolar expansion
- The appliance consists of an omega shaped wire of 1.25mm thickness, placed in the mid palatal region
- The free ends of the omega wire are embedded in acrylic covering the slopes of the palate
- The spring is activated by pulling two asides apart manually

Fig 10 Coffin spring

Ni ti expander

- It generates optimal ,constant expansion forces
- Its central component is made of a thermally activated ni ti alloy and rest of component id made of stainless steel

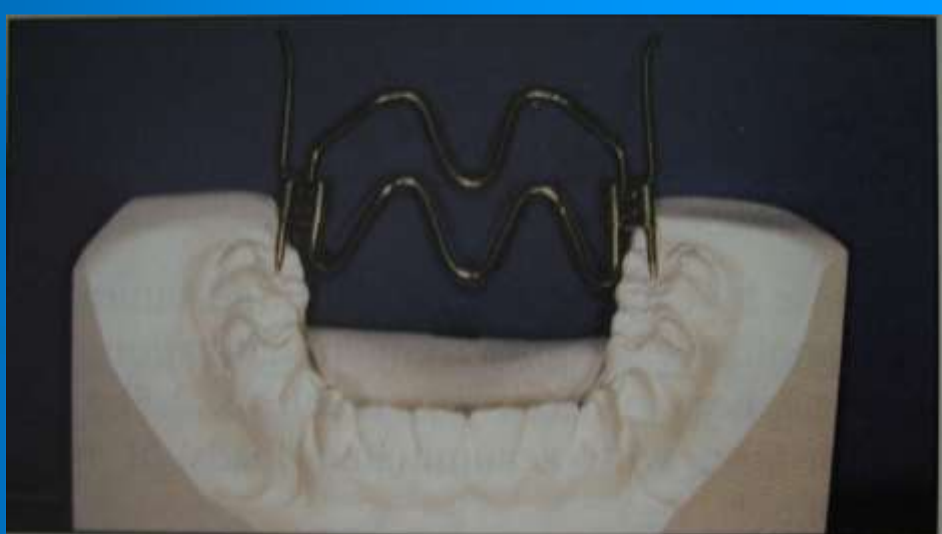


Fig. 1 Nickel titanium expander: central component formed from thermally activated nickel titanium alloy; anterior arms made of stainless steel.

Fig. 6 Molar bands equipped with lingual sheaths for insertion of expander.

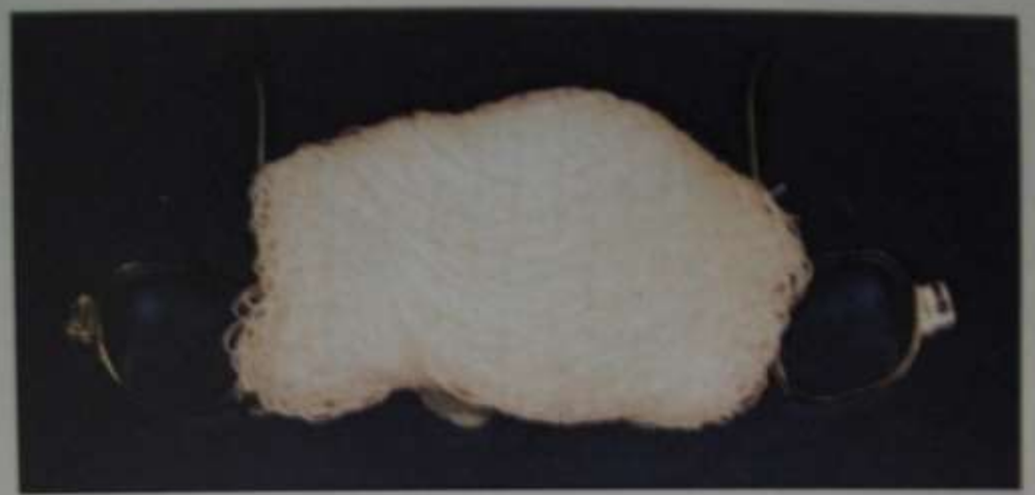


Fig. 5 Moist gauze insulates expander from oral temperature, allowing more working time before expander returns to original shape.

Ni Ti expander

- The expansion to the mandibular inter molar width will provide optimal occlusion
- It is appropriate add 1-2 mm to expansion requirement and 2 – 3 additionally for over expansion
- If more than 8 m expansion is required then 2 expanders are required .

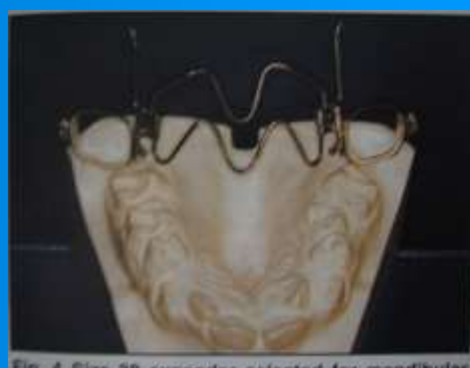


Fig. 4 Size 38 expander selected for mandibular intermolar width of 35mm, plus 3mm for overexpansion.

Fig. 2 Mandibular intermolar width measured between central fossae.

Ni Ti expander

- For patients in primary of early mixed dentition can be expanded in 1 to 2 months
- In adoslents can take as longer time of 3 months.
- Retention it should be 50 -100% of the expansion time

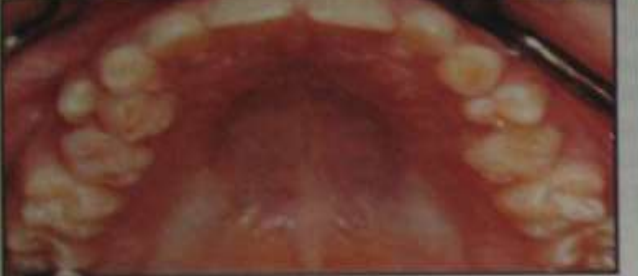
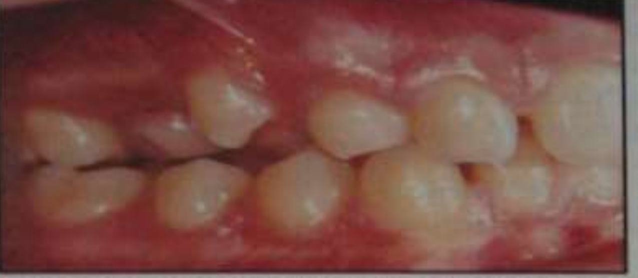
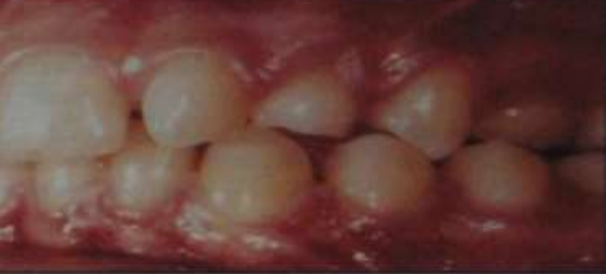
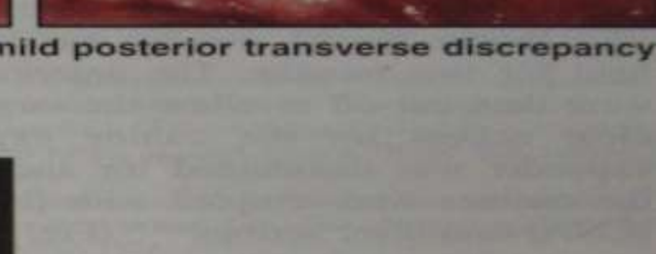




Fig. 16 Case 3. 13-year-old male with impacted maxillary canines and mild posterior transverse discrepancy before treatment.



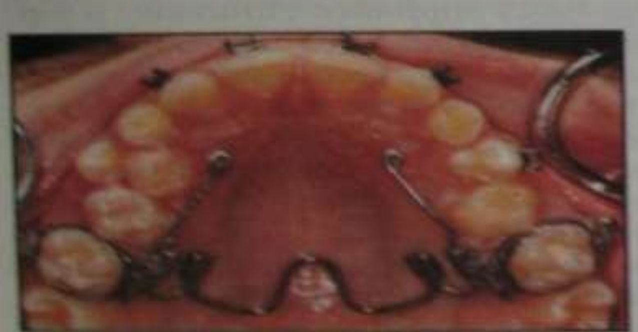
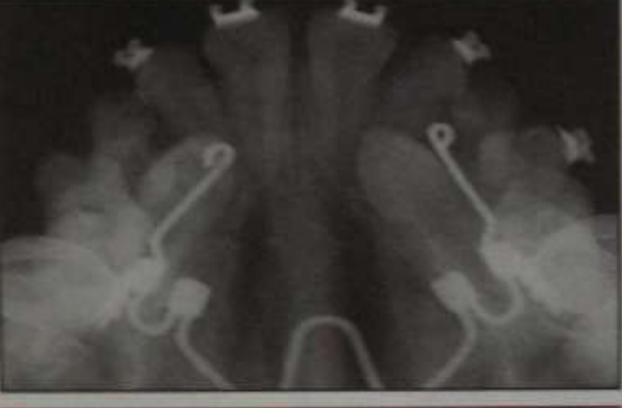
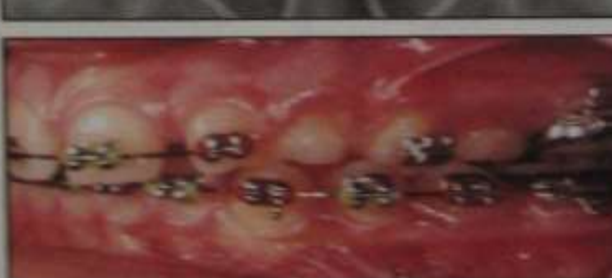



Fig. 17 Case 3. Exposure of palatally impacted canines delayed until desired expansion was achieved; note minimal tipping of molars.



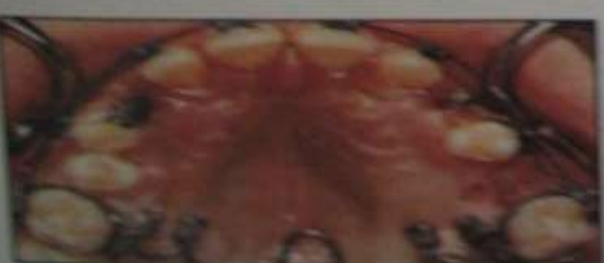


Fig. 18 Case 3. Expander left in place for retention and molar stabilization during eruption of palatally impacted canines with cantilever springs.

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.

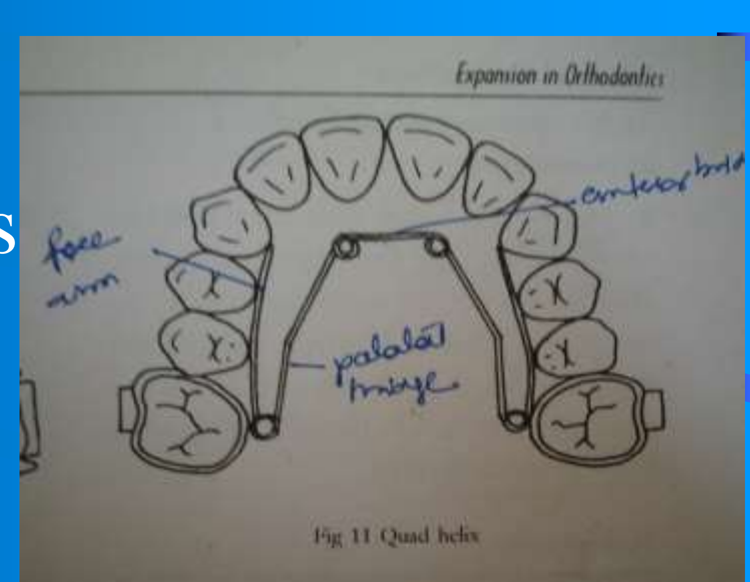
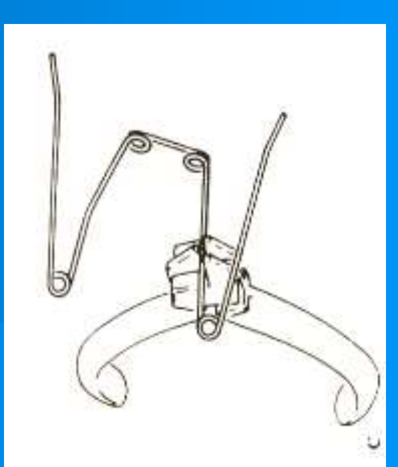


Fig 11 Quad helix

Quad Helix Appliance: indications

- 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.



W- arch

- The W –arch is a fixed appliance constructed of 36 mil steel wire soldered to molar bands .to avoid soft tissue irritation ,the lingual arch should be constructed so that it rests 1-1.5mm off the palatal soft tissue .
- The w –arch is activated simply by opening the apices of w- arch and is easily adjusted to provide more anterior than posterior expansion ,or vice versa if this is desired .

w- arch

- The appliance delivers proper force levels when opened 3-4mm wider than the passive width and should be adjusted to this dimension before being inserted .
- Expansion should continue at the rate of 2mm per month until the cross bite is slightly overcorrected.

spring jet

- The active components of the spring jet are soldered or attached to the molar bands .
- The transpalatal arch replaced by telescopic unit with ni ti coil spring .

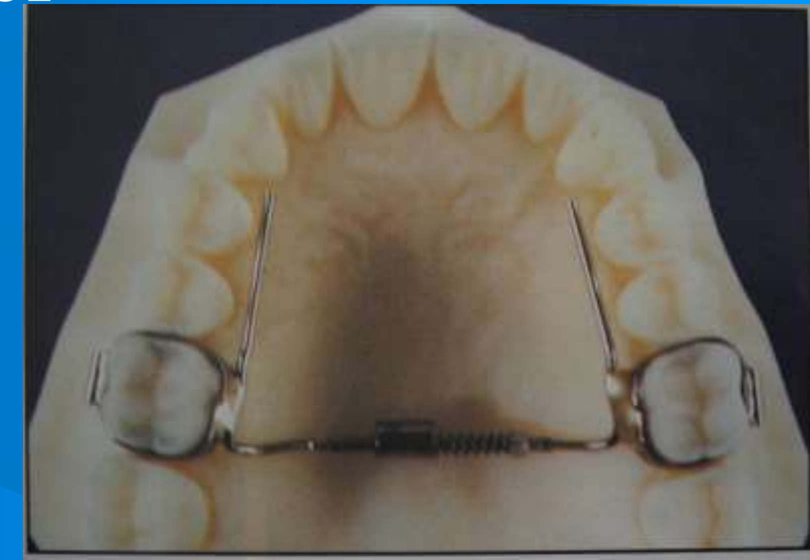


Fig. 1 Spring Jet uses nickel titanium coil spring and lockscrew.

spring jet

- The telescopic unit is placed high 5 mm up from center of molar tubes so that the forces passes close to the center of resistance of maxillary teeth .
- But it should be 1.5 mm away from palatal tissue

- 240 grams of force in mixed dentition and 400 g spring in the permanent dentition .
- Activation: by moving the lock screw horizontally along the telescopic tube. A ball stop on the transpalatal wire allows the spring to be compressed.

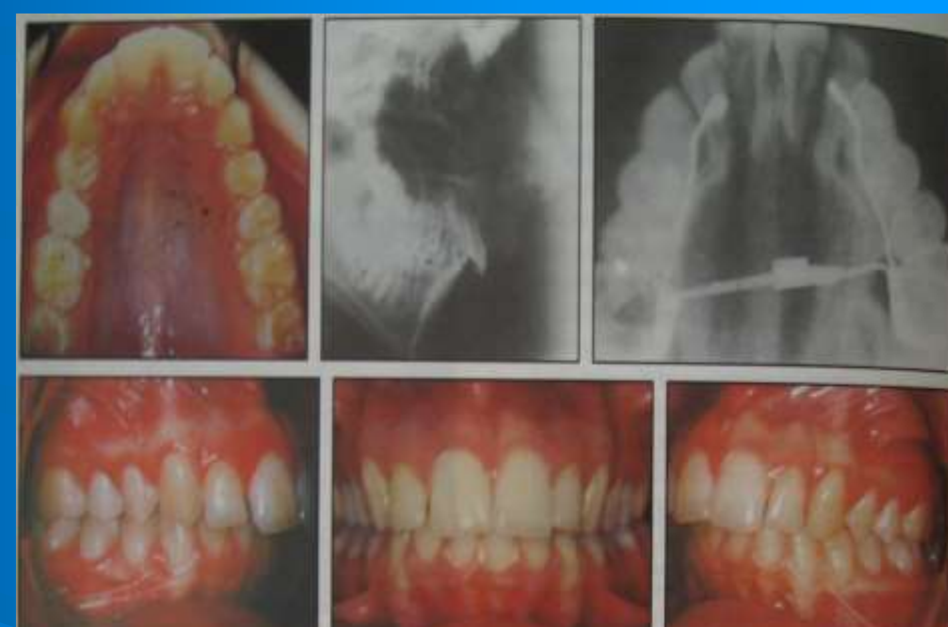
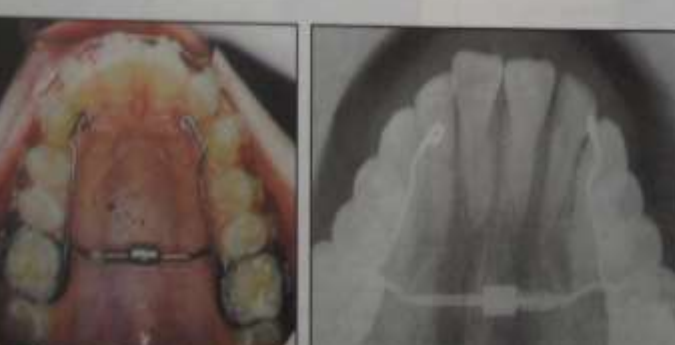


Fig. 3 Case 1. 16-year-old female with Class II, division 1, subdivision right malocclusion and maxillary constriction before treatment.



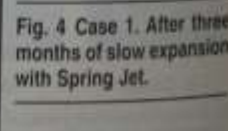
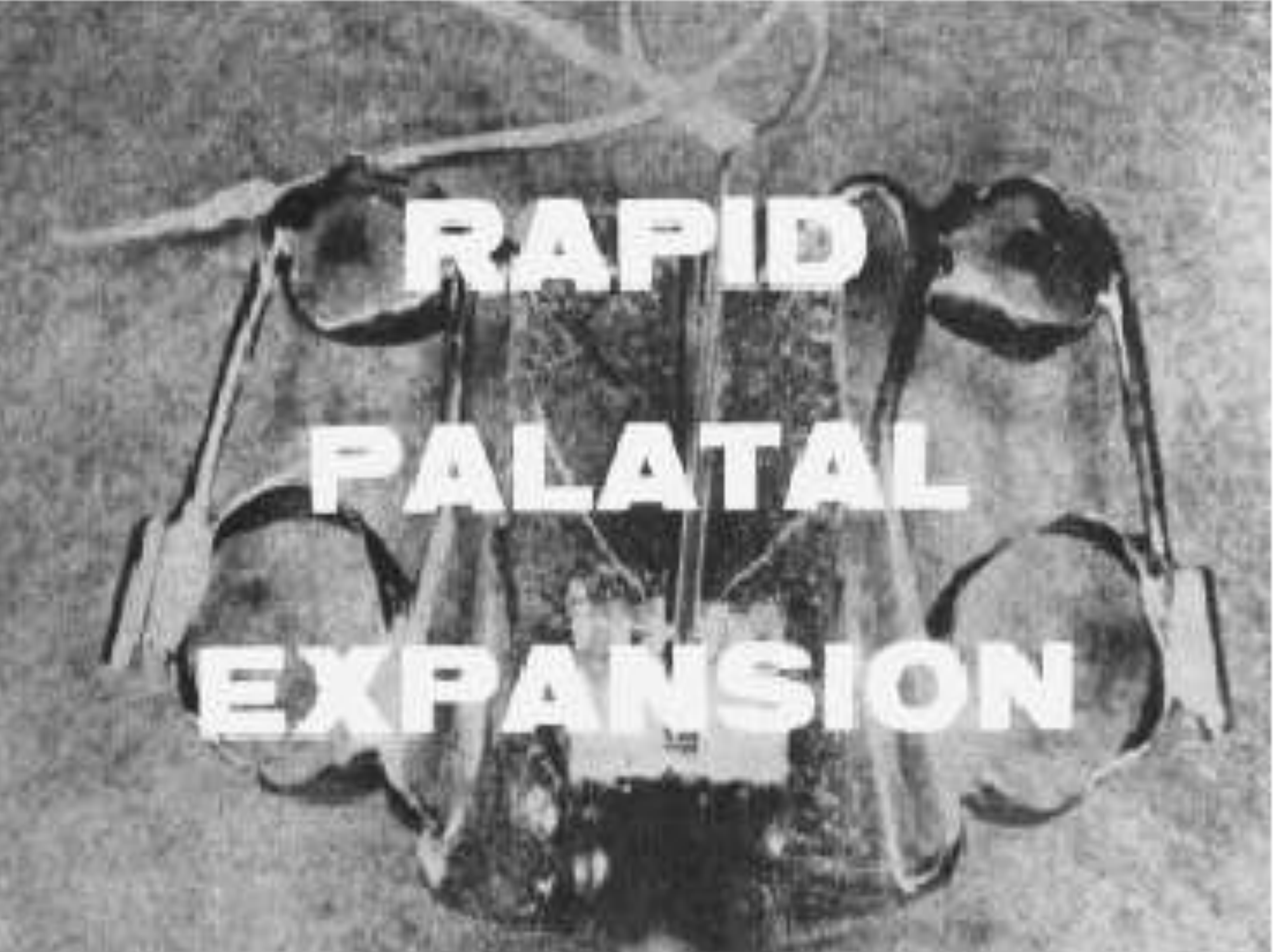


Fig. 4 Case 1. After three months of slow expansion with Spring Jet.


RAPID
PALATAL
EXPANSION

INDICATION OF **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.
- Patients who have lateral discrepancies that result in either unilateral or bilateral posterior crossbites involving several teeth are candidates for RME.

- The constriction may be skeletal (narrow maxillary base or wide mandible), dental, or a combination of both skeletal and dental constriction.

- Anteroposterior discrepancies are cited as reasons to consider RME.For example, patients with skeletal Class II, Division 1 malocclusions with or without a posterior crossbite,

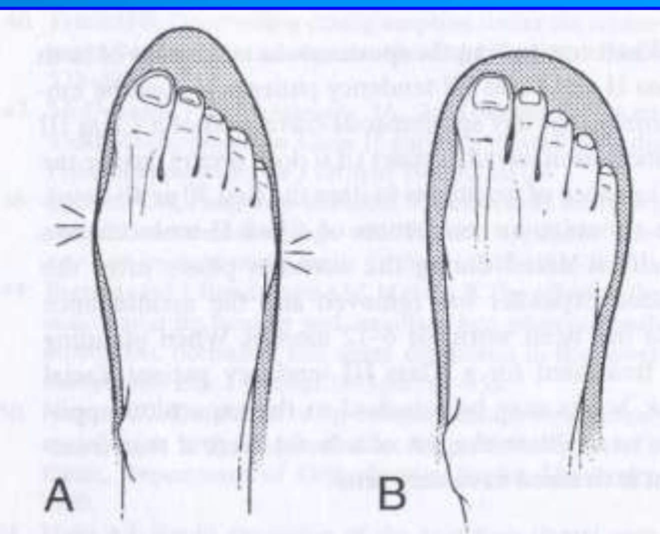


Figure 4-42. Maxillomandibular relationship as indicated by the foot and shoe example. *A*, The foot (mandible) is unable to be moved forward in the shoe (maxilla) due to transverse constriction. *B*, A wider shoe will allow the foot to assume its normal relationship. After Reichenbach and Taatz.[114]

- Patients with Class III malocclusions, and patients with borderline skeletal and pseudo Class III problems are candidates if they have maxillary constriction or posterior crossbite.
- Cleft lip and palate patients with collapsed maxillae are also RME candidates.
- Finally, some clinicians use the procedure to gain arch length in patients who have moderate maxillary crowding.

- According to Bell, the enhanced skeletal response that accompanies RME redirects the developing posterior teeth into normal occlusion and corrects asymmetries of condylar position.
- This should allow more vertical closure of the mandible, and eliminates both functional shifts and possible temporomandibular joint dysfunction

Gray and Brogans Medical indications

- Poor nasal airway
- Septal deformity
- Recurred ear nasal or sinus infections
- Allergic Rhinitis
- Asthma

R.M.E and Nasal Airway Resistance

- RME causes a relative reduction in the nasal airway resistance by disarticulating the maxilla from other bone particularly Septal and palatine bone

- Nilnimmar et al 1980
- 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.

- Study by Dale

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

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.

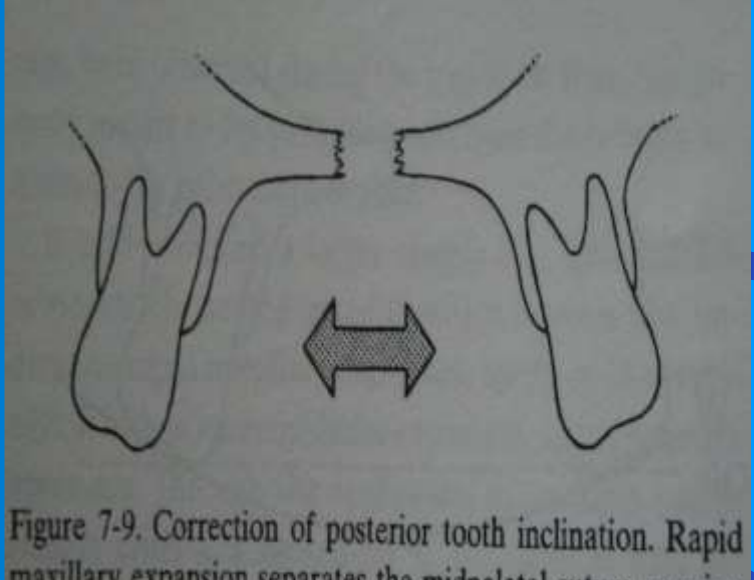
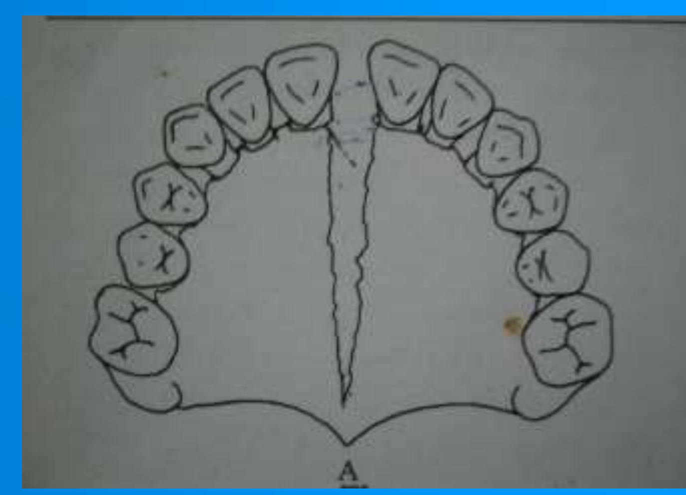


Figure 7-9. Correction of posterior tooth inclination. Rapid maxillary expansion separates the midpalatal suture, moving the apices of the posterior teeth laterally.

Viewed occlusally

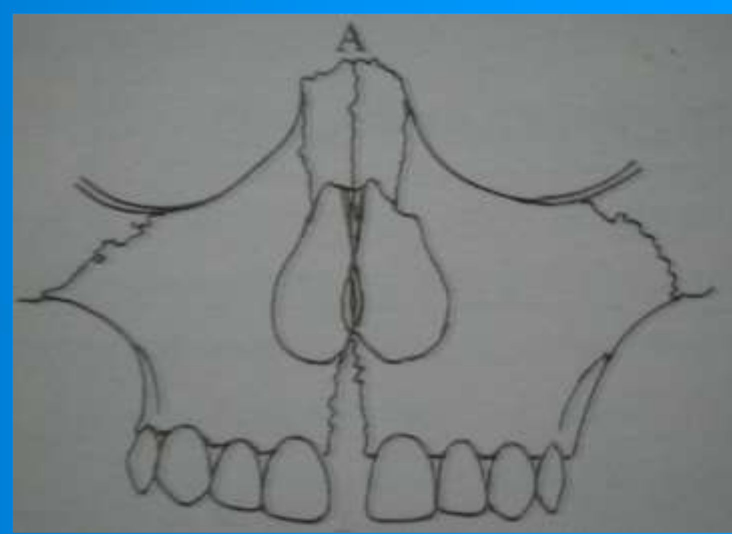
- Inoue found that the palatine processes of the maxillae separated in a nonparallel— that is, in a wedge-shaped— manner in 75% to 80% of the cases observed.



- Wertz's study of three dry skulls, one adult and two in the mixed dentition, also indicated that the shape of the anteroposterior palatal separation was nonparallel in all three skulls

Viewed frontally

The maxillary suture was found to separate superoinferiorly in a nonparallel manner.It is pyramidal in shape with the base of the pyramid located at the oral side of the bone



- The magnitude of the opening varies greatly in different individuals and at different parts of the suture. In general, the opening is smaller in adult patients. The actual measurement ranges from practically no separation to 10 mm or more.

Relation between amount of sutural separation and extent of molar expansion

- Krebs studied maxillary expansion with metallic implants. He placed implants in the alveolar process lingual to the upper canines and along the infrazygomatic ridge, buccal to the upper first molars. He found that the mean increase in intermolar distance measured on casts was 6 mm, while the mean increase in infrazygomatic ridge implants was 3.7 mm.

- In 20 of 23 patients examined, the amount of sutural opening was equal to or less than one half the amount of dental arch expansion. He also found that the sutural opening was on average more than twice as large between the incisors than it was between the molars.

- Changes during fixation and retention. Krebs noted that although dental arch width was maintained during fixed retention, the distance between implants in the infrazygomatic ridges decreased during the 3 months of fixed retention by an average of 10% to 15%.
- This relapse continued during retention with removable appliances. After an average period of 15 months, approximately 70% of the infrazygomatic maxillary width increase was maintained

Maxillary halves

Krebs showed that the two halves of the maxilla rotated in both the sagittal and frontal planes.

Haas and Wertz found the maxilla to be more frequently displaced downward and forward. The final position of the maxilla, after completion of expansion, is unpredictable and it has been reported to return, partially or completely, to its original position

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.
- This tipping explains some of the discrepancy observed between molar and sutural expansions. Tipping of the two maxillae results in less width increase at the sutural level than at the dental arch level.

Palatal view

- Fried and Haas reported that the palatine processes of the maxilla were lowered as a result of the outward tilting of the maxillary halves.
- On the other hand, Davis and Kronman reported that the palatal dome remained at its original height.

Alveolar processes

- 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.
- Therefore, one can appreciate the need for overcorrection of the constricted dental arches to compensate for the subsequent up righting of the buccal segment.

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
- It is estimated that during active suture opening, the incisors separate approximately half the distance the expansion screw has been opened, but the amount of separation between the central incisors should not be used as an indication of the amount of suture separation.

- Following this separation, the incisor crowns converge and establish proximal contact. If a diastema is present before treatment, the original space is either maintained or slightly reduced. The mesial tipping of the crowns is thought to be caused by the elastic recoil of the transseptal fibers. Once the crowns contact, the continued pull of the fibers causes the roots to converge toward their original axial inclinations. This cycle generally takes about 4 months.

- The maxillary central incisors tend to be extruded relative to the S-N plane and in 76% of the cases they upright or tip lingually. This movement helps to close the diastema and also to shorten arch length. The lingual tipping of the incisors is thought to be caused by the stretched circumoral musculature.

Maxillary posterior teeth

- Hicks found that With the initial alveolar bending and compression of the periodontal ligament, there is a definite change in the long axis of the posterior teeth the angulation between the right and left molars increased from 1° to 24° 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.

Palatal mucoperiosteum, periodontal tissues, and root resorption.

- Cotton suggested that the postexpansion angular changes of the maxillary first molars may be related to the stretched fibers of the attached palatal mucosa.
- Maguerza and Shapiro attempted to relieve the stretch of the mucoperiosteum after "slow" expansion by making incisions along the palate down to the cortical bone, 3 mm away from the teeth. The incisions did not effectively reduce the relapse tendency.
- Whether such incisions might be effective with RME expansion or whether the incision wound itself causes contraction is yet to be determined

- Greenbaum and Zachrisson evaluated the effects of orthodontic treatment alone, RME (tissue-borne fixed appliance), and slow (quad-helix) palatal expansion on the periodontal supporting structures located at the buccal aspects of the maxillary first permanent molars. They found that the differences among the groups were not significant and were clinically of small magnitude.
- Other investigators, reported marked buccal root resorption of the anchor teeth during RME and fixed retention. These defects tended to gradually repair.

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.
- There is some disagreement regarding the magnitude and the permanency of the change.
- The fairly consistent opening of the mandibular plane during RME is probably explained by the disruption of occlusion caused by extrusion and tipping of maxillary posterior teeth along with alveolar bending.
- RME should be cautiously performed on persons with steep mandibular planes and/or open bite tendencies

Effects of RME on the mandibular teeth

- Gryson recorded changes in maxillary and mandibular intercanine and intermolar widths before and after expansion in 38 patients. The ages of the groups ranged between 6 and 13 years.
- The mandibular teeth have been observed to upright or to remain relatively stable over the short period of treatment
- The mean increase in the mandibular intermolar width was 0.4 mm; most patients either had no change or showed an increase of up to 1 mm.
- Therefore, one can conclude that in general RME could influence the mandibular dentition, but the accompanying changes are neither pronounced nor predictable.

SOFT TISSUE EFFECT

- Because of their relative rigidity, skeletal tissues offer the immediate resistance to the expansion force. But another equally important factor is the soft-tissue complex that invests these skeletal structures.
- The muscles of mastication, the facial muscles, and the investing fascia are relatively elastic and can be stretched as the expansion force is applied.
- But the ability of the stretched muscles, ligaments, and fascia to permanently adapt to the new environment is a matter that deserves further investigation.
- Orthodontists are acutely aware of the limitations imposed by the soft tissues when teeth are moved

Effects of RME on adjacent facial structures.

Kudlick, in a study on a human dry skull that simulated in vivo response of RME, concluded the following:

- (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, and
- (4) the sphenoid bone, not the zygomatic arch, was the main buttress against maxillary expansion.

EFFECTS OF AGE & R.M.E

- Growth Ceases first In Transverse dimension
- 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

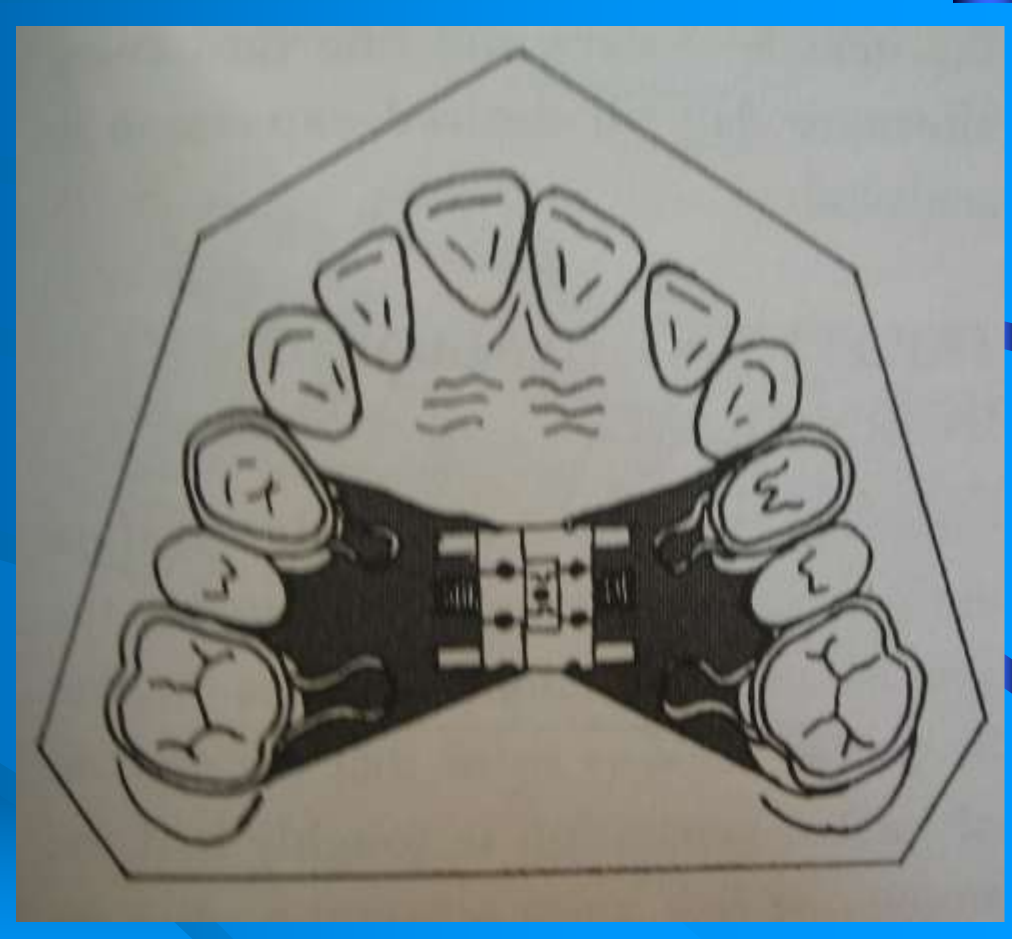
COMMON APPLIANCES

- 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)

Deririch Sweiler

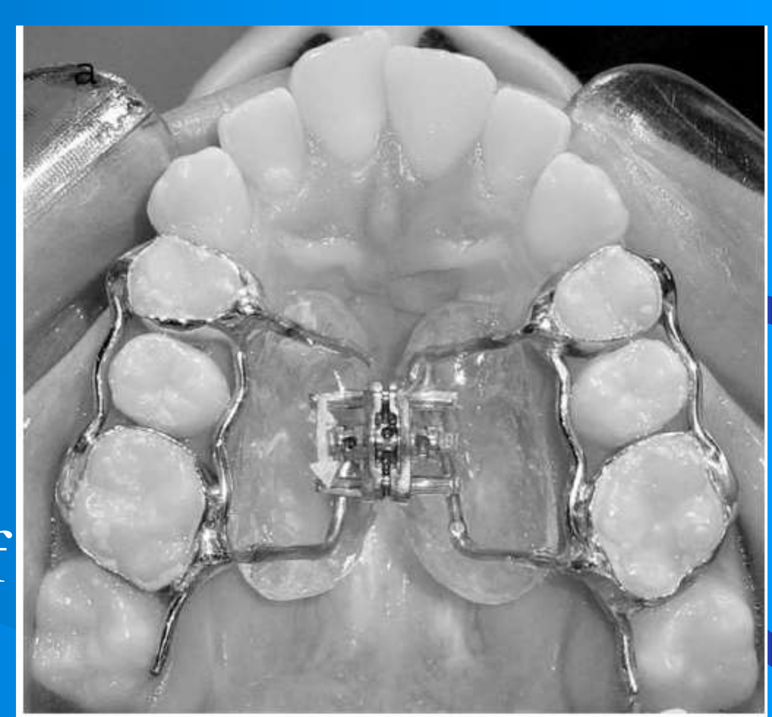
Derirch Sweiler

Tags are welded & soldered to palatal aspect of bands to provide attachment for acrylic which is extended to palatal aspect of non-bonded teeth.



Hass

- Hass
- 0.045inch (1.5) SS wire soldered to palatal aspect of the bands.
- Free ends – Turned back embedded in acrylic short of bands.
- Screws is in the mid line.

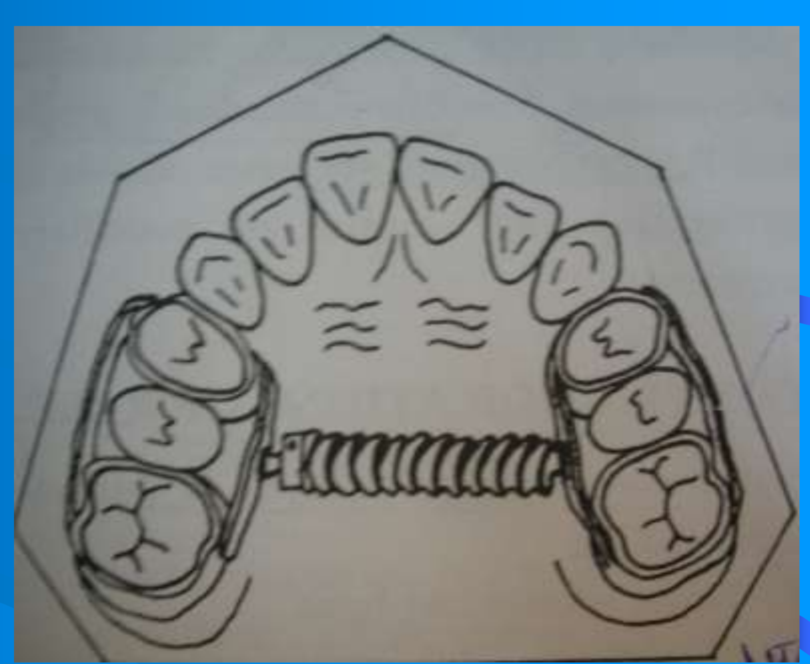


Issacson

- Issacson :-
- This is atooth borne applaince with out any acrylic palatal covering
- Mini expander

(developed by university of minnesota ,dental school) soldered directly to the bands

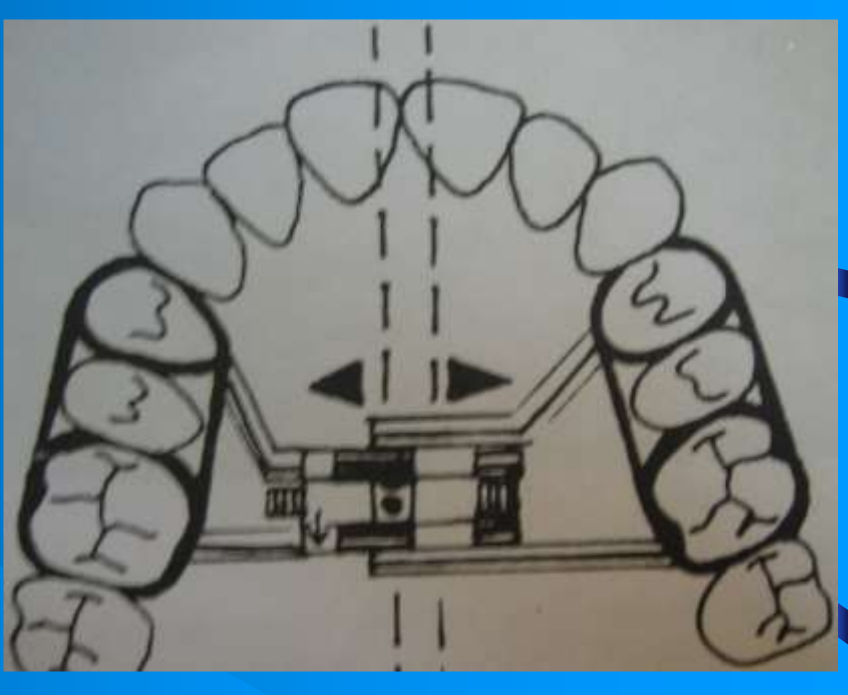
- Screw reduced in length for narrow arches



Bidermann

- Bidermann :-
- Special screw of either Hyrax , Leaone or Unitek

  Heavy gauge is extension are welded to palatal aspect of bands



Raymond P How

- Raymond P How (1982)
- Bonded appliance.
  - Mid palatal Jack Screw
  - 4 rigid 0.060 SS wire loops – bend circumferentially at cervical level to include all posterior teeth.
  - Encased by collar of acrylic surround wire loops only. Extending from free gingival margin to occlusal surface.
  - Advantage :-
  - Used in deciduous & severely malposed teeth
  - Reduced food deposition as palatal acrylic removed

John L Spolyar

- John L Spolyar:- (1984)
- Spider type rigid expansion screws
- Tooth borne anchorage (fully covered buccal segment)
- Screw placed anteriorly to prevent interuption to tongue functions
- Arms bend inverted U shape for rigidity between mechanical devices & attached medium.
- Acrylic or polyvinyl chlorine wafer

Vel Ivanovski

Vel Ivanovski (1985):-

- Used for an adult with severe maxillary insufficiency
- Partial denture for missing teeth & bonded rapid maxillary expansion.
- Bridge was attached to the expander with acrylic.
- After expansion , expander removed & prosthesis cut of.

- Adv: - expansion in one area.
- - maxillary & mandibular expansion simultaneously
- Disadv:- Patient cooperation
  Severe skeletal defects

Patrick K Turley

Patrick K Turley (1988):-

- Correction of calss IIImalocclusion with palatal expansion and custom protraction head gear
- Adv:
- bite opens rapidly
- Anterior cross bite correction very effective.

Radanski

Radanski(1989) :

- Modified Hyrax for inclined abutment teeth.
- Helices between screw & band to make frame elastic permiting engagement of the bands on the laterally inclined abutment teeth.
- Deliver force to align & upright them .

David Sarver

- David Sarver (1989) :-
- Bonded RME coverage over occlusal & buccal surface of posterior teeth.
- Expand & interfere free way space by its vertical thickness acts as a functional appliance.
- Elevator musculature stretched gives stretch reflex thus giving apically directed force on maxillary & mandibular teeth.
- Vertical holding by intrusive forces.

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

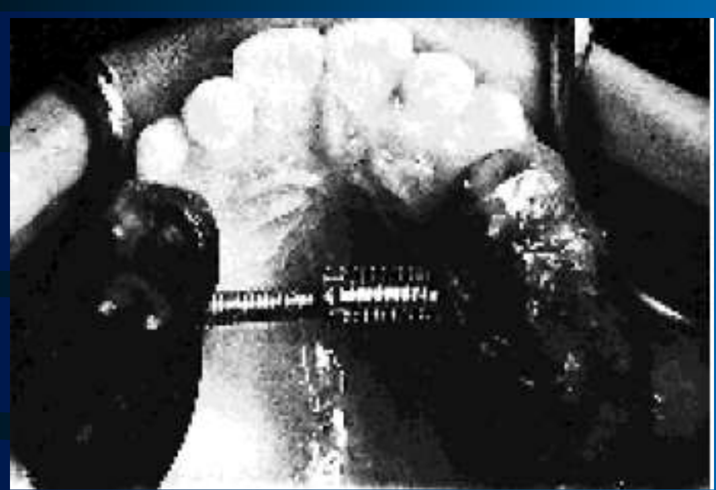
JACKSCREW TURN SCHEDULES

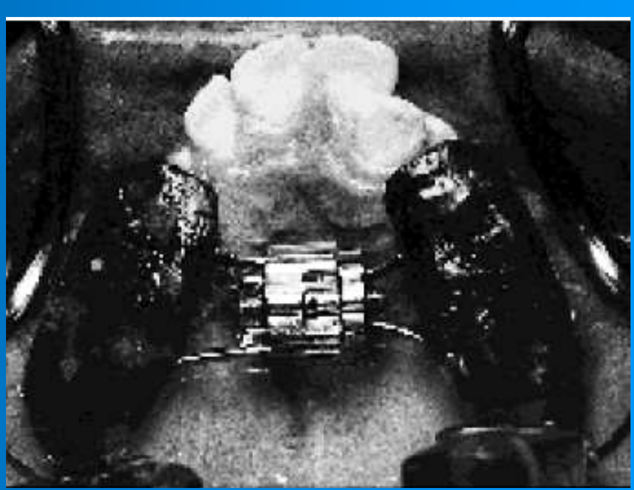
Zimmring and Isaacson recommend the following turn schedules:

- 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

Dental arch and arch perimeter changes

By Lorenzon & Ucem
EJO 1998


SME – Minne Expander

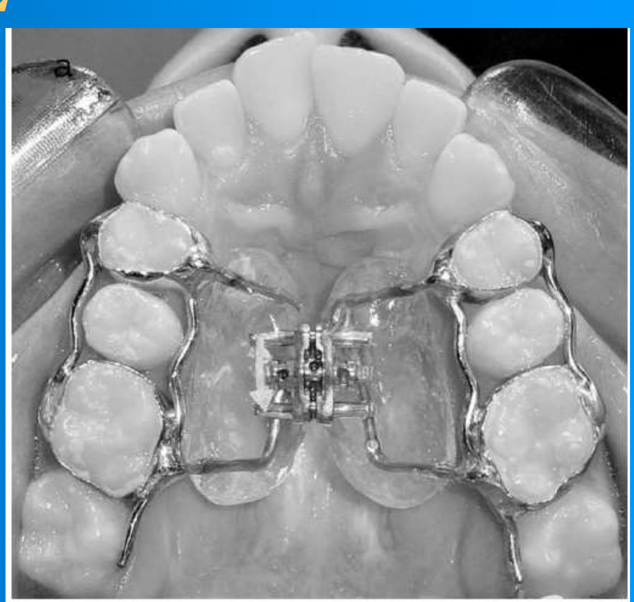

RME - HYRAX

Results:

1. Increase in upper intercanine width greater in RME group than in SME.
2. Regression analysis indicated maxillary arch perimeter gain :- arch perimeter gain = 0.65 times of **posterior expansion** in RME & 0.60 times in SME group.
3. Evaluation of the prediction equation shows maxillary arch perimeter gain :- 0.54 times at **premolar width** in RME & 0.52 times in SME group.

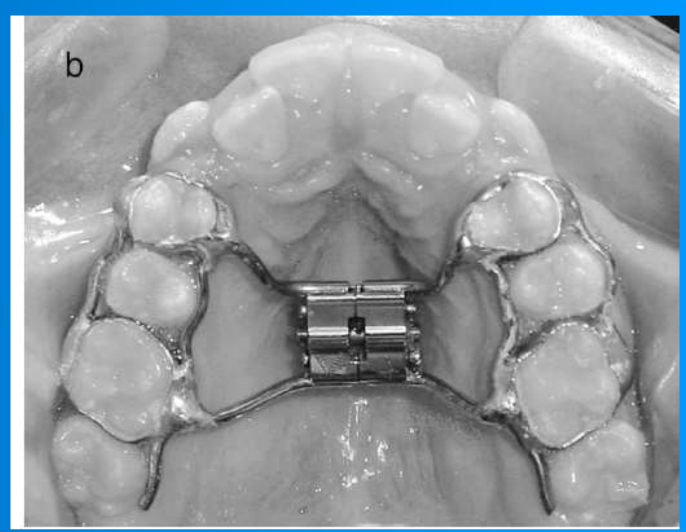
COMPARSION OF TOOTH AND TISSUE

- This study evaluated rapid maxillary expansion (RME) dentoskeletal effects by means of computed tomography (CT), comparing tooth tissue–borne and tooth-borne expanders.
- The sample comprised eight girls aged 11 to 14 years presenting Class I or II malocclusions with posterior unilateral or bilateral crossbite that were randomly divided into two treatment groups



(Angle Orthod 2005;75:548–557.)

- palatal acrylic (Haas-type) and hygienic (Hyrax) expanders.
- All appliances were activated up to the full seven mm capacity of the expansion screw



- The patients were subjected to a spiral CT scan before expansion and after a three-month retention period when the expander was removed.

DENTOSKELETAL EFFECTS OF RAPID MAXILLARY EXPANSION 551

FIGURE 2. Standardized head position.

- One-millimeter-thick axial sections were scanned parallel to the palatal plane, comprising the dentoalveolar area and the base of the maxilla up to the inferior third of the nasal cavity.
- Multiplanar reconstruction was used to measure maxillary transverse dimensions and posterior teeth inclination by means of a computerized method.

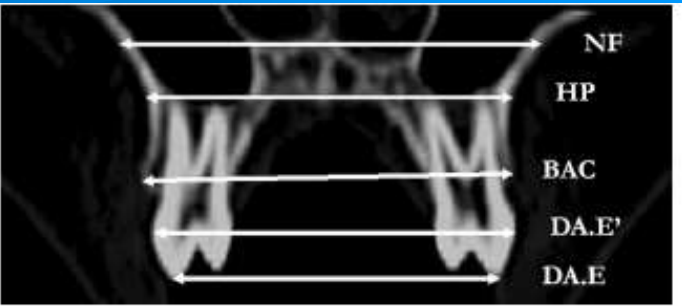


FIGURE 3. External maxillary widths. NF indicates maxillary width parallel to the lower border of the CT image and tangent to the nasal floor at its most superior level; HP, maxillary width parallel to the lower border of the CT image and tangent to the hard palate; BAC, maxillary width at the level of the buccal alveolar crest; DA.E′, dental arch external width measured at the most prominent area of the buccal aspect of the posterior teeth; and DA.E, dental arch external width measured at the level of the buccal cusp tips.

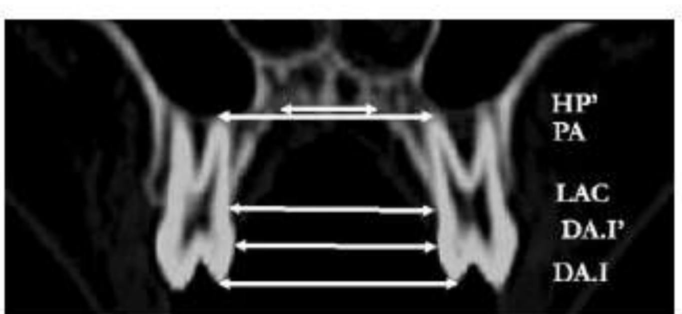


FIGURE 4. Internal maxillary widths. HP′ indicates hard palate width; PA, width between the tooth apices measured on the palatal root of the posterior teeth; LAC, maxillary width between the lingual alveolar crests; DA.I′, dental arch internal width measured at the most prominent area of the lingual aspect of the posterior teeth; and DA.I, dental arch internal width measured at the level of the palatal cusp tips.

- The results showed that RME produced a significant increase in all measured transverse linear dimensions, decreasing in magnitude from dental arch to basal bone.
- The transverse increase at the level of the nasal floor corresponded to one-third of the amount of screw activationOF Tooth-borne (Hyrax) and tooth tissue–borne (Haastype)
- Expanders tended to produce similar orthopedic effects. In both methods,

- RME led to buccal movement of the maxillary posterior teeth, by tipping and bodily translation.
- The tooth tissue–borne expander produced a greater change in the axial inclination of appliance-supporting teeth, especially first premolars, compared with the tooth-borne expander.

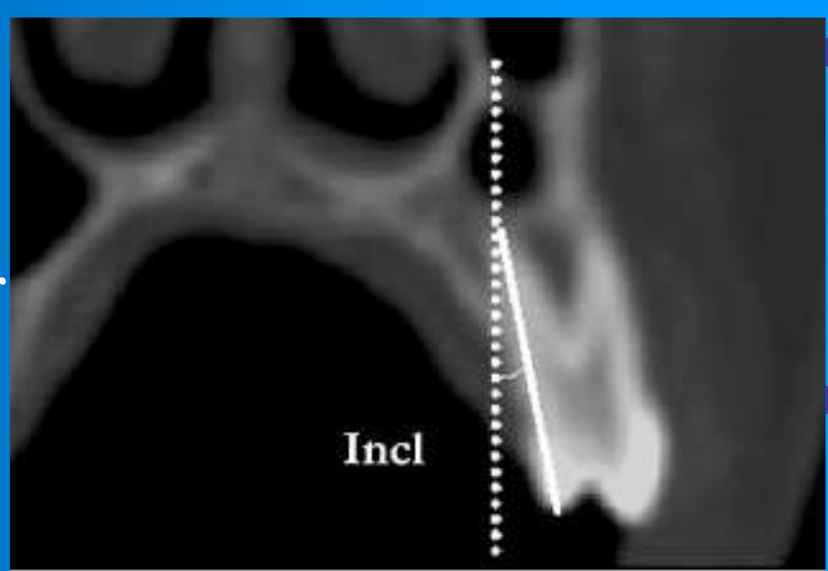


FIGURE 5. Incl—tooth inclination, corresponding to the angle between one line passing through the palatal cusp tip and palatal root apex, and one line perpendicular to the CT image lower border.

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.

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

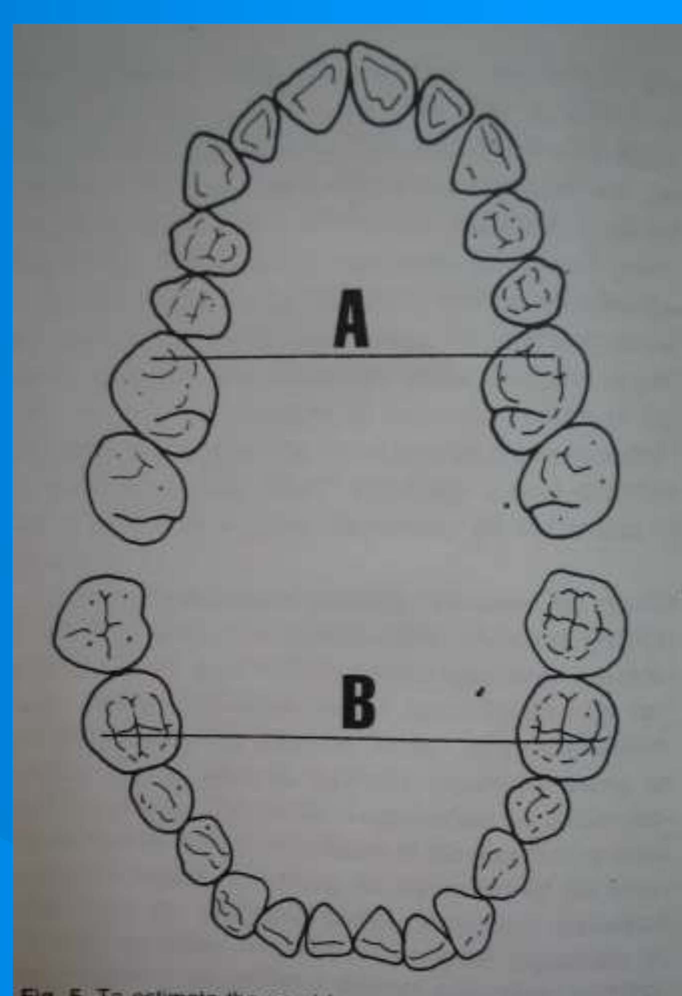


Fig. 5. To estimate the need for expansion, measure the distance between the mesiobuccal cusp tips of the maxillary molars (A) and the buccal grooves at the middle of the buccal surfaces of the mandibular first molars (B). Subtract B from A. The mean differences in persons with normal occlusion are +1.6 mm (males) and +1.2 mm (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 surrounding buccal musculature does moves these buccal segments medially to a position lingual to the premaxilla producing varying degrees of buccal cross bites .
- Subtenly (1957) found width between the pterygoid hamuli is slightly wider than in no cleft patient
- The cleft palate subjects manifests a normal lateral at the posterior teeth
- The collapse is not parellel but an inward rotation of maxilla about the fulcrum in the pterygoid region

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 appliance

- 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.
- Johnson in 1974 reported in 125 patients who had undergone bone grafting following expansion after 8 years observed only slight relapse of intercanine and inter molar width

- Roberston and Fish 1972 conclude late bone grafting following after RME did not prevent relapse and recurrence of cross bite .they related the degree of relapse to the tension in the soft tissue and claimed that bone graft remained in place and did not cause inference with anteroposterior growth

Indications for SAME

- Surgically-assisted maxillary expansion can be considered as part of the overall treatment plan for a mature patient with a constricted maxillary arch for the following.

1. To widen the arch and to correct a posterior crossbit .
2. Necessity for a large amount (>7mm) of expansion, or preference to avoid the potential increased risk of segmental osteotomies
3. To widen the arch following maxillary collapse associated with a cleft palate
4. Extremely thin, delicate gingival tissue or presence of significant buccal gingival recession in the canine-bicuspid region of the maxilla;
5. significant nasal stenosis

Surgical RME

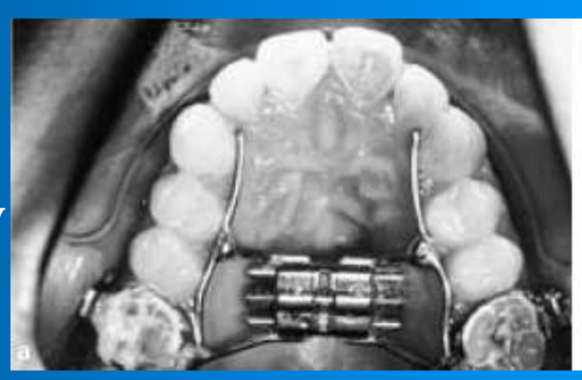
- The 3 principal areas of vertical and horizontal maxillary support are nasomaxillary ,zygomaticomaxillary and pterygomaxillary butress .

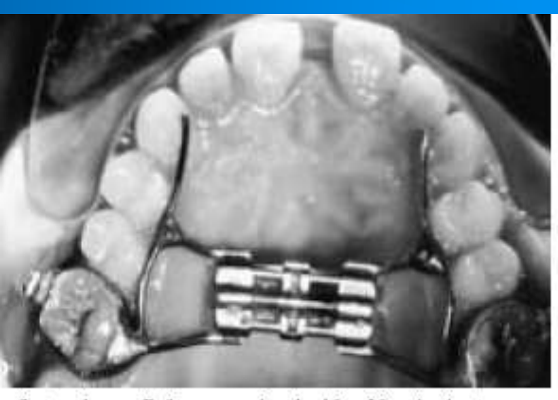
- Brown first described SAME in 1938performly only a midpalatal osteotomy

- Timms hypothesized based on histological studies that mid palatal was the major area of resistance
- Kennedy and colleagues reported the most effective is lateral maxillary osteotomy
- while other authors have recommended sectioning of all maxillary bony articulation
- The recent studies show that the midpaltal suture followed by pterygomaxillary articulation were primary areas of resistance

Technique of SAME

- A rigid expansion appliance is usually cemented to the first premolars and first molars on each side, but it may also be attached only to the first molars





e first molars. a, Before expansion. b, After 28 activating turns.

- The appliance is placed in the mouth a few days before surgery to allow the patient to accommodate to it.
- After the SAME procedure, there is often some temporary paraesthesia associated with the maxillary posterior teeth. It may therefore also be helpful to fit and cement molar bands in the lower arch before this surgical procedure is carried out, if the patient's bite is to be used when seating those bands

- incision made in the depth of the maxillary vestibule from the region of the first molar on one side to the midline
- The soft tissues are reflected subperiosteally from the lateral aspect of the maxilla, with dissection to expose the anterior floor of the nose and piriform aperture area, posteriorly to the pterygo-maxillary fissure

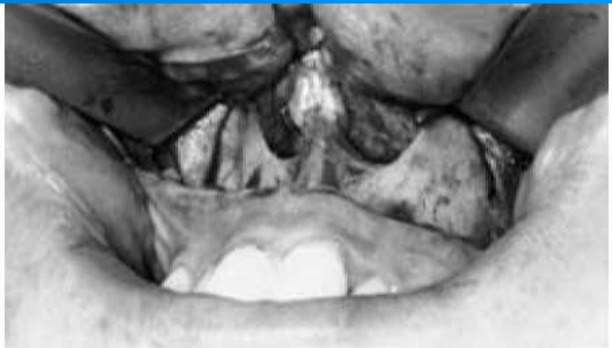


Fig. 2.–Operative view following anterior incision and dissection of the nasal floor, with the nasal spine still in place.

Fig. 3.–Operative view demonstrating the nasal spine being released with a fine straight osteotome.

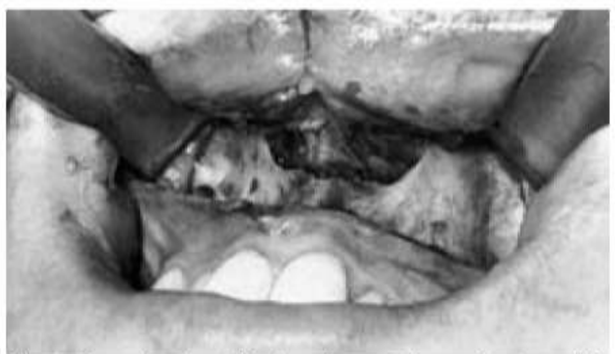
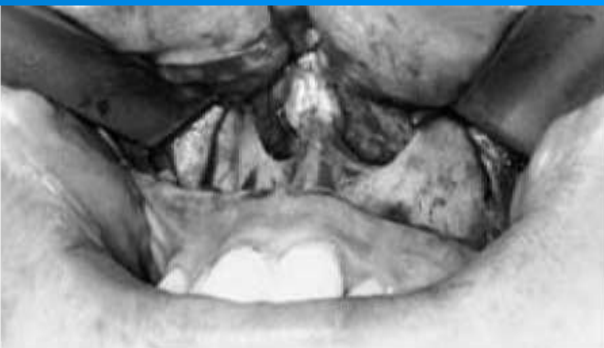


Fig. 4.–Operative view following release of the nasal spine, which remains attached to the nasal septum.

- The level of the lateral maxillary osteotomy is measured to be at least 5 mm above the apices of the teeth. As the anterior portion of the osteotomy is being performed, a periosteal elevator is maintained in the piriform rim, lifting the nasal mucoperiosteum to protect it.
- The lateral wall osteotomy is extended posteriorly to the pterygo-maxillary fissure. This osteotomy cut is designed with a step, as for a complete maxillary osteotomy



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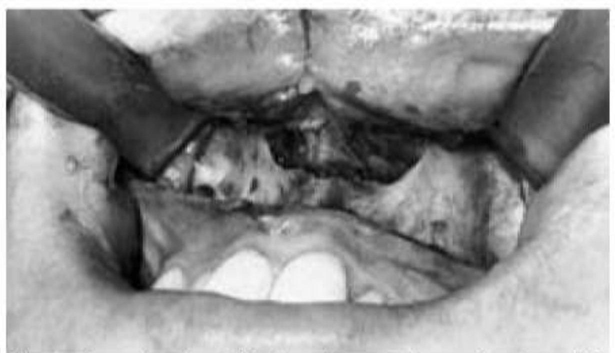


Fig. 4.–Operative view following release of the nasal spine, which remains attached to the nasal septum.

Michael woods and etal

It is the authors'

- observation that, when a subsequent definitive maxillary osteotomy is performed, there may not be complete bony healing along the original bone incision.
- This might compromise any subsequent surgery, if a non-stepped osteotomy design were

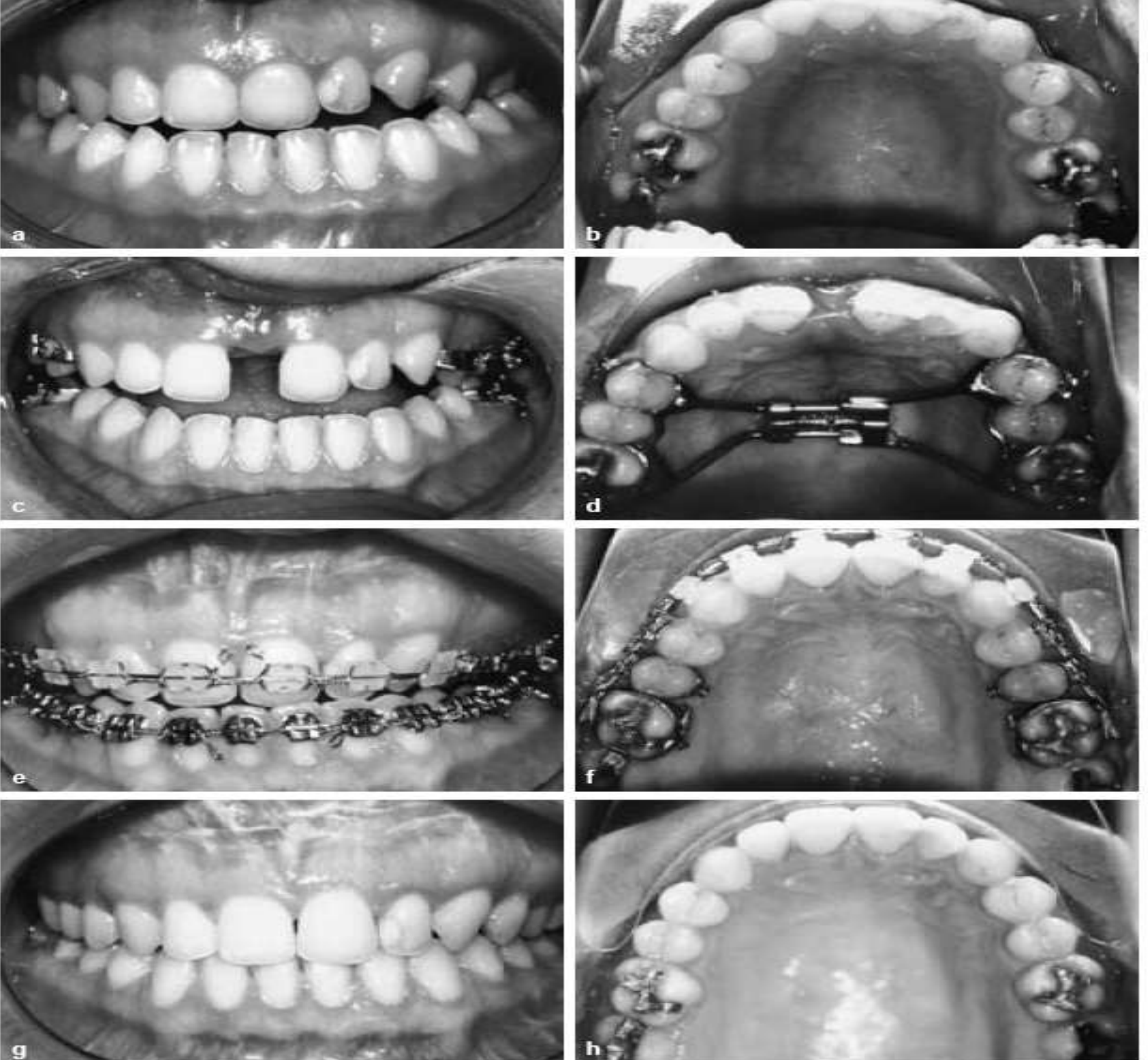


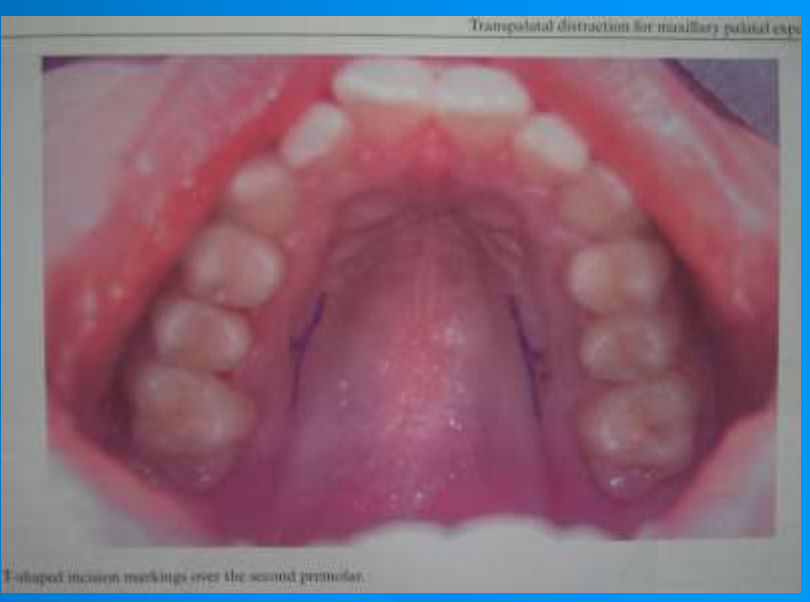
Fig. 5.–Frontal and occlusal views of a patient with an asymmetric Class III malocclusion and associated maxillary constriction. a, b, Before treatment. c, d, After 28 activating turns (7 mm). e, f, Following placement of fixed labial appliances and removal of expansion device. g, h, Following definitive maxillary and mandibular osteotomies and completion of active orthodontic treatment.

Trans palatal distraction

- Under general anesthesia ,the anterior lateral and median bony supports of the maxilla are transsected with a reciprocating saw and an osteotome.

Trans palatal distraction

- A T shaped incision is made in the palatal gingiva ,in the area of the further abutment plate.the horizontal segment of the T is approximately 12 mm long overlying the second premolar root.



- The perpendicular segment measures approximately 3 mm and extends cranially.
- The 2 abutment plates have 30 ^{0} angled box –like extension with horizontal slot,in between holes of 2.4mm diameter which centers are 8 mm apart

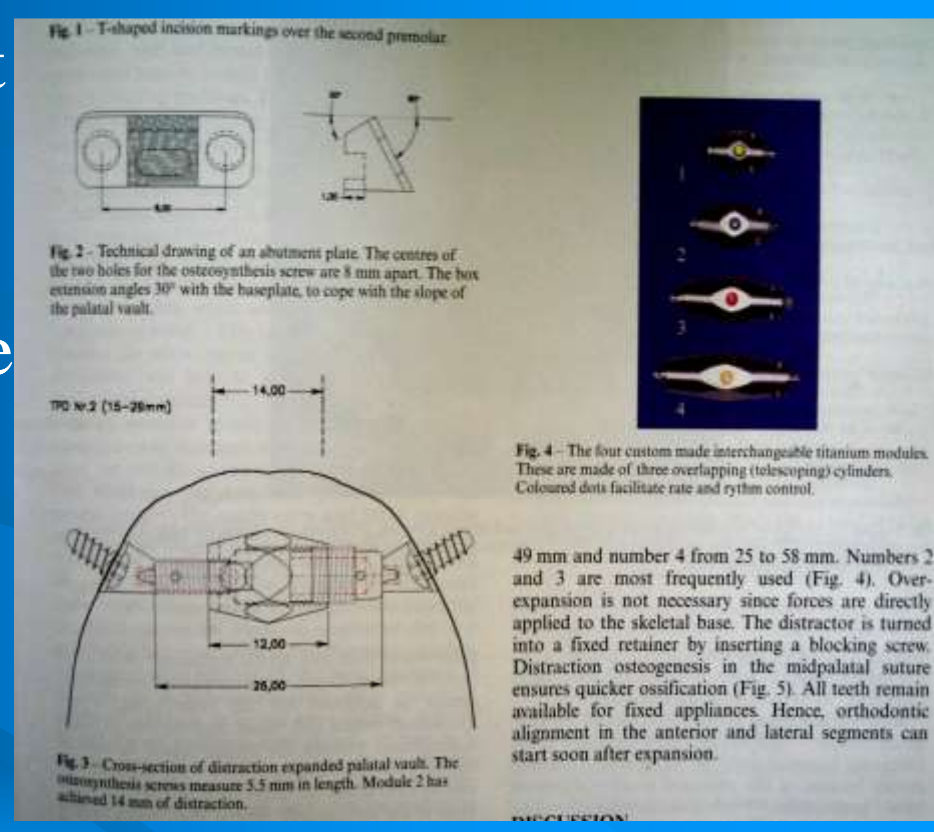


Fig. 1 - T-shaped incision markings over the second premolar

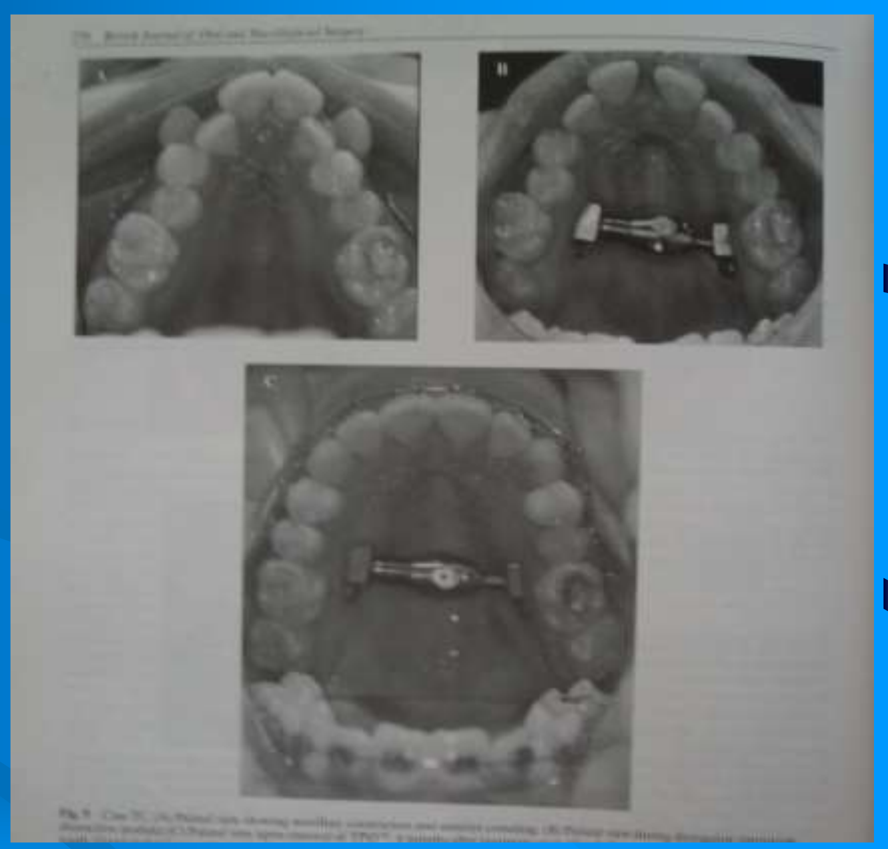
Fig. 2 - Technical drawing of an abutment plate. The centres of the two holes for the osteosynthesis screw are 8 mm apart. The box extension angles 30° with the baseplate, to cope with the slope of the palatal vault.

Fig. 3 - Cross-section of distraction expanded palatal vault. The osteosynthesis screws measure 5.5 mm in length. Module 2 has achieved 14 mm of distraction.

Fig. 4 - The four custom made interchangeable titanium modules. These are made of three overlapping (telescoping) cylinders. Coloured dots facilitate rate and rythm control.

49 mm and number 4 from 25 to 58 mm. Numbers 2 and 3 are most frequently used (Fig. 4). Over-expansion is not necessary since forces are directly applied to the skeletal base. The distractor is turned into a fixed retainer by inserting a blocking screw. Distraction osteogenesis in the midpalatal suture ensures quicker ossification (Fig. 5). All teeth remain available for fixed appliances. Hence, orthodontic alignment in the anterior and lateral segments can start soon after expansion.

- After a latency period of 5-7 days a titanium grade 2 telescopic distractor module is placed in the slots of the abutment plates and expansion starts at the Rate of 0.33mm daily .
- Distraction osteogensis in the midplatal suture ensures quicker ossification .



HAZARDS OF RME

- Oral hygiene
- Tissue damage

  Ziebe (1930) advised limited rate of expansion to 0.5mm per day
- 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.

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 harmony with a wider maxilla.

CLINICAL ADVISE FOR RME PATIENTS

1. 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.
2. When possible avoid orthodontic movement of the maxillary posterior teeth prior to RME. Mobile teeth may tip faster during expansion.

3. 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.
4. 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.

5. 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.

6. 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.

7. 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.

8. 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.

9. After removing the RME appliance, place a transpalatal arch between the maxillary first molars to minimize relapse tendencies

10. 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.

11. 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.

11. 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.. Similar symptoms occur if the appliance is removed for repair or recementation during the expansion phase or if the force is deactivated rapidly.

MANDIBULAR EXPANSION osteogensis

- First described by Cordivilla in 1905.but it is russian orthopedist IIizarov is credited with pioneering the technique.
- In 1992 Guerrero and Contastr presented a technique to surically assist expansion of the lower arch .

MANDIBULAR EXPANSION

- Activation of the appliance was delayed 4 – 5 days . The appliance was activated 3 times a day for 0.75mm per day .the expansion contiuned until the desired amount of expansion was achived.
- The mean distraction period was 14.2 days .after the achievement of the desired distraction ,the tram was inactivated and the appliance left in place for stabilization for 3 months.

MANDIBULAR EXPANSION

Schwarz appliance

Is named behind A.M Schwarz.

It is a simple arcylic removable plate which incorporates a midline screw.

Activation – activated once per week until desired expansion is achieved.

Uses –

- in pts who have arch length discrepencies and abnormal lingual inclination of the posterior teeth - schwarz appliance will help to upright posterior teeth and creates modest amount of arch length anteriorly.
- to correct scissor bite.

Usually both Schwarz and RME ARE USED IN combination for correcting transverse dimension as stabiltily of mandibular dentoalveolar region is maintained retention period .

MC Namara in 2004 evaluated short term treatment effects of acrylic splint RME in conjuction with acrylic splint RME and Schwarz appliance.

The finding showed *increase in lower facial height in only RME group was not observed as acrylic splint RME acted like a posterior bite block*. In RME –Sz LAFH was increased by 1.7mm due to eruption of lower molars. Forward displacement of maxilla was seen in RME group but sagittal position of maxilla remained unchanged in RME SZ group, maxillary molars were intruted in both groups, Sz appliance prevented mesial movement of molars.

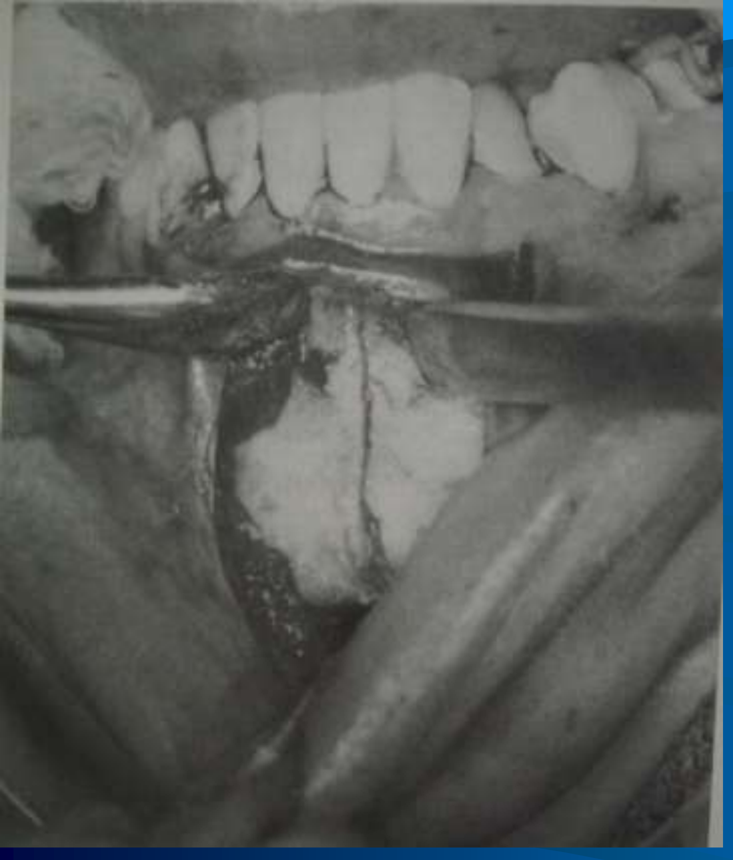
Sequencing of schwarz and RME appliance - schwarz appliance is activated first till expansion is almost completed prior to the onset of RME as frequency of activation is more for RME and it is better to correct mandibular dento alveolar compensations before RME is begun, a greater transverse expansion of the maxilarry dental arch can be attained.

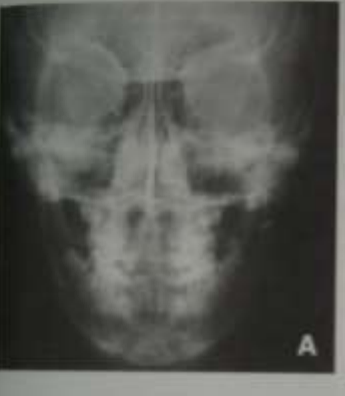
Lateral tipping of the molars should be considered because excessive expansion may result in excessive buccal tooth inclination which may disturb occlusal relationship.

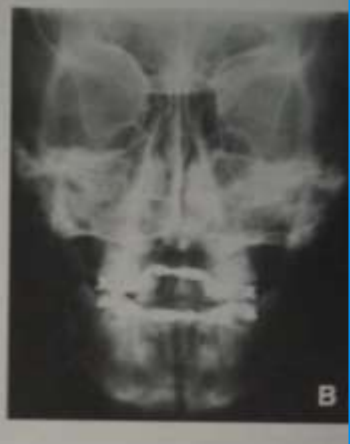
Mitsuru motoyoshi and shinya yano have found a regression co – efficient of the angle of buccal tooth inclination during expansion to the increment of the intermolar width was approximately 0.2 .this means 1mm of expansion of mandible arch is accompanied by 5 degree of molar lateral tipping.

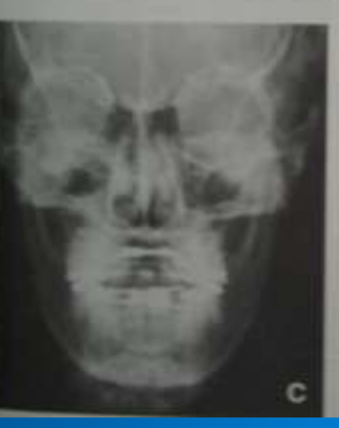
This co –efficient is clinically usefull for estimating the permissable limit of mandibular expansion.

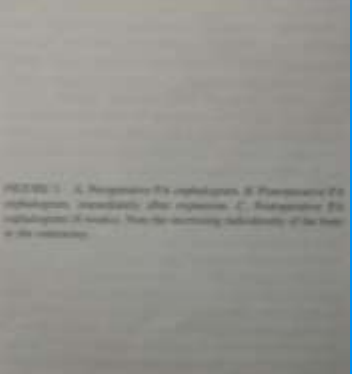
- Reconstruction of deformities of dentofacial complex has undergone remarkable changes over decades.
- Many surgical solutions have evolved to treat myraid of deformities.
- But , surgical invention of mandibular deficiency has been elusive.
- *Distraction osteogenesis has unique ability to increase arch length and width.*
- first described by cordvillia 1905.
- Ilizarov - technique
- Mc Carthy described method to lenghen hypoplastic mandible in children
- In 1992 Guerroro and Contastr presentd a technique to surgically assist expansion of lower arch.

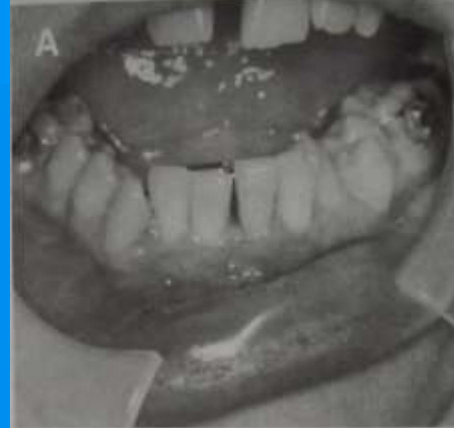












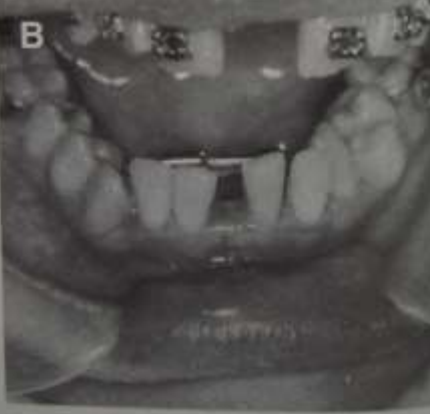
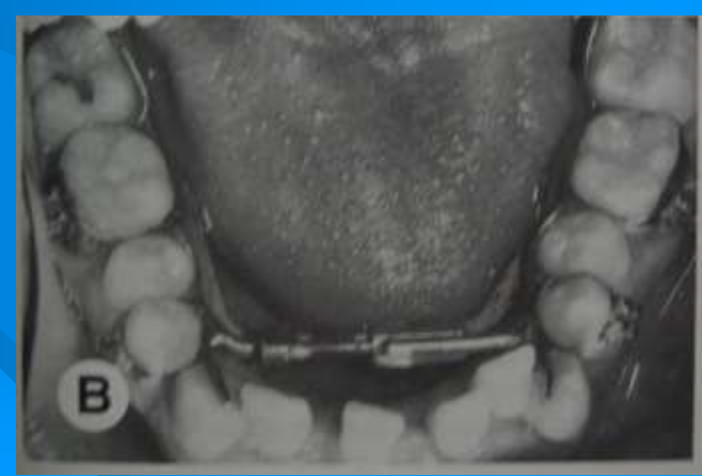


FIGURE 5. A. The mandibular arch early in the distraction process. B. Seven days later. Note the diastema created with activation of the appliance.

CASE REPORT OF MID-SYMPHYSIAL DISTRACTION



- In young adults, orthopaedic expansion can be achieved by using orthodontic forces alone.
- In teens, orthopaedic expansion is unsucessfull because of resistance of maxillary articulations.
- Segmental expansion by le-fort osteotomies or surgically assisted rapid palatal expansion are options .
- But segmental osteotomies are unstable

- In a report publised by Thomas s. weil and Joseph .E. Van in 1997 described their experience of treating 9 pts who underwent symphyseal distraction osteogenesis and surgical assisted rapid palatal expansion to correct upper and lower transverse discrepencies.

Appliance protocol-

maxilla – hyrax appliance was used and was activated 4 times/day – on day of maxillary osteotomy. Latter , twice daily

Mandible- the distraction device is placed on the lingual aspect of th mandible and activatd trice daliy to achieve .075mm expansion.

osteotomty cut was made at the inferior border of the symphysis that extends superioly to meet facial corticomy made b/w 2 central incisors.

The mean expansion achieved was 3.9mm

A review of their data showed more expansion was achieves posteriorly than anteriorly when measured b/w teeth.

Meta analysis of immediate changes with RME treatment

JADA Jan 2006

- Results: Of the 31 selected abstracts, 12 were rejected b coz they failed to report immediate changes after the activation phase of RME and instead reported changes only after the retention phase.
- The greatest changes were in the maxillary transverse plane in which the width gained was caused more by dental expansion than true skeletal expansion. Few vertical and anteroposterior changes were statistically significant, and none was clinically significant.

Skeletal and dental changes with fixed slow maxillary expansion treatment. Systematic review.

JADA Feb 2005

- Eight studies were selected, each lacked a control group, and four also did not have a measurement error treatment.
- A control group is necessary to factor out normal growth changes in the dental arch and cranio facial structure.
- No strong conclusion could be made on dental and skeletal changes after SME.

A systematic review concerning early orthodontic treatment of unilateral posterior cross bite

Angle Orthod 2003;73:588-596

The aim of this study was to assess the orthodontic treatment effects on unilateral posterior cross bite in primary and early mixed dentition by systematically reviewing the literature. Two RCT's of early treatment of cross bite have been found and these two studies support grinding as treatment in the primary dentition. There is no scientific evidence to show which of the treatment modalities, grinding, quad helix, expansion plates or RME is most effective

Conclusion

- Only during the last decade ,rapid palatal expansion has got a measure of acceptance. For a century before that the concept had been repeatedly rejected by some of most prominent members of our specialty ,but in spite of an uncertainty as to the actual separation of the maxilla, rapid maxillary expansion a wave of popularity with both orthodontist and rhinologist during the twentieth century.

THANK YOU