

Removable Orthodontic Appliances For Tooth Movement

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Terminology

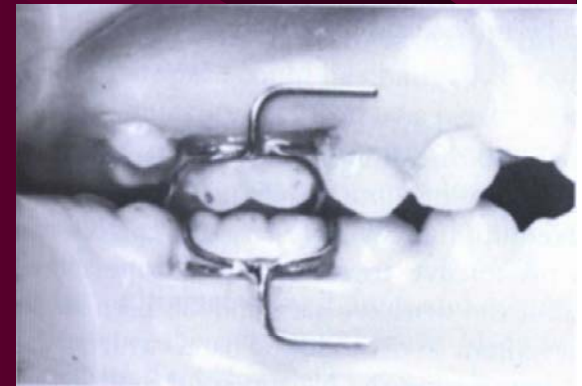
- **Removable appliance**

An appliance that is not fixed to teeth, but can be removed by the patient.



History and Development

- Victor Hugo Jackson (early 20th century)
Vulcanite bases & precious metals
- Crozat used precious metal (gold) for
expansion appliance



Classification Of ROA

- Active (produce tooth movement/growth modification)

Mechanical appliances

Functional appliances (FA s.)

- Passive

Retainers

Space maintainers

Tooth movement with removable appliances

- Tooth movement with removable appliances almost always falls into one of the following categories:
 - 1- Increase arch perimeter (arch expansion).
 - 2- Repositioning of individual teeth within the arch.
 - 3- Intrusion or Extrusion of teeth.

Active Plates for Arch Expansion

- Anterior Expansion of maxillary incisors.
- Transverse Expansion of the Arches.
- Simultaneous Anterior and posterior Expansion

Active Plate for Arch Expansion

Active plate are most useful when a few millimeters of space are needed (1.5-2 mm side). The active element of expansion plate is a jackscrew placed so that it holds the parts of the plate together.

The screw produces a heavy force that decays rapidly. Most screws open 1 mm per complete revolution, so single quarter turn produces 0.25 mm of tooth movement.

We should not exceed 1 mm per month
i.e. one $\frac{1}{4}$ turn/week and not more than two
 $\frac{1}{4}$ $\frac{1}{4}$ per week and it should be activated
while the appliance is worn (inside the
mouth)

Anterior expansion of maxillary incisors.

The simplest uses of an active plate is to correct a maxillary anterior crossbite.

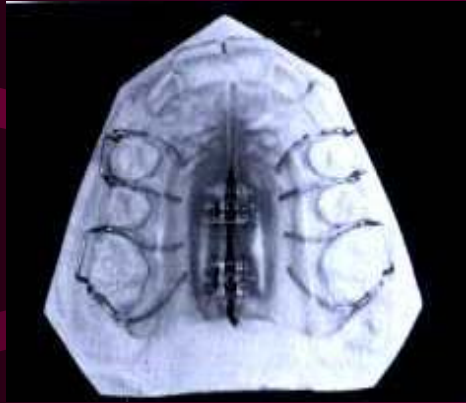
Posterior biteplane is necessary in adult to allow clearance for the upper incisor to move out of crossbite ($\frac{1}{2}$ crown or more is covered).

Transverse Expansion of the Arches

Active plate split in midline will expand constricted maxillary arch almost totally by tipping the posterior teeth buccally **Not** by opening mid-platal suture. Therefore this appliance is not indicated for skeletal crossbites or dental expansion for more than 2 mm per side.

Simultaneous Anterior and posterior Expansion.

By dividing the maxillary appliance baseplate into 3 segments. This design was the basis of Schwartz's original Y plate used to expand the maxillary posterior teeth laterally and the incisors anteriorly. Careful and slow activation can be quite effective in arch expansion. More than two teeth should be moved by this appliance, for a single tooth spring should be used instead.



- Removable Appliances with springs for positioning individual teeth.
- Spring design for individual teeth.
- Clasps: Adams Clasp, Circumferential Clasp, Lingual Extension Clasp
- Clinical Adjustment
- Combined functional and Active plate Treatment

Removable Appliance with Springs for Positioning Individual Teeth

Originally, the removable appliances with springs were used to bring about tipping movement anteriorly, labial bow for more than 3-4 mm of flared incisors, but root control is needed (Hawley 1920 used the classical type).

spring designs for individual teeth

The design of the spring to move the tooth in M-D or labio or bucco-lingual, we have to keep in mind two important principles:-

1) Adequate springiness and range and acceptable strength.

2) The spring must be guided to appropriate direction.

The major problem with long flexible spring is that spring can deflect 3-D.

The deflection can be overcome in three ways:-

- 1) By placing the spring in an undercut area of a tooth.
- 2) By using a guide which is either a rigid wire or a shelf of baseplate material extended over the top of the spring to prevent its displacement.
- 3) By bonding an attachment to tooth surface to provide a point of positive attachment for the spring (Bond stop or ledge toward the incisal edge into which the spring can fit securely)

Retention of the removable appliance

Retention is the means whereby displacement of an appliance is resisted

In order to retain the removable appliance in place clasps has to provide that to insure good clinical performance of the appliance.

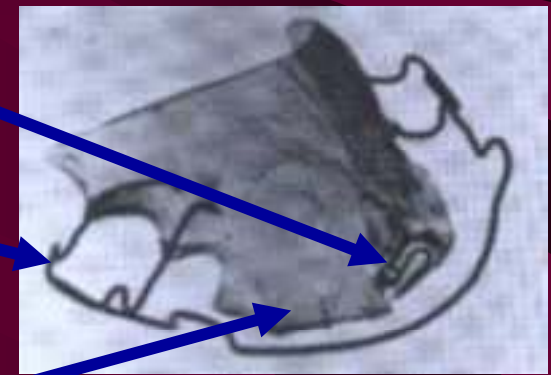
Different type of clasps are available, but the most useful are Adam's clasp, Circumferential clasp, Ball clasp and lingual extension clasp.

Components Of Removable Applaine

- Active Components
- Retentive Components
 - Acrylic Base Plate
 - Anchorage

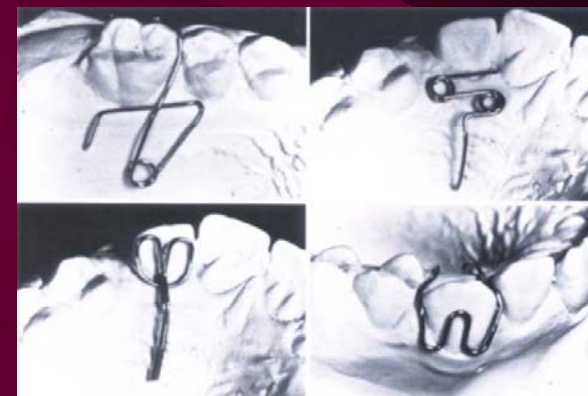
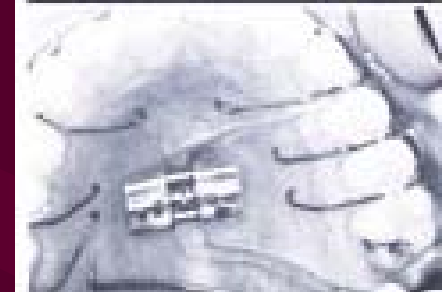
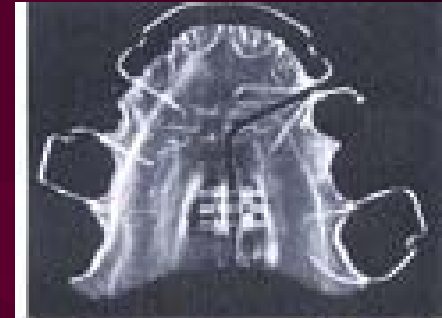
Component of Removable Appliances

- Active component
 - Spring, screw, elastics,....
- Retentive components
 - Clasps (Adam's, C-clasp, Ball clasp, Lingual extension clasp)
- Acrylic base plate



Active component

- Screws
 - Uni-dimensional screws
 - Bi-dimensional screws
- Wire springs
 - Finger spring
 - Z-spring
 - Canine retractor
 - Short labial arch



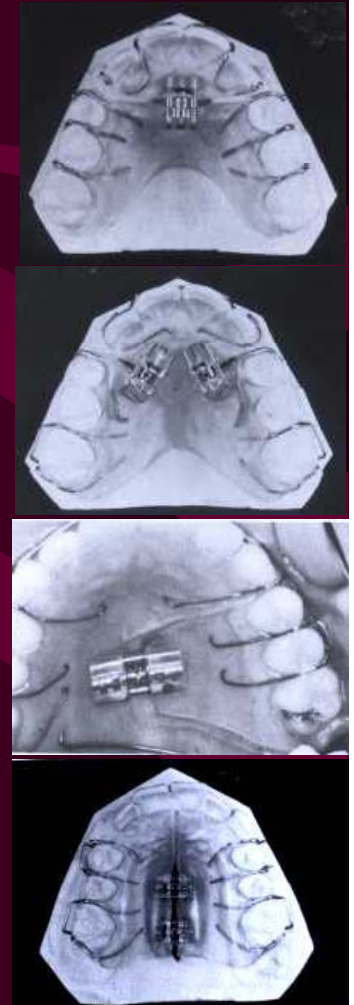
Active components

- **Screws**

- Expansion is 1 mm. per one full turn i.e. 0.25 mm. per quarter turn
- May be used for moving one tooth or group of teeth (usually more than one tooth to be moved with a screw)
- Have different sizes and range of activation
- Useful only when a few millimeters of space is needed
- Usually jackscrews been used as active component
- Clasps for retention

Active components

- Expansion screws
 - For anterior Expn. of Max. incisors
 - For simultaneous Expn. of maxillary incisors anteriorly and posteriors laterally (Y-plate).
 - Y-plate can be modified for Tx. Of unilateral x-bite
 - Maxillary split plate (By post. teeth tipping not by opening mid-palatal suture).



Active plate

- The simplest uses of an active plate is to correct a maxillary anterior crossbite.
- Posterior biteplane is necessary in adult to allow clearance for the upper incisor to move out of crossbite ($\frac{1}{2}$ crown or more is covered).

Active plate

- Active plate split in midline will expand constricted maxillary arch almost totally by tipping the posterior teeth buccally **Not** by opening mid-palatal suture. Therefore this appliance is not indicated for skeletal crossbites or dental expansion for more than 2 mm per side.

Active components

- **Springs**
 - Provide extra length of wire to increase range of action and resiliency
 - Extra length can be provided in the form of coil (s), loop (s) or change configuration to provide extra length of the wire

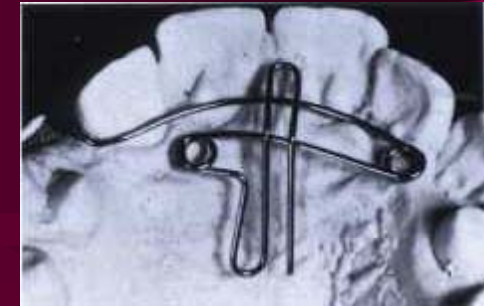


Active component

- Wire springs

- Spring design

- Recommended wire is St. St. round wire (0.5mm) in diameter
 - The design must ensure adequate springiness and range while keeping acceptable strength
 - The spring must be guided so that its action is exerted only in the appropriate direction by:
 - Place the spring in an undercut of the tooth so that it does not slip occlusally during activation
 - Use a guide to hold the spring in its position during activation
 - Bond an attachment to the tooth surface to engage the spring



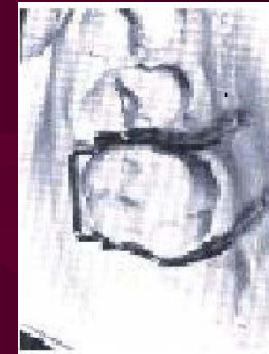
Active component

- Short labial arch
 - Constructed from 0.030 inch (0.7 OR 0.8) round St. St. wire
 - It must contact the middle 1/3 of the labial surface of the teeth 21|12
 - Loops should be $\frac{1}{2}$ width of the canine, should extend slightly above the gingival margin
 - Wire must be closely adapted where it cross the occlusal surface
 - Palatal retentive arms must be adapted to the contour of the palate.



Retentive components

- Clasps
 - Adam's clasp
 - C-clasp
(Circumferential clasp)
 - Lingual extension clasp
 - Ball clasp

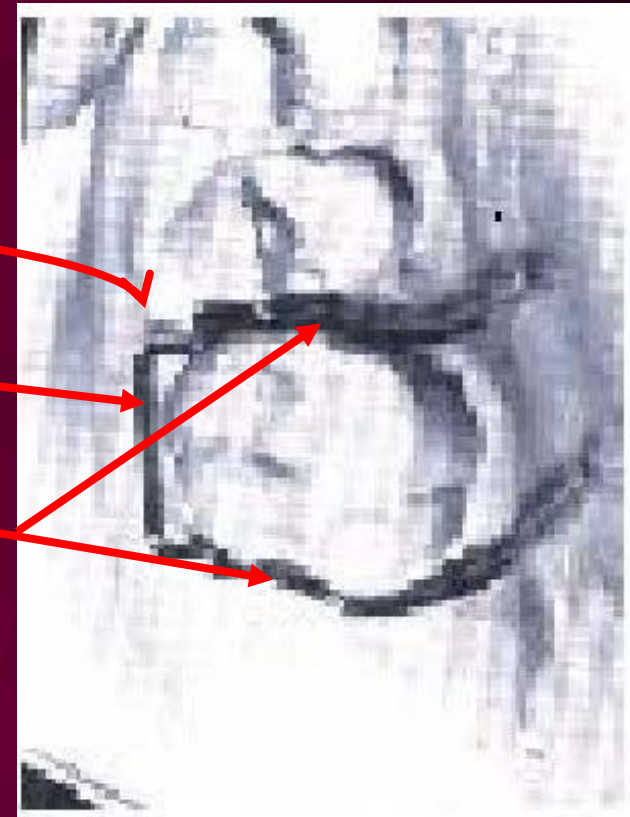


Adam's Clasp

- The most useful clasp in removable appliances.
- It is designed to engage the MB, DB undercuts of posterior teeth.
- Advantage, it does not separate teeth and has excellent retention.

Fabrication of Adam's Clasp

- Components of Adam's Clasp
- 1- Arrow heads
- 2- Bridge
- 3- Tags
- 4- Retentive parts
- It is made of 0.7 mm diameter hard St. St. round wire



Adam's Clasp

- Design modifications

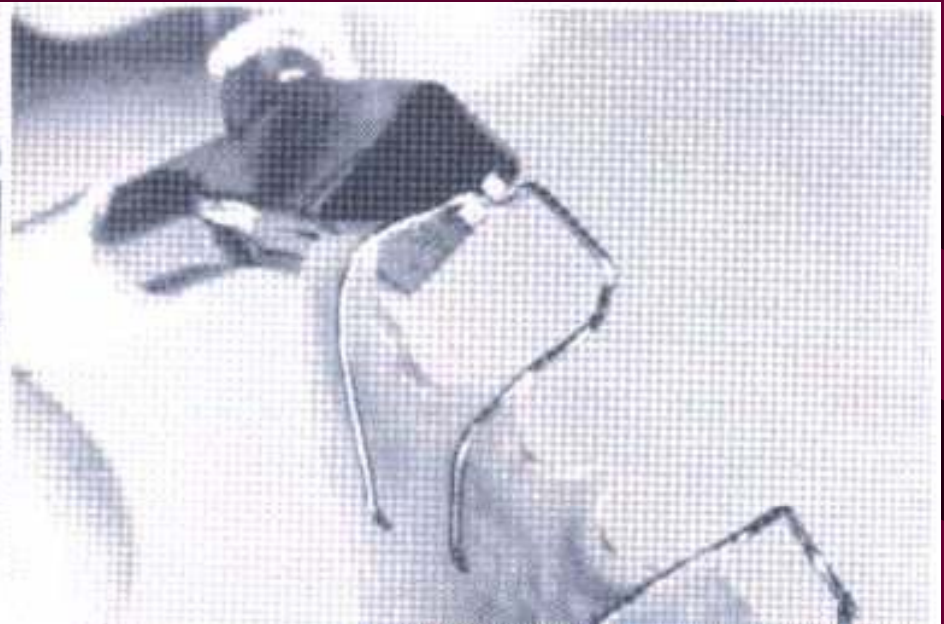
Long bridge

One arrow head

Solder a HG tube to the bridge

Solder hook to the bridge

Adjustment of Adam's clasp



Retentive component

- Circumferential clasp
 - Useful for second molars and canines
 - Easier to keep it out from occlusal contact
 - It is only supportive, not as retentive as Adam's clasp
 - It can be adequate for a retainer, but not for an active appliance



Retentive component

- Ball Clasp
 - It like Adam, extends across the embrasure
 - Uses buccal undercuts for retention
 - Easy to fabricate
 - It is stiff that could not be extended deep into the undercuts



Retentive component

- Lingual Extension Clasp
 - It works only from the lingual aspect without crossing the occlusal surface or embrasures
 - Short loop of (0.4 mm) wire
 - Can be placed in the first molar second premolar lingual embrasure
 - Difficult to adjust
 - Break easily
 - May cause tissue irritation
 - Can separate teeth if active
 - Can be used for retainers,
 - not for active appliance



Acrylic base plate

- It is used as a vehicle to carry all Removable Appliance components together.
- It is the Anchor tool for tooth movement.
- Use self-curing acrylic resin.
- Steps in construction (see handouts).

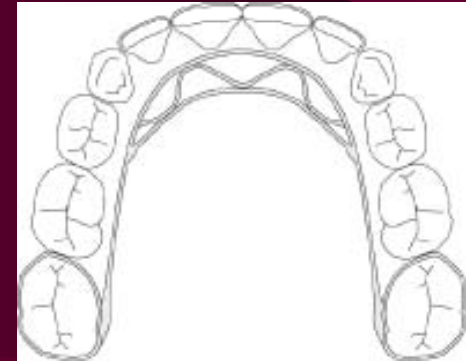
Adjunct to fixed orthodontic appliances

- Bite plane

The horizontal shelf-like part of a bite plate, on which the teeth touch.

Bite planes also can be used in a fixed design (i.e. bonded to the teeth, or attached to a palatal arch).

To prevent or treat abnormal oro-functional habits



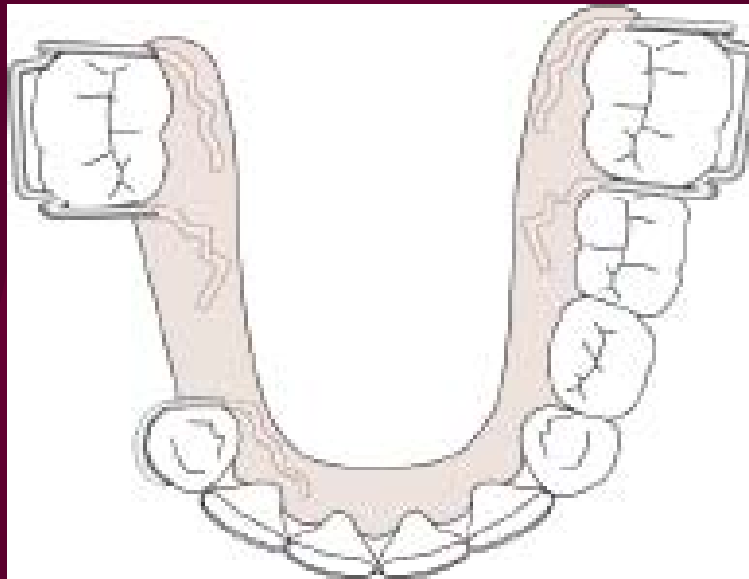
Crib

An interceptive appliance used for correction of deleterious habits such as a deviating tongue position and/or digit-sucking. A crib consists of a transpalatal [0.036-inch (0.9-mm) or heavier gauge] wire.

For removable appliance, the wire is embedded in acrylic base plate supported via retentive means (clasps) or soldered on two maxillary first permanent molar bands (for the fixed appliance). The wire extends toward the anterior palate where it forms a crib-shaped "fence" meant to interfere with the habit. Posterior (lateral) tongue cribs can be used as part of removable appliances in patients with unilateral or bilateral posterior open bite.

Space maintainers

- To replace prematurely lost deciduous teeth



To retain the obtained tooth movement, either by removable or fixed orthodontic appliances



Clinical Adjustment

- Maxillary removable appliances are more tolerable and successful than the mandibular ones. Because the maxillary removable appliance can provide more stability as the baseplate fits better than lower removable appliances.
- During the treatment the adjustments can be performed as follow:
 - 1- Tightening of clasps as they become loose
 - 2- Activation of the spring/screws /bows
 - 3- Trimming of the baseplate (as required)

Combined functional and active plate treatment

- Growth guidance can be combined with active tooth movement by adding springs or screws with three problems:-
- Active tooth movement is not the goal of functional appliance therapy.
- Long-term stability of arch expansion is questionable VS improving Class II open-bite or deep-bite treatment success.
- Two point contact is difficult to be attained using removable appliance for tooth movement.

Advantages of Removable Appliance:



- More acceptable to the patient (can be removed on socially sensitive occasions).
- They are fabricated in the lab rather than directly in the patient's mouth, reducing the dentist's chair time.
- Allow some types of **growth guidance** treatment to be carried out more readily than is possible with fixed appliances.

Disadvantages



- Heavily dependant on patient compliance.
- It is difficult to obtain the two point contacts on teeth necessary to produce complex tooth movement.

Indication of Removable appliances:

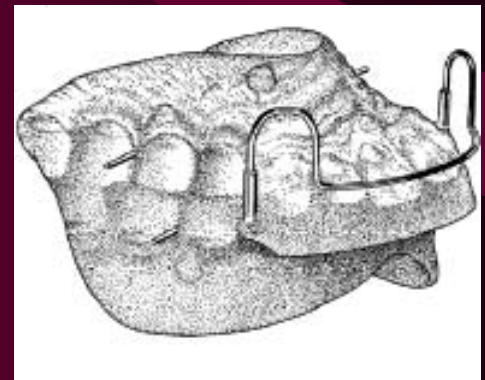
- Growth modification during mixed dentition
- Limited (tipping) tooth movements (arch expansion, individual tooth mal position).
 - Retention following orthodontic treatment
- Adjunct to fixed orthodontic appliances,
- Interfere with (or prevent the development of) abnormal orofacial habits

Any Question

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Growth modification (Functional Appliances) [FA s.]

- A removable or fixed appliance that alters the posture of the mandible and transmits the forces created by the resulting stretch of the muscles and soft tissues and by the change of the neuromuscular environment to the dental and skeletal tissues to produce movement of teeth and modification of growth.



Categories of function appliance

Graber and Neumann (1948) categorized functional appliances into two categories:

- 1- Myodynamic: that displace the mandible only to a moderate extent.
- 2- Myotonic: that displace the mandible to a more extreme displacement and rely on the elastic properties of the muscle and facia for their action.

Categories of function appliance

Vig and Vig (1986) have proposed a classification based on the components that each appliance incorporates; these components are:

- 1- bite planes – which produce differential eruption.
- 2-Lip/cheek shields-which alter the linguofacial muscle balance.
- 3-The working bite-which affects the mandibular posture.

Categories of function appliance

More recently, Isaacson, Reed and Stephens (1990) divided these functional appliances into two types:

- 1-Rigid (Anderson, Harvold, Activator, bionator, etc...)
- 2- More flexible (e.g. function regulator of Frankel)

Proffit (1986)

proposes the following classification:

- 1- Tooth-borne passive.
- 2- Tooth-borne active
- 3- Tissue borne

The effect of functional appliance treatment usually include:

- 1- Acceleration of mandibular growth.
- 2- Restraint of mandible growth.
- 3- Backward tipping of maxillary incisors and forward tipping of mandibular incisors entire mandibular dentition (class II elastic effect).
- 4- differential eruption of teeth (frequently, rotation of the occlusal plane)

The effect of functional appliance treatment

In order to modify growth, the ideal patient for functional appliance treatment would have (in addition to the CI II malocclusion with mandibular deficiency).

- Normal or slightly excessive maxillary development.
- Normal or slightly short face height.
- Slightly protrusive maxillary incisors.
- Normally positioned or retrusive incisors.

The effect of functional appliance treatment

It is interesting that the effect seems to be limited in duration and that for their displacement of the mandible seems to be necessary to maintain the condylar response (McNamara, 1980)

Functional appliances have been, and still are, subject of a certain amount of controversy regarding their mode of action.

Preliminary treatment

- In class II treatment, the upper arch has to be expanded transversely to a minor extent in order to conform the lower arch.
- In class II division two upper incisors can be procline some what more than average inclination and anterior bite plane to assist in reduction of the overbite by using removable appliance for both treatment.

Anterior bite plane

It is the simplest form of functional appliances that produces a small amount of lower incisors intrusion through the direct action of the muscles of mastication.

The Oral Screen

Also simple F.A. that takes the form of a curved shield of acrylic material placed in the labial vestibule

Oral screen has no place in modern orthodontics; it is inefficient and limited in scope as an orthodontic appliance; and there is no evidence that its use as a lip training device (Thuer and Ingerval 1990)

Lip bumper

A functional component that has a use in conjunction with a lower fixed appliances to enforce anchorage. It has been suggested that it can be incorporated into lower removable appliance (Bell 1983)

Functional Appliance

A functional appliance is one that changes the posture of the mandible, holding it open or open and forward. Pressure created by stretch of the muscles and soft tissues are transmitted to the dental and skeletal structures, moving teeth and modifying growth.

- * Most functional appliance cases ultimately require fixed appliance treatment in order to complete the detailing of the occlusion.

From component basis point of view the functional appliances grouped as follow:-

*** Passive tooth-borne Appliances**

- The Andresen Activator
- Woodside and Harvold Activator
- The Bionator
- The Herbst Appliance
- Twin Block

These appliances depend only on soft tissue stretch and muscular activity to produce treatment effects.

* Active Tooth-borne Appliances

- Modified Activator

- Expansion Activator

These are appliances have intrinsic force-generating capacity from springs or screws, and largely a modifications of activator and bionator designs

Tissue-borne Appliances

Frankel

Is the only tissue-born functional appliance.

Despite its minimal contact with the dentition, the appliance can be used to enhance dental eruption, but it alter both mandibular posture and the contour of facial soft tissue.

Component Approach to functional Appliances

Functional appliance is simply a melding of wire and plastic components. Regardless whose name it carries, if one understands the different component parts and how the components translate into treatment effects, it is possible to plan functional appliance treatment by combining the appropriate components to deal with specific aspects of the patient's problems.

Components of Functional Appliances

❖ Functional components

❖ Active components

❖ Miscellaneous components

The functional components generates forces by altering posture of the mandible, changing soft tissue pressures against the teeth, or both (mandible+teeth) components:-

1- Lingual pad or flanges

Lingual pads contact the tissue behind the lower incisors, the flanges are against the alveolar mucosa below the mandibular molars provide the stimulus to posture the mandible to a new position.

The new posture tends to accelerate growth at the condyles and increase the vertical dimension so that tooth eruption can be allowed or prevented, lingual component contacts the mandibular incisors can also produce alabially directed force against these teeth as the mandible attempts to return to normal resting posture. For this reason the appliance usually is relieved behind the lower incisors.

2- Sliding Pen and Tube:

Normally found only in the Herbst appliance, also force the mandible to be positioned forward not by pressure against the mucosa, but by holding the teeth.

3- Bite Ramps:

Ramps that contact when the patient closes down where the mandible can be posture forward (Twin block)

4- Lip Pads:

These pads are positioned in the vestibule and remove lip pressure from the teeth. Also force the lip to stretch during function, presumably improving the tonicity of the lips and may promote soft tissue remodeling stability of incisors position

5- Buccal shields, cuspid wires and Buccinator Bows:

These components are used to remove the buccal soft tissue from contact with dentition.

The effect is to disrupt the tongue-cheek equilibrium, and this in turn leads to facial movement of the teeth and arch expansion.

6- Lingual Shields:

Remove the resting tongue from between the teeth therefore reduce the force tooth eruption while posterior teeth are blocked (open bite cases)

7- Occlusal or Incisal Stops (including Bite blocks):

Eruption is impeded both posteriorly and anteriorly posterior stops can be of wire or acrylic. Incisal stops can extend to the facial surface to control the anteroposterior incisor position. The posterior bite block allow either mandibular or maxillary teeth to erupt, therefore controlling vertical facial dimension

Categories of FAs.

1. Passive Tooth-borne appliances (have no intrinsic force-generating capacity or mechanical component & depend on soft ts and ms. stretch to produce Tx effect).

Activator, Bionator, Herbst appliance, Twin Block,



Categories of F A s.

2. Active tooth-borne appliances (include tooth moving mechanical components)

Expansion screws or springs



Categories of FAs.

3. Tissue-borne Appliances (Frankle appliance) [passive expansion]



Components of FAs.

1. Functional components

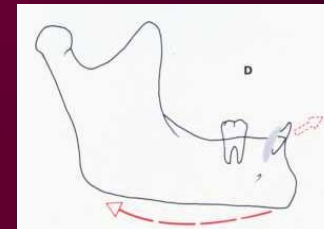
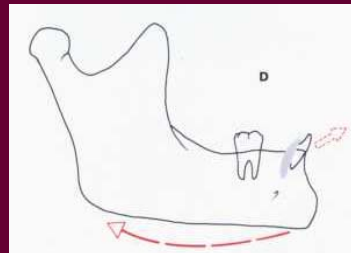
Lingual flanges (effective)

Lingual pad (less effective)

Sliding pin & tube (tooth movement)?

Tooth-supported ramps (Tooth movement)

Lip pads

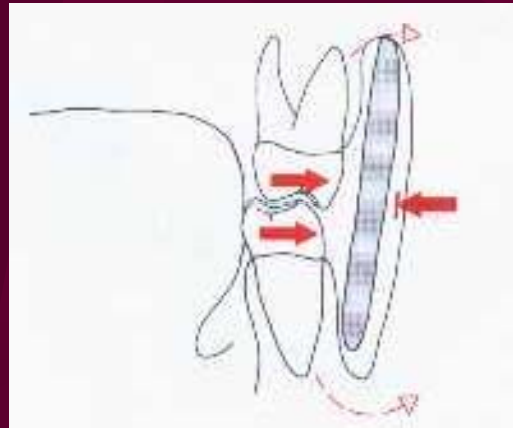
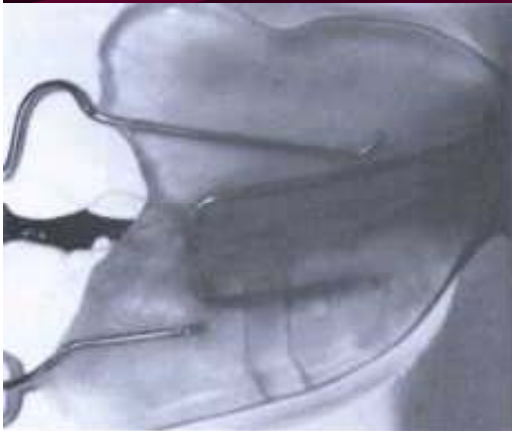


Components of FAs.

2. Tooth-controlling components

A. Arch expansion

Buccal shields, Wire shields, Expansion screws and springs

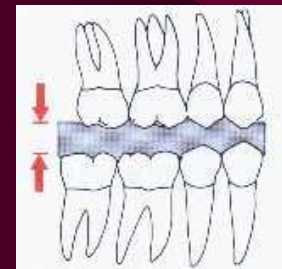
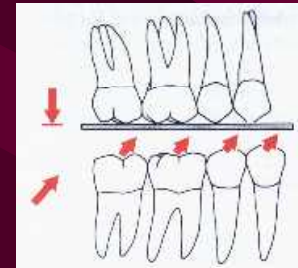
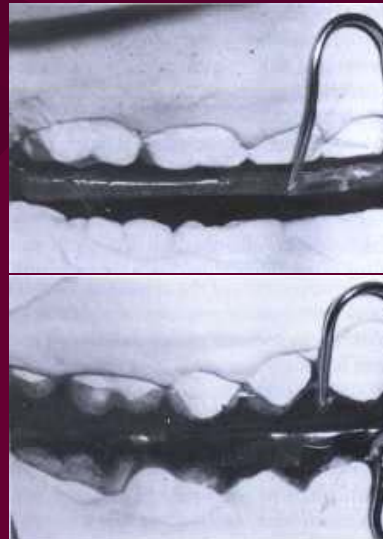
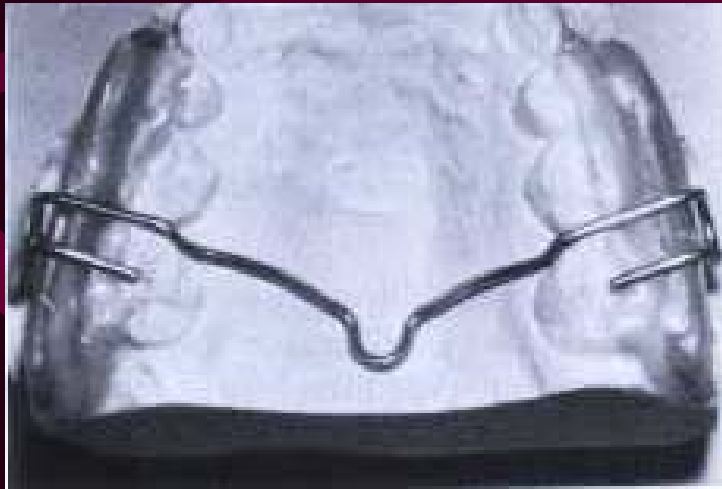


Components of FAs.

2. Tooth-controlling components

B. Vertical control

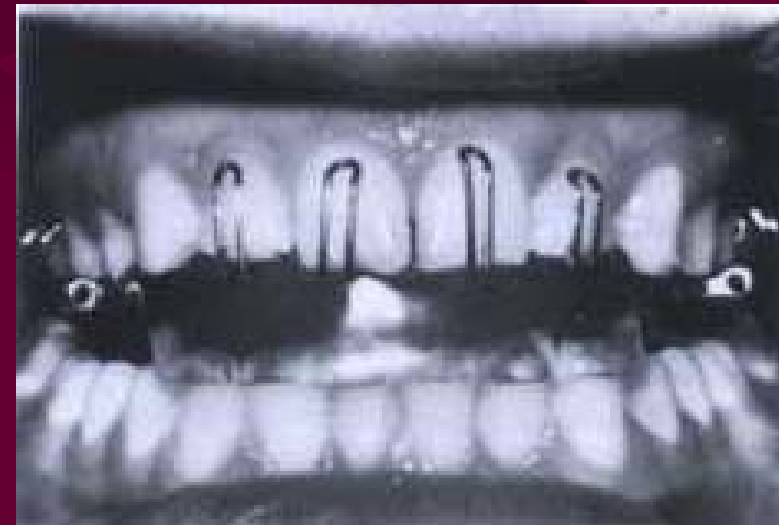
Occlusal stops & bite blocks



Components of FAs.

3. Stabilizing components

Clasps, labial bows & Ant. torquing springs



Clinical management of FA s.

1. Impression [different]

Appliance-soft tissue contact area clearly reproduced

NO soft tissue stretch during impression

2. Bite Registration

(4-6 mm advancement)

3-mm opening

5-6 mm for bite blocks



Clinical management of FA s.

4. Appliance Adjustments

- A) Trimming of interocclusal elements
- B) Adjustment of the labial bow (to reduce contact with ant. teeth)
- C) Outward bending of buccal shields and lip pads to facilitate arch expansion

Clinical management of FA s.

3. Decisions on Appliance Design

- A. What is desired in Tx.
- B. Cost and complexity considerations
- C. Vertical control
- D. Acceptability to the patient

Any Question

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