

# Removable Functional Appliances

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**Abstract:** Malocclusion Functional appliances or myofunctional appliances are referred to appliances that depend upon the oro facial musculature for their action. These appliances transmit, eliminate or guide the natural forces of the musculature and are used to alter the mandibular position in the Sagittal, Vertical and Transverse plane resulting in Orthopedic and Orthodontic change. They are designed to alter the activity of various muscle groups that influence the function and position of the mandible in order to transmit forces to the dentition and the basal bone. Functional appliances are given in the management of skeletal class II malocclusion and Class III malocclusion in growing children. They are also called “GROWTH MODIFYING APPLIANCES” and “INTERCEPTIVE APPLIANCES.

They are used for growth modification procedures that are aimed at intercepting and treat in jaw discrepancies by increase or decrease in jaw size, change in spatial relationship of the jaws, change in direction of growth of the jaws and acceleration of desirable growth. A new pattern of function dictated by the appliance leads to development of corresponding new morphologic pattern. The new morphologic pattern includes a different arrangement of the teeth within the jaws, an improvement of the occlusion and an altered relation of jaws. There are different removable functional appliances which harness natural forces of oro facial musculature that are transmitted to the teeth and alveolar bone through the medium of appliances such as oral screen, lip bumper, activator, bionator, frankel's functional regulator, twin block appliances etc.

**Keywords-** *Activator, Bionator, Frankel's functional regulator, Twin block appliance.*

## I. INTRODUCTION

Malocclusion A Myofunctional appliance is defined as a loose fitting or passive appliance which harnesses the natural forces of the orofacial musculature that are transmitted to the teeth & alveolar bone in a predetermined direction through the medium of the appliance.

A functional appliance refers to a variety of appliances designed to alter the arrangement of various muscle groups that influence the function & position of the mandible in order to transmit forces to the direction of the basal bone<sup>1</sup>.

### History of development of Functional Appliances<sup>2</sup>

- Norman Kingsley in 1879 gave the “bite-jumping” appliance

- Pierre Robin in 1902 gave the monobloc
- Viggo Andresen in 1908 gave the Activator
- Emil Herbst in 1934 gave the Herbst appliance
- Wilhem Balter in 1960 gave the Bionator
- Hans Bimler in 1964 gave the Bimler's appliance
- Rolf Frankel in 1967 gave the Frankel's appliance
- William J Clark in 1977 gave the Twin Block appliance

### **Classification of Functional Appliances**

#### **1. Proffit<sup>3</sup> classified it as**

- A. Tooth borne passive appliances (e.g., activator, bionator)
- B. Tooth borne active appliances (e.g., appliances incorporating active springs and screws)
- C. Tissue borne appliances: mostly located in the vestibule. (eg., frankel's functional regulator)

#### **2. Depending on the degree of displacement of the mandible – Graber and Neumann<sup>4</sup>**

a. **Myo-dynamic Appliance** – displace the mandible to a moderate extent, and are intended to stimulate muscle activity Eg: activator

b. **Myo-tonic Appliance** – it rely on the elastic properties of the muscle and fascia for their action, displace the mandible extremely. eg Bimler's Appliance, Harvold's Activator, Herren's Activator.

#### **3. As given in GRABER AND NEUMANN<sup>4</sup>,**

- a. Group I appliance - that transmits muscle forces directly to teeth. Eg: oral screen, inclined plane
- b. Group II appliance -that reposition the mandible and the resultant force is transmitted to the teeth and other structures. Eg: activator
- c. Group III appliance -these also reposition the mandible, but their area of operation is the vestibule Eg: Frankel's Functional Appliance.

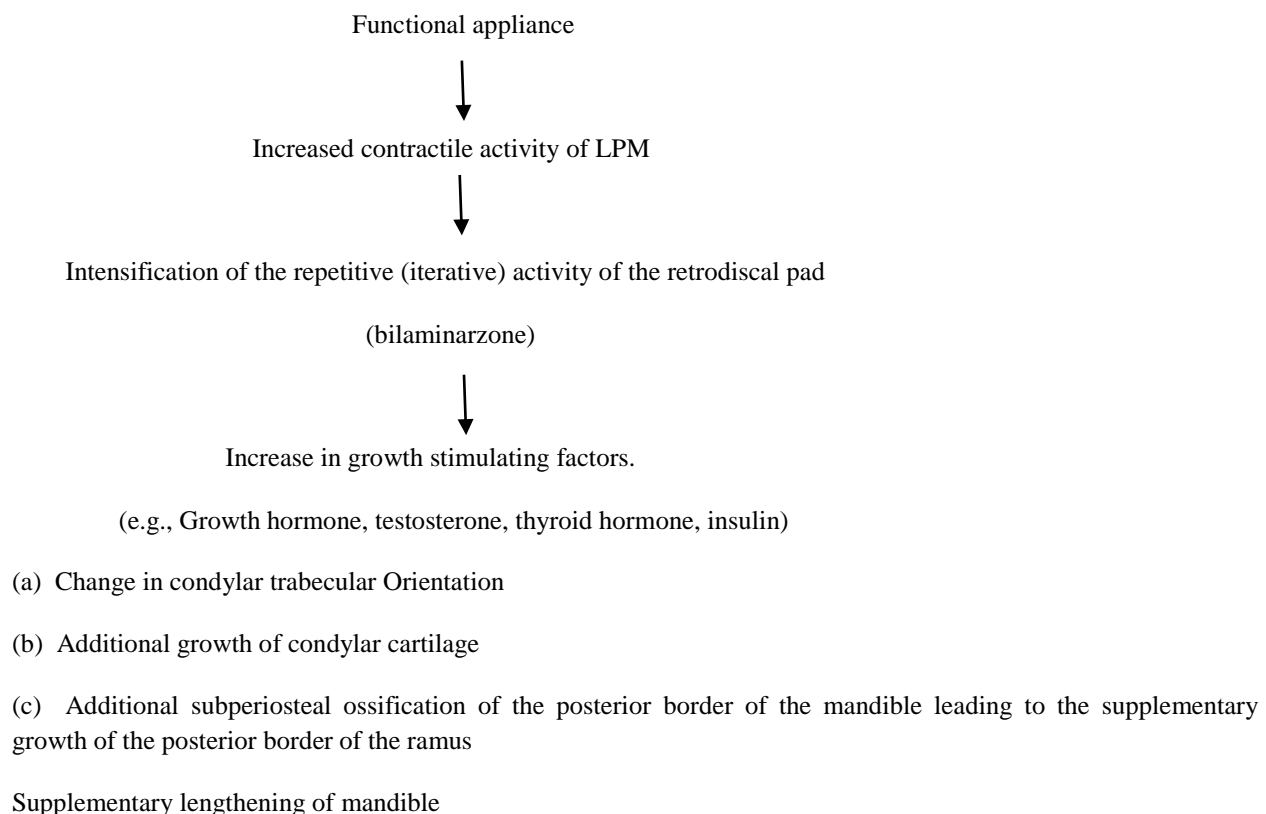
#### **4. As given by Vig and Vig<sup>5</sup>:**

Classification is based on the components that each appliance incorporates:

- 1) Bite planes- produce differential eruption.

- 2) Lip/cheek shields- which alters the linguofacial muscle balance
- 3) Working bite- which affects the mandibular posture
- 5. Based on whether the appliance is removable or fixed
  - a. Removable functional appliance -(e.g., activator)
  - b. Fixed functional appliance -(e.g., herbst, jasper jumper appliances)

## **II. BASIC STEPS INVOLVED IN THE MODE OF OPERATION OF FUNCTIONAL APPLIANCES<sup>4</sup>**



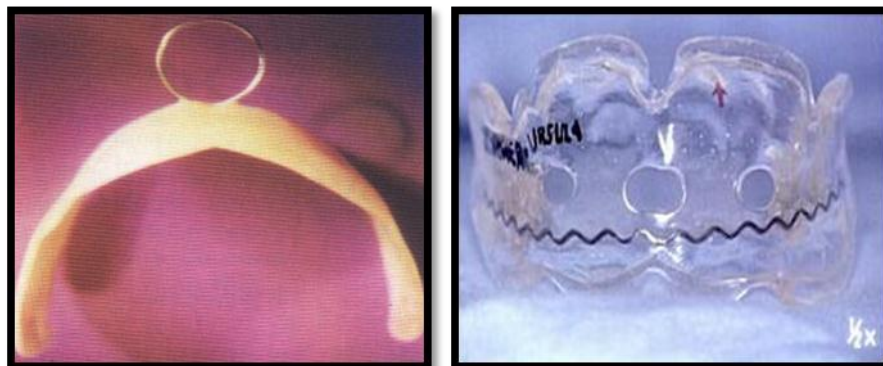
## **III. ORAL SCREEN/VESTIBULAR SCREEN<sup>4</sup>**

Introduced by NEWELL in 1912. It is a screen made up of acrylic base material which fits in buccal/labial vestibule of mouth. It can be used either to apply the forces of circum oral musculature to certain teeth or to relieve those forces from teeth, thus allowing tooth movement.

### **INDICATION**

- 1. Mouth breathing

2. Thumb sucking
3. Lip biting
4. Tongue thrust
5. Mild disto occlusions with pre maxillary protrusion & open bite in deciduous % mixed dentition
6. In the presence of flaccid, hypotonic, orofacial musculature as muscle exerciser
7. For the correction of proclined upper anterior teeth.



**Figure 1. Vestibular Screen A) With Ring B) With Holes**

**LIP BUMPER<sup>4,6,7,8,9</sup>:**

Lip sucking and (perverted lower lip function) hyperactivity of mentalis muscle can be activated. By guiding the lower lip into a more forward position and eliminating the lip trap, they enable dento alveolar development to follow a normal pattern.

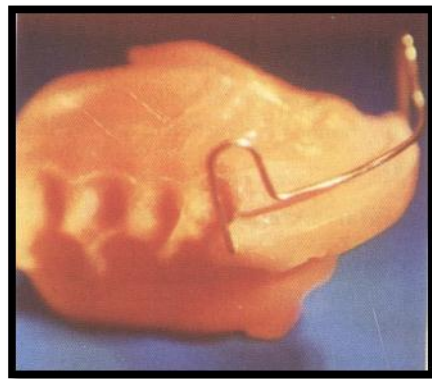


**Figure 2. Lip Bumper**

**Activator**<sup>3,4,6,10,11</sup>:

**IV. History and evolution of activator:**

- **KINGSLEY** introduced "Jumping of the bite": in 1879 to correct sagittal relationship between Upper and lower jaws.
- **HOTZ** modified the kingsley's plate into a vorbissplate (used it for deep bite and retrognathism).
- From Kingsley's concept, **VIGGO Andresen** 1908 developed a loose fitting appliance on his daughter as a retainer during summer vacations which gave remarkable results. He called it biomechanical retainer.
- Andresen moved to Oslo University, Norway where he met **KARL HAUPL** (a periodontist and histologist) who became convinced that appliance induced growth changes in a physiological manner. Then the name activator or Norwegian system was coined.



**Figure 3. Andresen 's Activator Appliance**

**Indications of activator:**

- Actively growing individual with favorable (horizontal) growth pattern.
- Well aligned maxillary and mandibular teeth
- Mandibular incisors should be upright over the basal bone.

**Used In**

- Class II Div 1
- Class II Div 2 after aligning the incisors
- Class III
- Class I open bite

- Class I deep bite
- For cross bite correction (Trimming done in such a way that maxillary molars are moved laterally and mandibular molars lingually).
- Preliminary before Fixed appliance to improve skeletal jaw relationship.
- For post- treatment retention
- Simultaneously serves as a space maintainer in mixed dentition, the acrylic is extended into the space of missing tooth.
- Treatment of snoring. Found to be more effective than soft palate lifter mouth shield

#### **Contraindications**

- Class I crowding, due to tooth size jaw discrepancy
- Increased lower facial height.
- Extreme vertical mandibular growth
- Severely procumbent lower incisors
- Nasal stenosis.
- Non growing individuals

#### **BIONATOR<sup>3,4,12,13</sup>**

The bionator is a functional appliance developed by Balters in 1956. The bionator is a generic term that refers to a family of appliances used to treat malocclusions characterized in part by mandibular deficiency.

#### **Principles**

The theoretical principles of Balters are based on the works of Robin, Anderson and Haupl but it differs from that of the activator.

The essential part of Robin's concept is function and Balters is the role of the tongue.

“The equilibrium b/w the tongue and cheeks, especially b/w the tongue and lips in height, breadth and depth in an oral space of maximum size and optimal limits, providing functional space for the tongue is essential for the natural health of the dental arches and their relation to each other. Every disturbance will deform the dentition and during growth that may be impeded too. The tongue is the essential factor for the development of the dentition and it is the centre of reflex activity in the oral cavity”

The functional space for the tongue is essential for normal development of the orofacial system. The equilibrium between the tongue and circumoral muscles are responsible for the shape of the dental arches and intercuspation. A discoordination of its function could lead to abnormal growth & actual deformities.



**Figure 4. Bionator**

Balters constructed his appliance to achieve the following,

- accomplish lip seal & bring dorsum of tongue into contact with soft palate
- bring incisors into edge to edge relationship
- enlarge oral space & train tongue functions
- improve relationships of jaws, tongue & teeth
- designed to help patients learn normal functional patterns

The principle of the bionator is not to activate the muscles but to

- Modulate muscle activity,
- Enhance normal development of the inherent growth pattern and
- Eliminate abnormal and deforming environmental factors.

#### **Construction bite registration**

Horizontal considerations:

- Incisors in edge to edge relationship/ molars in class I
- Excessive overjet-step wise posturing of the mandible
- Edge to edge with lateral incisors when centrals are mal positioned.

Vertical considerations:

- Bite is not opened/incisors in edge to edge
- High construction bite impairs tongue function and or acquires tongue thrust habit

Lateral considerations:

- Condyles on both sides should move symmetrically in the glenoid fossa /reference lines-upper and lower midlines & frena.
- Midline deviations due to functional / dental / skeletal problems have to be analyzed and diagnosed first.

**Types of appliances:**

- THE STANDARD BIONATOR
- CLASS-III / REVERSE BIONATOR
- THE OPEN BITE APPLIANCE

**Indications for standard bionator:**

- Actively growing children with the following malocclusions
- Class II / I in mixed dentition
- Class I malocclusion with class II/I symptoms with lip trap
- In Class II/I -dental arches - well aligned
  - -the mandible in posterior position
  - -the skeletal discrepancy not very severe
- Indicated in deep bite cases due to infra occlusion of molars and premolars because of lateral tongue posture.

**Not indicated if**

- Class II due to prognathic maxilla
- Labially tipped lower incisors
- Vertical growth pattern



- Not used in deep bite cases with strong horizontal growth pattern

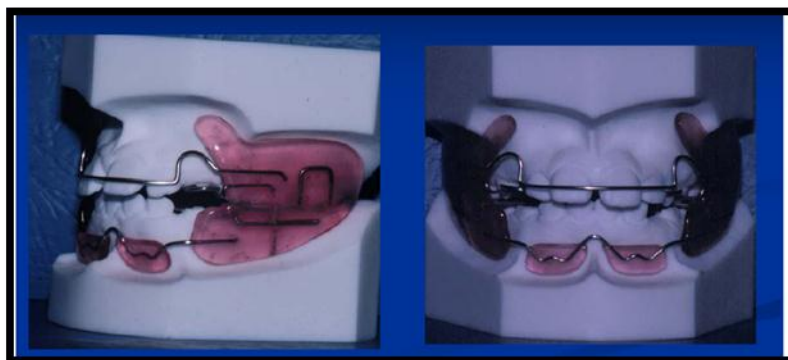
#### **FRANKEL'S APPLIANCE<sup>3,4,14,15</sup>**

##### **Philosophy:**

1. Vestibular arena of operations.
2. Sagittal correction via tooth borne maxillary anchorage.
3. Minimal maxillary basal effect.
4. Periosteal pull, lip pads and buccal shields.

##### **FRANKEL'S APPLIANCE TYPES.**

- FR 1 : Treatment of Class I and Class II div 1.
- FR1a : Class I with minor to moderate crowding and in deep bite cases.
- FR1b : Class II div 1 where overjet does not exceed 5 mm.
- FR1c : Class II div 1 where overjet is more than 7 mm.
- FR2 : Treatment of Class II div 1 and div 2.
- FR3 : Treatment of Class III.
- FR4 : Open bite and bimaxillary protrusion.
- FR5 : Can incorporate head gear, indicated in patient with high mandibular plane angle and vertical maxillary excess.



**Figure 5. Frankel's Appliance**

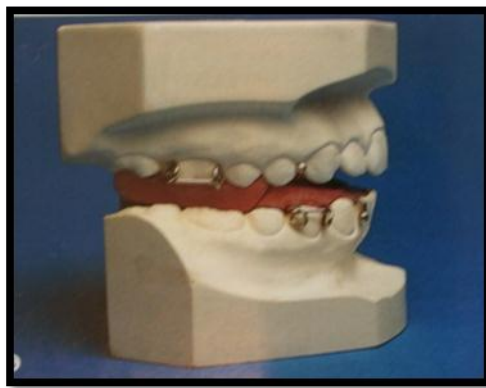
##### **Effects of Functional Regulator:**

- An increase of sagittal and transverse intraoral space.
- An increase in vertical intraoral space.

- A forward positioning of the mandible.
- The development of new patterns of motor function, the improvement of muscle tonus, and the establishment of a proper oral seal.

## **V. TWIN BLOCK APPLIANCE<sup>3,4,16,17,18</sup>**

Twin block appliances are simple bite blocks designed for full time wear that would maximise the growth response to functional mandibular protrusion by using an appliance system that is comfortable, simple and aesthetically pleasing to the patient. The unfavourable cuspal contacts of a distal occlusion are replaced by favourable proprioceptive contacts on the inclined planes of the twin block to correct the malocclusion.



**Figure 6. Twin Block Appliance**

### **History:**

History Evolved in response to a clinical problem when a young patient, son of a Dental colleague fell and luxated an upper incisor. The first Twin block was fitted on September 7th 1977.

### **Clinical Management**

- Class II Div. 1 with deep bite
- Mixed dentition
- Combination therapy in permanent dentition
- Twin blocks with extraoral traction
- Reduced overbite and anterior openbite management.
- Class II Div.2 malocclusion
- Class III malocclusion
- Extraction / Non extraction therapy

- Management of facial asymmetry
- Magnetic twin blocks
- Adult treatment
- Twin blocks in TMJ dysfunction
- Fixed twin blocks

#### **Appliance Design**

- The earliest twin blocks were designed with the following basic components.
1. Occlusal bite blocks
  2. Midline screws to expand the upper arch.
  3. Adam's clasps on upper molar and premolar.
  4. Adam's clasps on lower first premolars
  5. Inter dental clasps on lower incisors.
  6. Labial bow to retract the upper anteriors.
  7. Springs to move individual teeth and improve the arch form as required.
  8. Transmission for extra oral traction in cases of maxillary protrusion.

The position and angulation of the occlusal inclined planes are crucial to efficiency in correcting inter arch relationships. The earliest twin blocks had bite blocks articulating at a 90 degree angle. This forced the patient to make a conscious effort to bite in a forward position. 30% of patients failed to bite forward consistently and tended to bite back to their retruded position. As a result, posterior open bites developed as the bite blocks occluded on their flat surfaces and the sagittal correction was hampered.

So, the occlusal inclined plane was developed based on the functional mechanism of the natural dentition. Initially 45° angulation was used which was immediately successful. However 45° angulation leads to an equal downward and forward stimulus to growth. Taking this into account, clinicians decided on a 70° angulation to increase the horizontal component of force, reasoning that this may cause more horizontal mandibular growth.

#### **VI. BITE REGISTRATION:**

The centric position is checked and the desired degree of activation decided. The patient is then trained to bite in the desired position by giving him a mirror. For accurate control the Exactobite registration device is recommended. This gauge allows the clinician to choose variable amounts of sagittal activation by selecting the appropriate groove to engage the upper incisors when the mandible closes into the incisal guidance groove. The wax is softened in a water bath and adapted. The patient is instructed to bite into the desired position. After the wax has hardened sufficiently, it is removed and chilled.

## **STAGES OF TREATMENT**

Twin block functional therapy is divided into 3 stages:

1. Active phase
2. Support phase
3. Retention.

### **Active Phase: 7-9 months**

During the active phase, twin blocks are worn full time. The objective is to correct the arch relationship in the sagittal, vertical and transverse dimensions.

Normally, overjet and overbite are corrected within 6 months and the lower molars erupt into occlusion in 9 months. The average wear time for twin blocks is 6 to 9 months though sagittal correction may be obtained in 2 to 6 months. At the end of the active phase, there should be a three point contact in the incisor and molar region and the sagittal relationship should be in a slightly overcorrected position.

### **Support Phase: 6-9 months**

The objective of the support phase is to retain the corrected incisor relationship until the buccal segment occlusion is fully established. The lower twin block is left out at this stage and posterior bite blocks are removed. The appliance of choice is a steep anterior inclined plane borne on a removable appliance. The anterior inclined plane, without interfering with occlusion, should engage the lower incisors and canines which should occlude at the base point of the upper incisors and canines. For this purpose the inclined plane should have an angulation of 70-80 degree to the occlusal plane and should have a thickness of 6 to 8 mm.

If the molars have fully settled, an upper Hawley type of retainer with clasps on molars can be used to bear the inclined planes. If the molars still require some settling, the inclined plane can be borne on a Begg type retainer. If fixed appliance therapy is to be instituted after the twin block stage, a simple "clip-over" removable retainer or a fixed anterior bite plane can be used.

The upper and lower buccal teeth usually settle into occlusion within 4 to 6 months. Full time wear is continued for another 3 to 6 months to allow time for internal bony remodelling to support the corrected occlusion.

### **Retention: 3-6 months**

A normal period of retention follows treatment after occlusion is fully established. The same appliance used during the support phase is used, where in appliance wear is gradually reduced to night time wear.

### **Reactivation**

Reactivation of the twin block can be done as a simple chair side procedure by the addition of cold cure acrylic to extend the anterior incline of the upper twin block mesially as the clinician inserts the appliance to record a new protrusive bite before the acrylic is fully set.

**Advantages of Twin Blocks:**

Twin blocks have a number of advantages over other functional appliances belonging to the monobloc series. As the upper and lower components are separated, there is freedom of jaw movements in anterior and lateral excursion. This also allows the operator independent control of the upper and lower arches. Speech is minimally affected as there is no restriction to movements of the tongue, lip or mandible.

Twin blocks are designed with minimum visibility of wire and acrylic components. Absence of lip and cheek pads prevents distortion of facial appearance. Rather, facial appearance is enhanced on wearing twin blocks.

The appliance is worn full time, especially during eating. Mastication provides the strongest functional stimulus to growth. On the other hand, monobloc appliances have to be removed for eating and the patient tends to posture back the mandible to the original retruded position, which is a deterrent to rapid functional correction.

Enhanced comfort and esthetics generally leads to excellent patient co- operation. If required, twin blocks can be easily fixed to the teeth temporarily or permanently to improve patient compliance.

**VII. Summary and Conclusions**

Functional appliances or myofunctional appliances are used for growth modification procedures that are aimed at intercepting and treating jaw discrepancies that depend upon the orofacial musculature for their action.

The treatment outcome of functional appliance depends on proper case selection, diagnosis and proper appliance selection.

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