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RESEARCH ARTICLE

REMOVABLE MYOFUNCTIONAL APPLIANCES : AN OVERVIEW

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Abstract

Conventional orthodontic appliances use mechanical forces to modify the position of tooth/ teeth into a more favorable position. However, the scope of these fixed appliances are greatly restricted by certain morphological conditions which are caused due to deviations in the developmental process or the neuromuscular capsule surrounding the orofacial skeleton. To overcome this drawback, myofunctional appliances came into being. These appliances are considered to be primarily orthopedic tools to guide the facial skeleton of the growing child. The distinctiveness of these appliances lies in the fact that instead of applying active forces, they transmit, eliminate and guide the natural forces like, muscle activity, growth, tooth eruption, to eliminate the morphological abnormalities and try to generate conditions for the harmonious development of the stomatognathic system. So a humble effort has been made to briefly explain the Removable Myofunctional appliances.

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Introduction:-

Webster's dictionary defines "esthetic" as "appreciative of, responsive to, or zealous about the beautiful; having a sense of beauty or fine culture." Esthetics is not absolute, but extremely subjective. Esthetic concerns undoubtedly continue to remain at the forefront for a significant segment of patients seeking orthodontic treatment.¹ A straight smile is not only important for esthetics, but is also an integral part of maintaining oral health and proper function. World Health Organization estimates malocclusions as the third most prevalent oral health problem.²

Braces generally pop up in everyone's mind concerning malocclusions. However, early orthodontic treatment can help correct the way the jaw is growing and address malocclusion at an earlier stage. As the famous quote states "An ounce of prevention is always better than the pounds of cure", but in some cases where prevention is not possible, interception can be the next best cure. Intercepting problems early, allows us to avoid braces or even orthognathic surgeries in later stages of life. So there arises the importance of early orthodontic treatment by means of myofunctional appliances which helps the jaw to grow in a proper direction and this have been in practice since early 20th century.

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Myofunctional appliance induces skeletal growth modifications when used during periods of active growth of a child before or during occurrence of puberty and thereby halt disproportional growth by redirecting the growth of the upper and lower jaw. It envelopes an assortment of removable appliances designed to influence the function and position of the mandible by amending the arrangement of various muscle groups so as to redirect forces to the dentition and the basal bone. Therefore, by shifting the mandibular position sagittally and vertically, muscular forces are produced, thereby resulting in orthodontic and/or orthopedic changes.³

Although today, several myofunctional appliances are being developed, but the prototype appliances for learning purposes are essentially Activator and its modifications including Bionator, Functional regulator and Twin block. Thus in light of above knowledge a humble effort has been made to briefly explain the Removable Myofunctional appliances.

Mechanism Of Action

Various theories/hypothesis have been put forward to explain how functional appliance stimulate mandibular growth.

1. Muscular hypothesis
2. Viscoelastic hypothesis
3. Functional Matrix Hypothesis
4. Growth relativity hypothesis

Muscular Hypothesis

It was stated that the myotatic reflex or the stretch reflex activity of protractor muscles, especially the lateral pterygoid, keep mandible in forward direction, thereby stimulating the growth of mandible. This concept was formulated as the “muscular hypothesis” (1952) in order to provide theoretical foundation for mechanism of action of Andersen’s activator.

Basis for this hypothesis

Lateral Pterygoid Muscle Theory :

It was reported that the attachments of the lateral pterygoid muscle to the condylar neck or articular disk (Fig 1) may be expected to cause condylar growth by drawing the mandibular head forward. (Rees, 1952)⁴

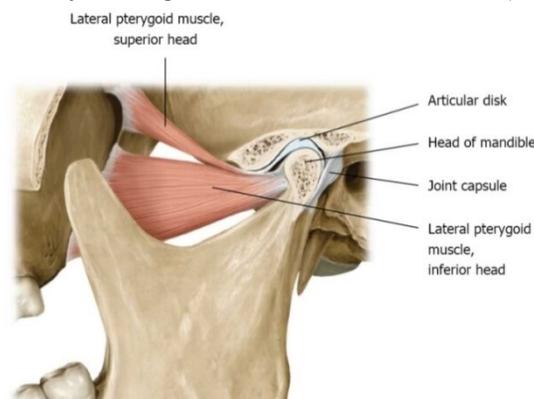


Figure 1:- Attachment of lateral pterygoid muscle to the articular disk.

Supporting Studies:

Many animals studies were conducted around 1950s to 1990s by Petrovic, Stutzmann (1975)⁵, McNamara JA Jr (1973)⁶, Kantomaa T, Ronning O (1982)⁷, Oudet C et al (1988)⁸ which confirmed this hypothesis.

Limitations:

Grude (1952)⁹ stated that lateral pterygoid muscle hypothesis is only possible with a slight bite opening. If there is increased stretching of muscles, then clasp knife response will take over the myotactic reflex. McNamara, Petrovic and Stutzmann (1970s, 1980s)^{5,6} stated that an appliance rigidly holding the mandible in an anteriorly displaced position does not activate any muscles and hence, does not stimulate condylar growth.

Pterygoid Response Theory:

When the mandible postures downward and forwards, there is an area of enormous cellular activity above and behind the condyle which is referred as **Tension Zone**. This area is quickly invaded by proliferating blood vessels and connective tissue. A new pattern of muscle behaviour is quickly established where by the patient finds it difficult and impossible to retract the mandible to its former retruded position. It was termed as '**Pterygoid Response**'. (McNamara and Petrovic 1980)¹⁰

1. Supporting Studies :Harvold, Woodside (1983)¹¹stated that pterygoid response was due to altered muscular balance resulting in 'tension zone' distal to condyle.
2. Limitations :This phenomenon can only be observed with functional appliances that are worn full-time like twin block appliance and fixed functional appliance.

B.Viscoelastic Hypothesis

According to proponents of viscoelastic hypothesis, the retrodiscal tissue is responsible for bony deposition in glenoid fossa or increase in length of condylar cartilage, not the lateral pterygoid muscle. Hence, any appliance which keeps the mandible forward (irrespective of how, actively or passively) will induce bone formation and subsequent increase in mandibular length.¹²

Basis for this hypothesis:

Herren, Harvold, and Woodside (1973)¹³Supported 'viscoelastic force' theory.

Limitations of the hypothesis:

This theory had to be revised because it failed to explain the exact role of fixed myofunctional appliances in growth enhancement ,as they could explain only the mechanism of removable myofunctional appliances.

C.Functional Matrix Hypothesis

The concept of Functional matrix theory was first introduced by Vander Klaawduring 1948-52. The fundamental basis for this hypothesis, laid out by Columbia anatomy professor Melvin Moss (1962, 1969, 1997)stressesthe ontogenetic primacy of function over form.¹⁴ He emphasized that length of mandible depends upon the size of oral capsule. Any increase in size of oral capsule will result in secondary bone deposition in TMJ region to keep unchanged relationship between temporal bone and mandible ('Carry away' phenomenon).

Basis for this hypothesis

Professor Rolf Frankel (1960)¹⁵ -Basis for this hypothesis came with the advent of his Functional regulator (also known as Frankel's appliance).

Enlow, Moffet and Graber (1996 , 1999)¹² - Confirmed the Frankel's findings that periosteal pull, which is a type of viscoelastic stretch has the potential to stimulate bone growth.

D.Growth Relativity Hypothesis

Growth relativity refers to growth that is relative to the displaced condyles from actively relocating fossae. The concept was proposed by John C. Voudouris in the year 2000. In his hypothesis, growth is discussed relative to long-term retention results, rather than short- term treatment outcomes that are different.¹⁶

Basis for this hypothesis :

Sessle, Woodside, Gurza, Powell, Voudouris and Metaxas (1990) -It was found that the condylar growth is actually related to decreased postural and functional lateral pterygoid muscle activity.¹⁷

The three main foundations promoting condylar growth are :

1. Displacement
2. Viscoelasticity
3. Referred force / Transduction

The concept that viscoelastic tissue forces can affect growth of the condyle suggests that modification first occurs as a result of the action of anterior orthopedic displacement. (Displacement). Second, the condyle is affected by the posterior viscoelastic tissues anchored between the glenoid fossa and the condyle, inserting directly into the condylar fibrocartilage (Viscoelasticity).Third and the most interesting aspect is the new bone formation some distance from the actual retrodiscal tissue attachments in the fossa by the transduction of forces over the

fibrocartilage cap of the condylar head.¹⁶ Hence this growth relativity theory totally discard any role of muscles in growth modification of mandible.

Concluding Hypothesis

After considering all these hypotheses/theories, Enlow and Hans (1996, 2001) presented an overall perspective suggesting that mandibular growth is a composite of regional forces and functional agents of growth control that interact in response to specific extracondylar activating signals.¹⁸ In other words, mandible grow under the influence of all these variables and therefore, it's growth cannot be attributed to any one particular.

Activator

Activator was one of the first functional appliances that was developed to correct functional jaw in the early 1900s (Fig 2). It was developed by Viggo Andersen in 1908 and he named it as "Biomechanical Retainer". The term "Activator" was coined by Viggo Andersen and Karl Haupl in the year 1936. Activator appliance became the universal appliance that was used widely throughout Europe in the earlier part of the 20th century.

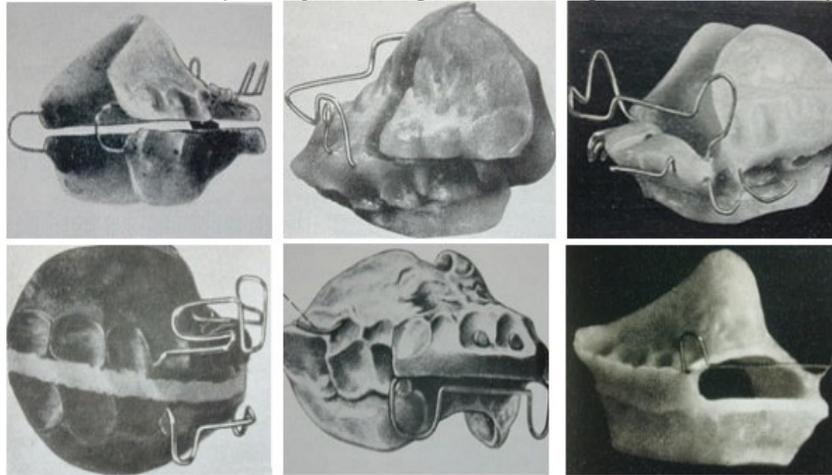


Fig 2:- Activator Appliance.

Indications For Activator Therapy

- Activators are indicated in moderate skeletal dysplasias between the midfacial area and the mandible in actively growing individuals with favourable facial growth pattern.³
- Well aligned maxillary and mandibular teeth should be upright over basal bone structures.
- Children with lack of vertical development in lower face height.
- It provides a useful preliminary treatment before major fixed appliance mechanotherapy.
- It can be indicated for post treatment retention in children with a deep overbite caused by overclosure.
- It can be used for cross bite correction.
- It can be a treatment option for snoring. It was found to be more effective than soft palate lifter mouth shield.^{19,20} (Swedish Dental Journal 1996)
- It can serve as a space maintainer in mixed dentition by extending the acrylic in to the space of missing tooth.

Contraindications For Activator Therapy

- Not useful in correction of class I and class II malocclusion with crowding as it doesn't perform detailed tooth positioning.
- In children with extreme lower anterior facial height as it tends to produce moderate mandibular rotations.
- In case where there is mandibular incisor procumbency at start of treatment.
- Children with nasal stenosis caused by structural problems within the nose or chronic untreated allergy.
- Has limited application in the non growing individuals.

Mode Of Action Of The Activator

The mode of action of Activator varies according to the construction of the appliance, especially depending on the mode of the construction bite.²¹ Depending on the construction of the appliance, we can differentiate between two modes of action:

Mode I : The forces generated in activator therapy are caused by muscle contractions and myostatic reflex activity. A loose appliance stimulates the muscles, and the moving appliance moves the teeth. The appliance applies intermittent forces utilizing the kinetic energy. For this mode of treatment, the “horizontal” activator (“H” type activator) is constructed, which is indicated in cases with horizontal growth pattern.

Mode II : The appliance is squeezed between the jaws in a splinting action. The appliance exerts forces that moves the teeth in this rigid position. The stretch reflex is activated, inherent tissue elasticity is operative, and strain occurs without intermittent movements. The appliance works using potential energy. For this mode of treatment, the “vertical” activator (“V” type activator) is constructed, with a high and only slightly forward-postured construction bite. It is indicated in cases with vertical growth pattern.

Methodology Of Activator Therapy For The Correction Of Class-Ii Division-1 Malocclusion

Initially dental changes predominate but later, there is an increase in SNB, decrease in SNA along with the skeletal effects. Following findings by McNamara and Moyers can be grouped into 6 categories:

- a. **Remodelling of mandibular condyle** - Adaptive changes in 3 general layers of condylar cartilage and surface changes at anterior aspect of posterior glenoid fossa can be appreciated.
- b. **Retardation or redirection of horizontal maxilla growth** - Basal area of maxilla are retarded in their normal forward development.
- c. **Mandibular rotation** - Increased height of mandibular alveolar process and variable degree of rate of eruption of teeth in buccal segment resulting in backward rotation of mandible. This may be compensated by vertical growth of condyles at a later age. An increase of lower anterior facial height is inevitable.
- d. **Dental arch changes** – Distal migration of maxillary molars is seen along with mesial migration of mandibular molars.
- e. **Altered eruption of teeth in buccal segments** - Vertical eruption of maxillary posterior teeth are inhibited. Eruption of antagonist can be undisturbed and free of occlusal imbalances.²²
- f. **Incisor tipping** – Anterior displacement of mandible occurs within dental arch in the incisor region.

Principle Of Therapeutic Trimming For Tooth Guidance

The aim of trimming is to achieve a loosely fitting appliance that patient can yet manipulate the one that maintains the sagittal relationship while stimulating or restricting selective eruption and movement of anterior and posterior teeth. The acrylic transmit the desired intermittent force and contact.²³The teeth are called guiding planes. The magnitude of force is determined by the amount of actual acrylic contacting the tooth surface. Larger the contacting surface, lesser is the force delivered.²⁴

Trimming for Vertical Control:

Intrusion of incisors can be achieved by loading the incisal edges of these teeth. Extrusion of incisors requires loading their lingual surfaces above the area of greatest concavity in the maxilla and below this area in the mandible. Extrusion of the molars can be facilitated by loading the lingual surfaces of these teeth above the area of greatest convexity in the maxilla and below this area in the mandible.

Trimming for sagittal control:

Protrusion and retrusion of the incisors can be accomplished only through grinding of the acrylic and guide planes and adjustment of the labial bow wires. By relieving pressure and muscle strains placed on the dentition by the lips and cheeks, the passive labial bow permits labial and buccal movements of teeth.²⁴

Advantages Of Activator Therapy

- a. Forces employed are physiological and produce no damage to teeth or supporting tissues.
- b. Intervals between adjustments are less (6.8 wks).
- c. Minimum hygiene and oral problems, minimum irritation and damage.
- d. Appliance worn at night.
- e. Appointments are brief.
- f. Uses existing growth of the jaws to the maximum.
- g. Provides in excellent control vertical direction particularly overclosure.
- h. Useful in correction of malocclusions associated with habits Thumb sucking, Tongue thrusting.
- i. After treatment appliance, itself acts as a retainer saving cost & professional time.
- j. Cost factor is low.

Disadvantages

- Careful case selection.
- No detailed precise finishing of occlusion.
- Patient compliance is required for successful treatment.

Modifications Of Activator

Modifications of activator appliance^{25,26,27,28} is as follows :

- Bimler Appliance (1949)
- The Kinetor (1951)
- Herren's Activator (1953)
- The Bow Activator Of A.M. Schwarz (1956)
- Elastic Open Activators (1960)
- U Bow Activator Of Karwetzky (1964)
- The Propulsor
- Harvold Woodside Activator (1971)
- The Reduced Activator Or Cybernator Of Schmuth
- Cut Out Or Palate Free Activator (1974)
- Teuscher-Stockli Activator/ Headgear Combination Appliance (1978)
- Van Beek Activator (1982)
- Reactivator Appliance

Bionator

Bionator (fig 3) was referred as the "skeleton of an activator" which was less bulky and elastic and permitted day and night wear (Except during meals). Bionator was developed by Professor Wilhelm Balter in the year 1950.²⁹



Fig 3:- Bionator.

Main Objective Of The Appliance

Main objective was to establish a muscular equilibrium between the forces of the tongue and outer neuro-muscular envelop. Bionator does not activate the muscle but modulates muscle activity thereby enhanced normal development of inherent growth pattern and eliminates abnormal and potentially deforming environmental factors.

Indications Of Bionator

- Class II div 1 MO in mixed dentition where there is no crowding, rotation ,etc
- Used in Open bite cases
- Used in Class III MO, TMJ problems in adults

Contraindications

- In Class II relationship if it is caused by maxillary prognathism
- In vertically growing patients
- Labial tipping of lower incisors.

Construction Bite

Bite is positioned in an edge to edge relationship as bionator cannot make allowances for facial pattern and growth direction. Balter reasoned that high construction bite drops the mandible open, tongue instinctly moves forward to maintain an open airway leading to tongue thrust. Since the bite is not opened, myotactic reflex activity is stimulated and loose appliance works with kinetic energy.

Bionator Types

Three types are present, which are as follows,

- a. The standard appliance
- b. Open bite bionator
- c. Reversed bionator for class III.

Standard Bionator

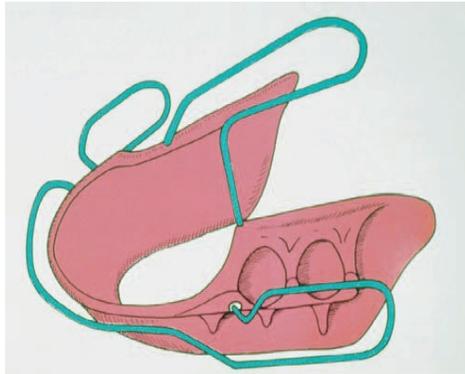


Fig 4:- Standard bionator.

Standard bionator (fig 4) is used in the treatment of class II division I malocclusion in order to correct the backward position of the tongue and its consequences and for the treatment of narrow dental arches of class I malocclusion. Components of the standard bionator are:

Wire components

Palatal arch:

The palatal arch (fig 5), emerges opposite the middle of the first premolars on the palatal side, follow the contour of the palate joining a curve that extends till the distal surface of the first permanent molar. The palatal arch is placed 1 mm away from the palatal mucosa and it helps in orientation of the tongue and directing mandible anteriorly to achieve class I relationship.

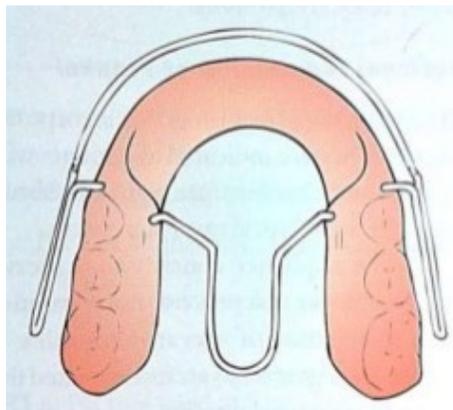


Fig 5:- Palatal arch.

Vestibular wire:

(fig 6) It emerges from the acrylic below the contact point between the maxillary canine and maxillary first premolars. It runs vertically and is bent at right angles and made to run distally along the middle of the maxillary

premolars crowding mesial to the first molar, rounded bend is made so that the wire runs at the lower papilla up to the mandibular canine where again it is bent to reach the maxillary canines. It forms a mirror image on the opposite side. The vestibular wire is kept free from the surface of the incisor teeth anteriorly and is kept sufficiently away from buccal surface of posterior teeth on either side of the arch to allow lateral expansion.

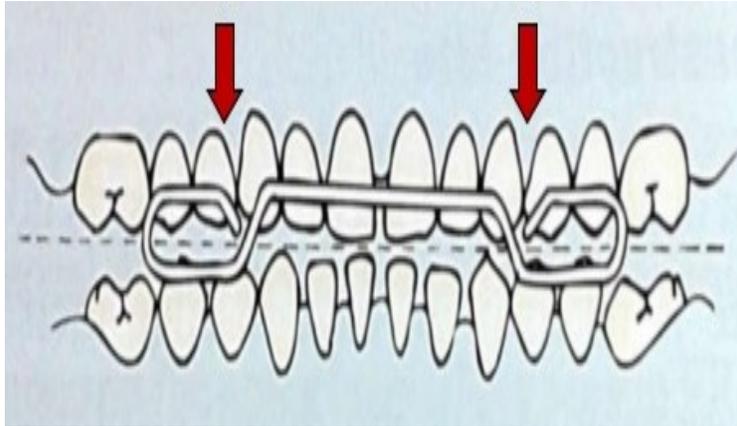


Fig 6:- Vestibular wire.

Acrylic component

1. **Maxillary acrylic part:** covers only the molars and the premolars with the anterior region remaining uncovered.
2. **Mandibular acrylic part:** horseshoe-shaped acrylic lingual plate extending from the distal of the last erupted molar to the corresponding point on the other side.
3. **Interocclusal acrylic:** The interocclusal space of some of the buccal teeth is filled with acrylic extending arch half of the occlusal surface of the teeth to stabilize the appliance.

b. OpenbiteBionator

The Bionator II (fig 7) was designed to correct anterior Open bites in Class I and Class II malocclusions. The posterior teeth were covered with acrylic to prevent their eruption. The acrylic was kept away from the incisors to allow closure of the open bite. The midline expansion screw can be used for arch development when its indicated.



Fig 7:- Bionator II or Open bite bionator.

Components of the open bite bionator are:

Wire Components:

The palatal arch wires and vestibular wires (fig 8) are same as that of palatal arch wire and vestibular wires of standard bionator.

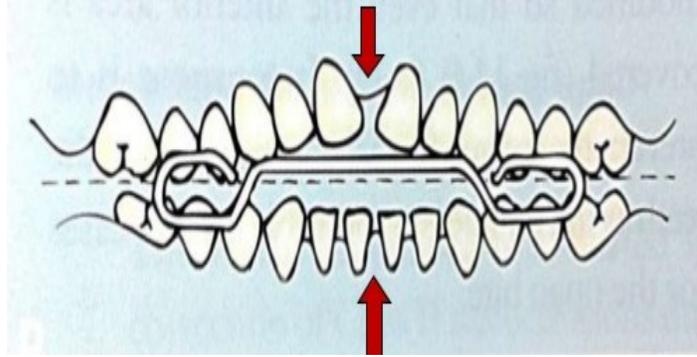


Fig 8:- Vestibular wire in Open bite bionator.

Acrylic Components:

The maxillary acrylic portion is modified so that even the anterior area is covered to prevent tongue thrusting. Other two acrylic components are same as that of a standard bionator.

c. ClassIII Or Reverse Bionator

Class III bionator is also known as reverse bionator (fig 9) and is used for the treatment of Angle's Class III malocclusion caused due to mandibular prognathism. Class III / Reverse Bionator is used to encourage development of the maxilla.

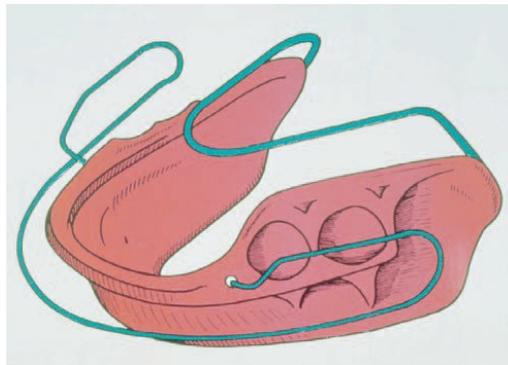


Fig 9:- Reverse Bionator.

Components of the Class III or Reverse Bionator are:

Wire components

Palatal arch wire:

It is placed in the opposite direction as that of the standard bionator. (Fig 10)

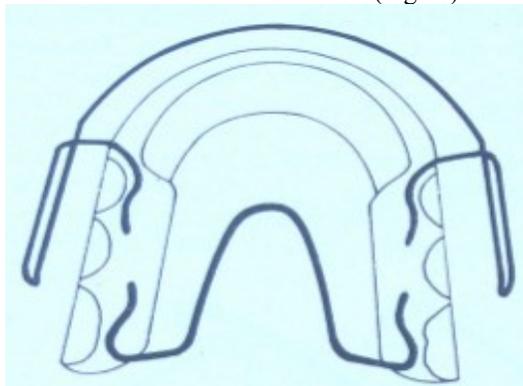


Fig 10:- Direction of palatal arch wire in reverse Bionator.

Vestibular wire:

The vestibular wire (fig 11) in the anterior region is made to run over the lower incisors instead of terminating at the lower canines.

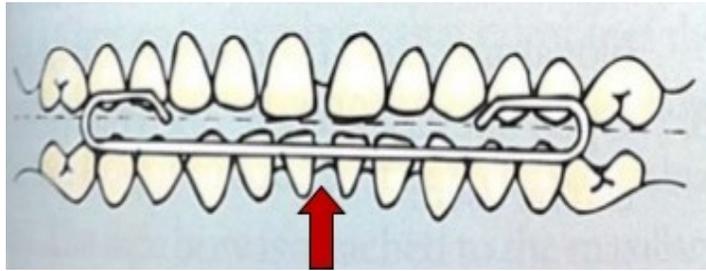


Fig 11:- Vestibular wire in Reverse bionator.

Acrylic Components:

Exactly similar to that of acrylic components of standard bionator.

4.6 Successful Treatment Considerations

- The appliance should be loose and should fall when the mouth is open.
- The time interval between office visits is 3 to 5 weeks depending upon the state of eruption of the tooth.
- The labial bow should be checked to ensure that it touches the teeth only lightly.
- The buccinator loops should be away from the deciduous first molars but should not irritate the cheeks.
- In accordance with the plan of anchorage, a growth promotion, loading and unloading of acrylic areas can be done depending on the teeth to be stimulated.

4.7 Advantages

- It can be worn both day and night.
- It is less bulky than activator.
- It has a constant influence on the tongue and perioral muscles because of longer wear time.
- Action is faster than the activator.
- Constant wear results in rapid sagittal adjustment of the musculature to forward mandibular position

4.8 Disadvantages

- Abnormal tongue function can be secondary ,adaptive or compensatory because of skeletal maldevelopment and difficulty in correctly managing it.
- Careful case selection is essential for successful treatment results.

5. FRANKEL APPLIANCE

Frankel appliance, also known as functional regulator (fig 12a), was a removable orthodontic appliance developed by Professor Rolf Frankel (fig 12b). This appliance was used during the mixed and early permanent dentition stages to effect changes in anteroposterior, transverse, and vertical jaw relationships.

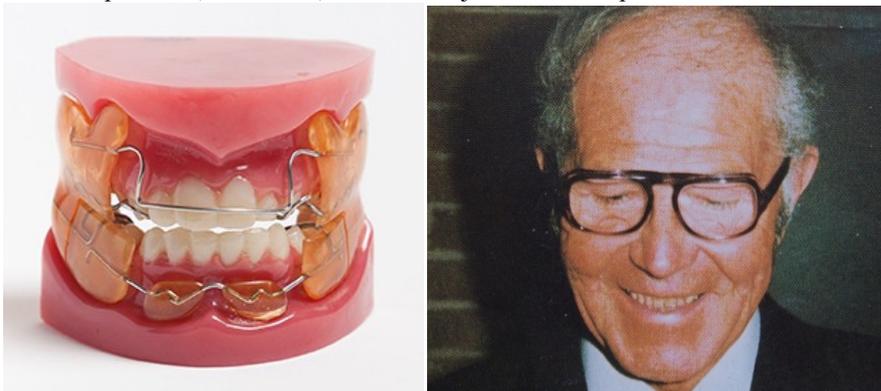


Fig 12:- a) Frankel Appliance ; b) Dr. Rolf Frankel.

Objective Of Appliance

There is considerable evidence that postural disorders of the orofacial musculature play a significant role in the causation of dento facial disharmony . The aim of frankel appliance is to identify the faulty performance of orofacial musculature and to correct it by orthopedic exercises. Therefore frankel appliance is an effective muscle trainer of the orofacial musculature.¹⁵

Indications

- a. Age group of 8-10 years (mixed dentition period)with growth spurts.
- b. Skeletal class II malocclusion with prognathic maxilla and retrognathic mandible.
- c. Functional class II malocclusion in a horizontal or neutral growth vector case.
- d. Class III malocclusions
- e. Bimaxillary protrusion and open bite problems.
- f. Functional retrusion , deep over bite , and excessive interocclusal problems with a normally positioned maxillae.

Contraindications

- a. Class II malocclusion with severe crowding
- b. Patients having thumb sucking habit
- c. Patients with severe dentoalveolar problems in permanent dentition.
- d. In uncooperative patients

Types Of Frankel Appliance

There are five types of Frankel's appliances¹⁵:

- a. **FR-I**
 - i. **FR-I a** : Treating Angle's class I malocclusion with deep bite.
 - ii. **FR-I b** : Indicated for treating the cases of Angle's class II division 1 malocclusion where the overjet does not exceed 5 mm.
 - iii. **FR-I c** : Indicated for treating the cases of the Angle's class II division 1 malocclusion where the overjet is more than 7 mm.
- b. **FR-II** : Indicated for treating cases of Angle's class II division 1 malocclusion and class II division 2 malocclusion.
- c. **FR-III** : Indicated for Angle's class III malocclusion.
- d. **FR-IV** : Indicated for treating bimaxillary protrusion and open bite.
- e. **FR-V** : It is used with headgear.

Parts Of The Frankel Appliance

Acrylic parts



Fig 13:- Acrylic parts of Frankel Appliance a) Buccal Shield, b) Lip pads, c) Lingual shield.

Buccal shield:

Extends deep into the sulci away from the lateral aspects of the teeth and the alveolus whenever expansion of dental arch and the alveolar process is required. Its thickness shouldn't exceed 2.5 mm. (fig 13)

Functions:

It expands the circum-oral capsule in the lateral direction, therefore, forcing the respective soft tissues to adapt in structure. Muscles of the cheeks are forced to adapt its functional performances with relation to the outer surface of the buccal shields.

Labial Pads :

The upper edges should have a distance of at least, 5 mm, from the gingival margin to prevent the stripping of the labial gingiva. While the distal edges, shouldn't overlap the labial protruberances, of the canine root which render speaking difficult and irritates the mucosa of the lower lip.

Functions :

Supporting effect on the lower lip, smoothening out of the mento-labial sulcus improves lip posture helps in the establishment of a competent lip seal

Lingual Shield :

Lingual shield lies lingually, below the gingival margin of the mandibular teeth and distal to the roots of the second premolars distally. Lingual cross over wires stabilize and secure the position of the lingual shield by connecting it with the buccal shields on either side.

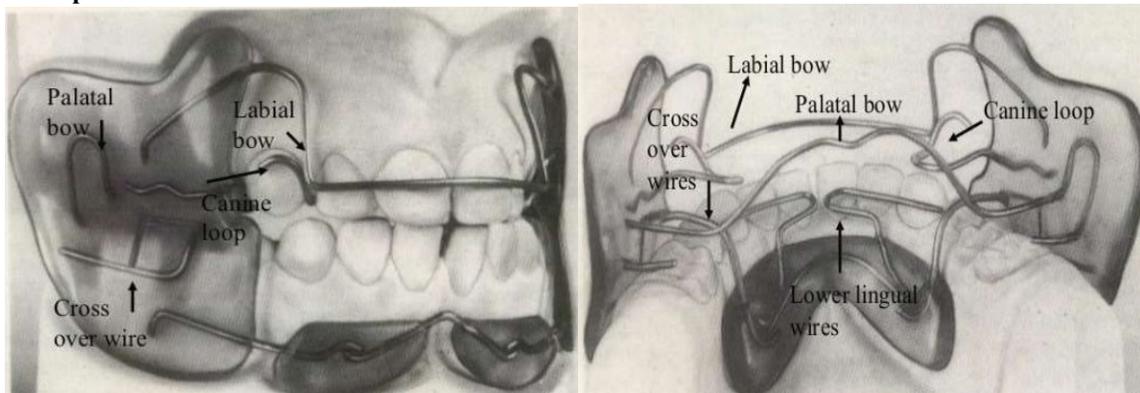
Wire Components

Fig 14:- Wire components Of Frankel appliance.

Vestibular wires :

Vestibular wires are not located within the acrylic shields. It should be at an appropriate distance from the outer, aspect of the alveolus not exceeding 1 ½ mm. They follow the depression of the labial surface of the alveolar process. (fig 14)

Function:

They connect the lip pads and the buccal shields and secure their position in the vestibule.

Labial Wire :

Labial wire lies in the middle of the labial surfaces of the maxillary incisors and runs gingivally at right angles in the natural depression between the roots of the lateral incisor and the canine. It forms a gentle curve, distally at the height of the middle of the canine root.

Functions :

Major functions include connecting and stabilizing the appliance. It helps in tooth movements, whenever it contacts the maxillary incisors.

Palatal Bow:

crosses the palate with a slight curve in the distal direction and runs inter dentally between the maxillary first molar and second premolar. It forms a loop in the buccal shield and emerges to form an “occlusal rest” on the buccal cusps of the molars.

Functions:

Major functions include connecting and stabilizing. Inter proximal portion provides, intermaxillary anchorage. Also prevents superior displacement, i.e, preventing a displacement in the vertical direction.

Canine Loop :

Canine loops are embedded with its tags in the buccal shield at the level of the occlusal plane and has to rise steeply to the gingival margin of the maxillary first premolar. It runs palatally to the lingual surface of the canine for a distance of about 1 mm and then crosses the interproximal contact between the canine and the lateral incisors.

Functions :

Labial portion keeps perioral tissues away from the canine and provides space for the lateral movement of the canine. It is used for the tooth movement of anteriorly or buccally displaced cusps and serves as a guide to prevent its malpositioning during eruption.

Lower Lingual Wires:

Two lower lingual wires have been attached to the lingual shield to pass along the lingual surface of the incisors at the level of the cingulum.

Functions:

It stabilize the mandibular incisors against lingual movement and in deep bite to prevent further eruption.

Methodology Of Frankel Therapy

The following are the changes that can be appreciated with the Frankel appliance:

- a. **Increase in intra oral space:** It is achieved primarily through buccal shields and lip pads which eliminate the harmful mechanical forces on the pressure sensitive membranous structures.
- b. **Vertical space increase :**It is possible because the construction bite is taken, so that the bite is opened in the posterior segments as the mandible is held forward.
- c. **Mandibular protraction :** The position of the mandible is changed through the gradual training of the protractor and retractor muscles followed by condylar adaptation.
- d. **Muscle function adaptation :** Development of new patterns of motor function , improvement of muscle tones and establishment of proper oral seal.

Wear Time Of The Appliance

Although the Frankel appliance has to be worn all the time except for the meals the treatment should be started slowly, for the first two weeks the appliance should be worn for 2 to 4 hours during the day.¹⁵ During the next 3 weeks the time is extended to 4 to 6 hours. It usually takes 2 months before the appliance is worn at night. The appliance and treatment progress should be checked at 4 weeks interval. An initial end to end molar relationship is corrected in 6 months. Optimum time to start the treatment is the mixed dentition period. (8 to 10 year age)

Advantages

- a. It enables elimination of abnormal muscle function thereby aiding in normal development.
- b. Treatment can be initiated at early age .
- c. Less chair side time is spent.
- d. The number of patient recalls are less.
- e. They do not interfere with oral hygiene status.
- f. Duration of treatment is comparatively less. They deal with skeletal as well as dento- alveolar problems.

Disadvantages

- a. The appliance is bulky and the cooperation of the patient is essential.
- b. They cannot be used in adult patients were the growth has ceased.
- c. Cannot be used to bring about individual tooth movement and in cases of crowding.

d. Fixed appliance therapy may be required at the termination of treatment for final detailing of the treatment.

Twin Block

Twin block (fig 15 a) was developed by William J Clark (fig 15 b), a Scottish orthodontist, in the year 1977. These are simple bite blocks designed to be worn 24 hours a day.

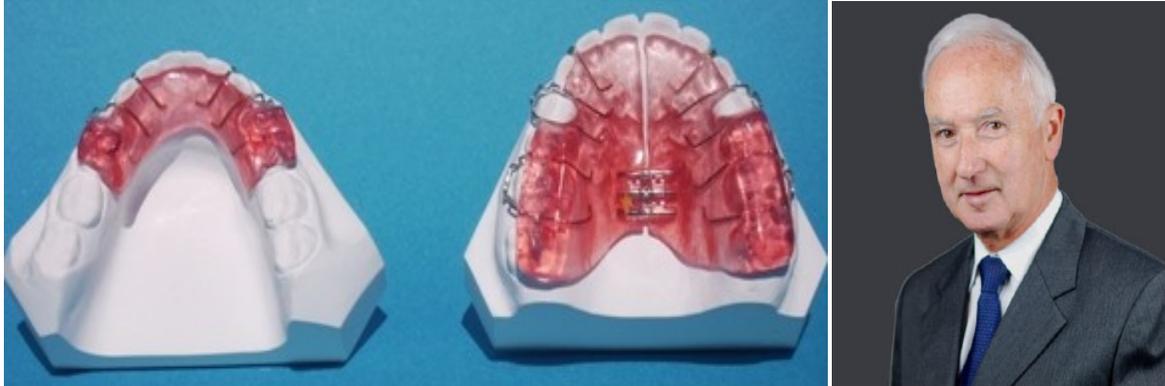


Fig 15:- a) Twin block appliance ; b) Dr. William J Clark.

Objective Of The Appliance

The inclined planes (fig 16) formed by cusps of the upper and the lower teeth represent a servo-mechanism that locks the mandible in a distally occluding functional position. The proprioceptive sensory feedback mechanism controls muscular activity and provides a functional stimulus or deterrent to the full expression of mandibular bone growth.³⁰ This unfavourable cuspal contacts of distal occlusion represent an obstruction to normal forward mandibular translation in function, and as such do not encourage the mandible to achieve its optimum genetic growth potential. A functional equilibrium is established under neurological control in response to repetitive tactile stimulus. Occlusal forces transmitted through the dentition provide a constant proprioceptive stimulus to influence the rate of growth and trabecular structure of the supporting bone.

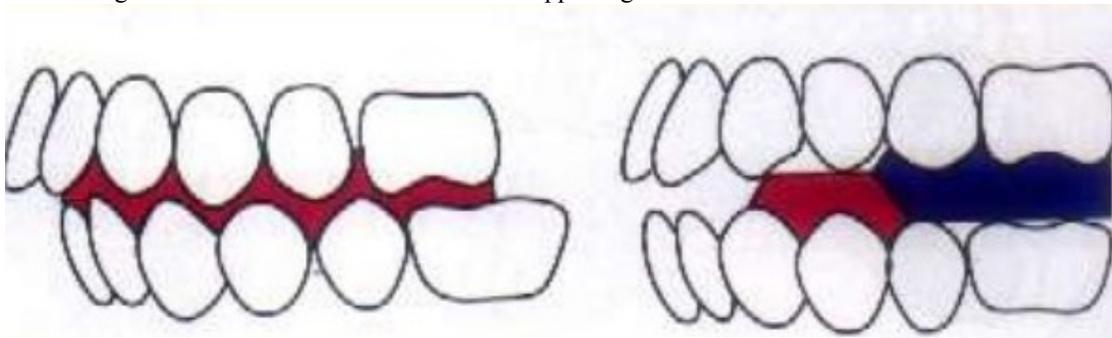


Fig 16:- Inclined planes.

Indications

- Treatment of uncrowded permanent dentition with class II div 1 with an overjet of 10 - 12mm and a deep overbite
- Designed to correct class II skeletal relationship, to correct molar relationship & to correct overjet
- Patient should be in growing age for favourable skeletal change
- Class II div 1 in mixed dentition period, with anterior open bite and with deep overbite
- Class II div 2 malocclusion
- Class III malocclusion

Contraindications

- Cases with vertical growth and crowding that may require extractions
- If profile doesn't improve when mandible is advanced that is a clear contraindication for functional mandibular advancement

Types Of Twin Block

A. Standard Twin Block

Standard twin blocks (fig 17) are used in the treatment of Class II div I malocclusion. Appliance design have been simplified over the years to simplify the appliance and increase the patient acceptance without reducing their efficiency.³¹

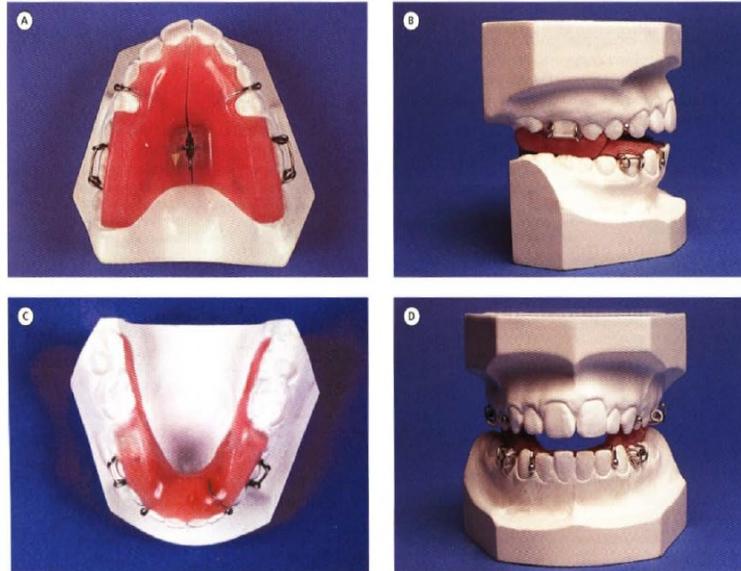


Fig 17:- Standard Twin Block.

Parts

1. **Labial Bow** :labial bow is not always required unless it is necessary to upright severely proclined incisors, and even then it must not be activated until full functional correction is completed and a class I buccal segment relationship is achieved.
2. **Delta Clasps** :improve retention, reduce metal fatigue and minimize the need for adjustment.
3. **Ball end Clasps** :Placed usually mesial to lower canine and in the upper premolar or deciduous molar region to gain interdental retention from adjacent teeth.
4. **Base Plate** :Appliance can be either made with heat cure or cold cure acrylic. Heat cure acrylic has the added advantage of additional strength and accuracy. Cold cure acrylic has the advantage of speed and convenience
5. **Occlusal Inclined Planes** :The position of the inclined plane is determined by the lower block and is critical in treatment of deep overbite. It is important that the inclined plane is clear of the mesial surface contact with the lower molar, which must be free to erupt unobstructed in order to reduce the overbite.
6. **Activation of the standard twin block**
 - i. **Active Phase** : Average time 6-9 months to achieve full reduction of overjet to a normal incisor relationship and to correct the distal occlusion. If the overjet is greater than 10mm it is advisable to step the mandible forwards, usually in the two stages. The activation brings the incisors to an edge-to-edge relationship.
 - ii. **Support Phase** : 3-6 months for molars to erupt into occlusion and for premolars to erupt after trimming the blocks. The objective is to support the corrected mandibular position after active mandibular translation while the buccal teeth settle fully into occlusion.
 - iii. **Retention Phase** : 9 months, reducing appliance wear when the position is stabilised. An average estimate of treatment time is 18 months, including retention.

Sagittal Twin Block

In the treatment of Class II division 2 malocclusion, twin block design is modified by the addition of sagittal screws (fig 18) to advance the upper anterior teeth. Control of the vertical dimension is achieved by sequentially adjusting the thickness of the posterior occlusal inclined planes to control eruption.³⁰

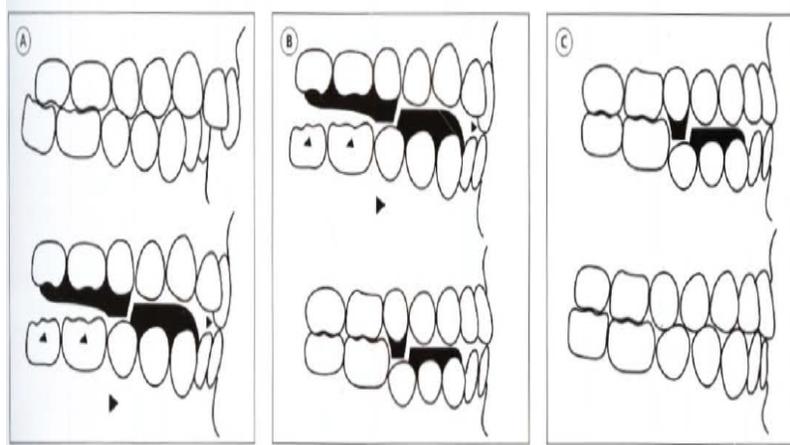


Fig 18:- Correction of Class II Division 2 malocclusion by advancing the mandible and proclining the upper incisors with sagittal screws.

Parts

The parts such as the labial bow, delta clasps, ball end clasp and occlusal inclined plane are similar to that of standard twin block appliance.

Screws incorporated on the base plate:

Some oblique movement is also possible by offsetting the angulation of the screws to achieve an additional component of buccal expansion. (fig 19)

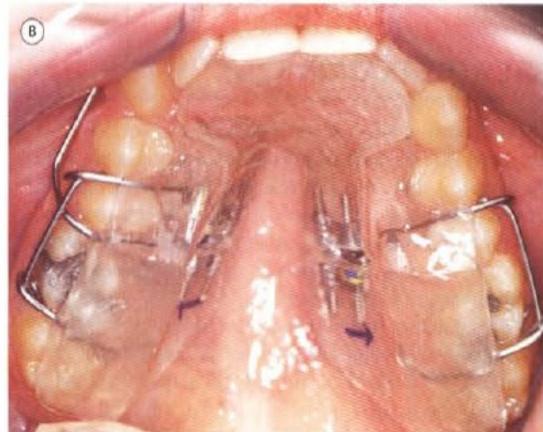


Fig 19:-Sagittal Twin block.

The lower twin block sagittal appliance applies similar principles in the lower arch. To advance the lower labial segment, curved screws are placed in the lower canine region, or to open premolar spaces, straight screws are placed in the second premolar region.

Activation of the Sagittal Twin Block:

Both palatal screws are opened two quarter-turns per week, once mid week and once at the weekend. This maintains the contact of the appliance on the lingual of the upper incisors, and is effective in advancing these teeth to release the mandible from its retrusive position, locked in distal occlusion.³² The upper bite block is progressively trimmed (fig 20) posteriorly to clear the occlusion for molar eruption in the early stages. When the molars are in occlusion, the lower appliance is gradually trimmed occlusally to allow lower premolar eruption to reduce the lateral open bite.^{33,34}

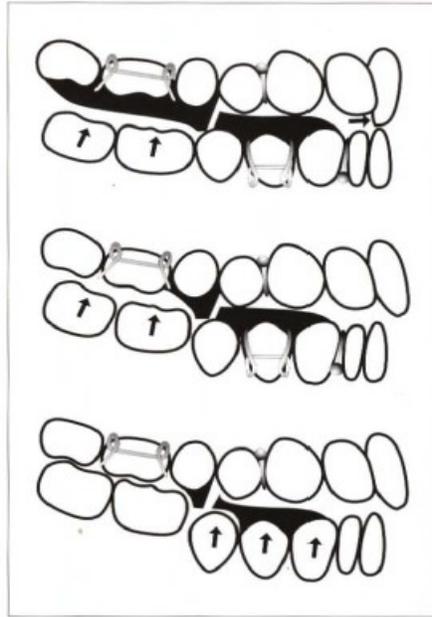


Fig 20:- Sequence of trimming blocks for Class II division 2.

Methodology of Twin Block in correction of class II malocclusion

The treatment effects are :

- Forward growth/repositioning of the mandible is seen after twin block therapy.
- Increase in SNB angle.
- Little change in SNA angle indicating maxillary restraint, but was not detected because of dentoalveolar remodeling disguising the skeletal effect.
- Forward growth/repositioning of the mandible does result in a significant change in ANB, thus severity of the class II skeletal pattern is reduced.
- Increase in lower anterior facial height.
- Dental changes as a result of Twin Block therapy includes overjet reduction, retroclination of the upper incisors, proclination of the lower incisors.
- Buccal segment correction occurred by distal movement of the upper molars lower molar eruption in an anterior and superior direction.

Reverse Twin Block

Treatment of Class III malocclusion is achieved by reversing the occlusal inclined planes to apply a forward component of force to the upper arch and a downward and distal force to the mandible in the lower molar region. The position of the bite blocks in reverse twin blocks (fig 21) are reversed compared to twin blocks for class II treatment.



Fig 21:- Reverse Twin Block.

Parts

The parts such as the labial bow, delta clasps and ball end clasp are similar to that of standard twin block appliance.

Occlusal Inclined Planes

Reverse twin blocks are designed to encourage maxillary development by the action of reverse occlusal inclined planes cut at a 70° angle to drive the upper teeth forwards by the forces of occlusion and at the same time, to restrict forward mandibular development.

Screws incorporated on the base plate:

The sagittal design is used to advance the upper incisors to correct the lingual occlusion in treatment of Class III malocclusion (fig 22).

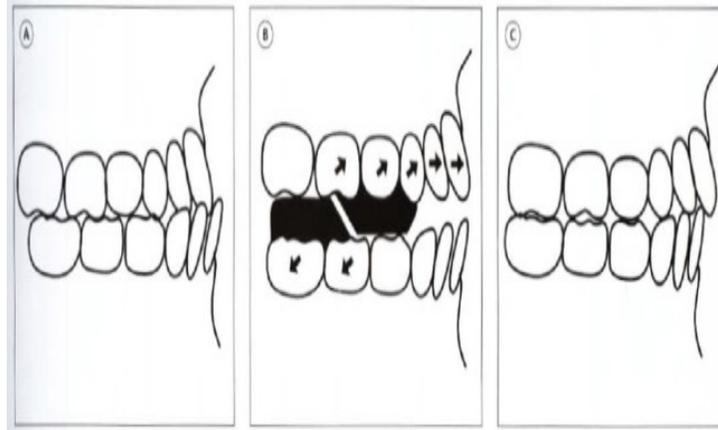


Fig 22:- Reverse Twin Blocks for correction of Class III malocclusion with sagittal screws to advance upper Incisors.

Lip pads :

To enhance the forward movement of the upper labial segment, lip pads may be added to support the upper lip clear of the incisors with an action similar to that of the Frankel III.

Activation of the Reverse Twin Block Appliance

Opening of screws has the reciprocal effect of driving the upper molars distally and advancing the incisors. Distal movement of the upper molars is resisted by occlusion of the lower bite blocks on the reverse inclined planes.

Methodology of Reverse Twin Block in correction of class III malocclusion

The treatment effects are :

- a. Retroclination of lower incisors.
- b. Proclination of upper incisors.
- c. Increase in SNA, ANB, MM angle
- d. Decrease in SNB and overbite
- e. Decrease in overbite.

Advantages

- a. Less interface with normal functions
- b. no visible anterior wires without losing efficiency in correction of arch relationships.
- c. Patient compliance is better
- d. Facial appearance is noticeably improved when twin blocks are fitted.
- e. Patients can learn to speak normally with twin blocks.
- f. Adjustment and activation is simple.
- g. The appliances are robust and not prone to breakage.
- h. Chair side time is reduced in achieving major orthopedic correction.
- i. Twin blocks allow independent control of upper and lower arch width.

- j. Twin blocks achieve excellent control of the vertical dimension in treatment of deep over bite and anterior open bite.
- k. Asymmetrical activation corrects facial and dental asymmetry in the growing child.
- l. Achieve more rapid control of malocclusion because they are worn full time.

6.7 Disadvantages

- a. Mandibular incisor proclination
- b. An increase in the vertical facial dimension is seen
- c. Clockwise rotation of maxillary plane

Conclusion:-

Myofunctional appliances are used to develop arches and to move mandibles or maxillae forward. They employ a non-extraction technique and were developed in Europe in the early 1900s. For over 100 years, clinicians worldwide have been using these appliances to improve facial esthetics in patients. Myofunctional appliances were originally used to bring the lower jaw forward and thereby improve the patient's esthetics. More recently, bringing the lower jaw forward has been shown to improve TMJ health as well as prevent snoring and sleep apnea later in life.

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