

Myofunctional Appliances: An Overview

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ABSTRACT

A functional appliance harnesses natural forces which it transmits to the teeth and alveolar bone in a predetermined direction. Myofunctional appliances are a variety of intraoral appliances that depend upon the natural forces of orofacial musculature for their action. They are generally removable and passive in nature. They instead of applying active forces either transmit, eliminate or guide the natural forces of the orofacial musculature for correction of aberrant growth and function of the dentofacial structures. They either transmit the favourable muscular forces to the teeth and alveolar bone through the medium of the appliance, or eliminate the abnormal forces of orofacial musculature. They are considered primarily for growth modification in skeletal Class II div 1 and Class III skeletal conditions. This article gives an overall view of myofunctional appliances.

Keywords: Functional Orthodontic Appliances.

DEFINITION

According to Moyers, Functional Appliances are loose removable appliances designed to alter neuromuscular environment of orofacial region to improve occlusal development and/or craniofacial skeletal growth.

According to Profit, Functional Appliances are appliances which alter the posture of mandible, holding it open or closed and forward or backward.

According to WHITE, GARDNER, LEIGHTON: A functional appliance harnesses natural forces which it transmits to teeth and alveolar bone in a predetermined direction.

Functional appliances are appliances which act by either harnessing the muscular forces or by preventing aberrant muscular forces from acting on the dentition.

ADVANTAGES OF FUNCTIONAL APPLIANCES

1. Are effective in vertical control of increased overbite.
2. Can be used in mixed dentition.
3. Require minimal chairside adjustment.

DISADVANTAGES OF FUNCTIONAL APPLIANCES

The forces of FA solely depends on patient cooperation.

Precise tooth movement not possible with FA.

Treatment duration often is prolonged.

FA treatment is only phase I of a 2 phase definitive orthodontic treatment protocol and often need the phase II of fixed orthodontic treatment.

CLASSIFICATION OF FA'S

FA'S are classified in different ways:

BASIC CLASSIFICATION

1. **Removable FA'S:** They are FA'S that can be removed and inserted into mouth by patient at his will.e.g.activator,bionator, Frankel.
2. **Fixed FA'S:**They are FA'S that are fitted on teeth by operator and cannot be removed by the patient at will.
3. **Both removable and fixed:**These appliances are available as both fixed or removable type,e.g.twin block,Herbest etc.
4. **Semi-fixed functional or Removable-fixed appliances:**They are FA'S with some components fitted on to while some components are detachable.e.g.Denholtz,Bass appliances,etc.

CLASSIFICATION PUT FORTH BY TOM GRABER

- **Group A-**Teeth supported appliances,e.g.,Catlan's appliance,inclined planes,etc.
- **Group B** - Teeth/tissue supported, e.g., activator, bionator, lip bumpers.etc.
- **Group C** - Vestibular positioned appliances with isolated support from tooth/tissue, e.g., Frankel appliance, vestibular screen.

CLASSIFICATION BY PROFIT

1. **Tooth-borne passive appliances-Myotonic appliances:** They are tooth-borne appliances that have no intrinsic force generating mechanical components such as springs or screws.They depend on muscular activity to produce desired treatment results.e.g.Andresen activator,Balter's bionator and Herbest appliance.
2. **Tooth-borne active appliances-Myodynamic appliances:** They are modifications of passive tooth-borne functional appliances with modifications that include expansion screws or other active components like springs to provide intrinsic force for transverse or anteroposterior changes,e.g.,elastic open activator(EOA),Bimler's appliance,modified

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bionator,stockfish appliance,kinetor,etc.

3. **Tissue- borne passive appliance:**Appliances are mostly located in vestibule and have little or no contact with the dentition.Examples include functional regulator of Frankel.
4. **Tissue-borne active appliances:** Appliances are located in vestibule and have contact with the dentition and transmit forces through some component of appliance,e.g.,lip plumpers(lip bumpers),oral screen,etc.
5. **Functional orthopedic magnetic appliances (FOMA)**

CLASSIFICATION BASED ON TRANSMISSION OF FORCE

Group I appliances: These appliances transmit the muscle force directly to teeth for purpose of correction of malocclusion,e.g.inclined plane.

Group II appliances: They reposition mandible and the resultant force is transmitted to teeth and other structures,e.g.activator and bionator.

Group III appliances: They also reposition the mandible but their area of operation is vestibule,outside the dental arch,e.g.Frankel appliance and vestibular screen.

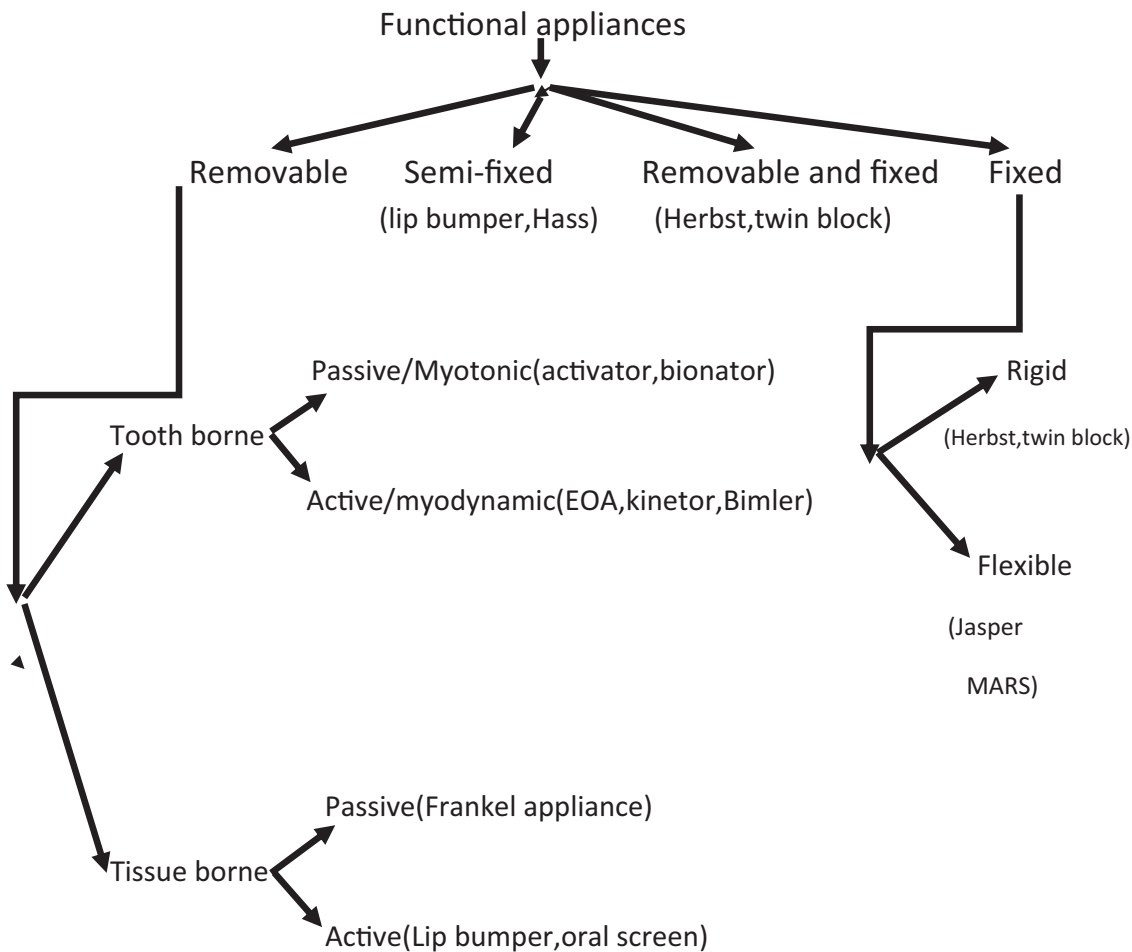
PRINCIPLES OF FUNCTIONAL APPLIANCE THERAPY

- (a) **FORCE APPLICATION:** The appliance wear by the patient results in compressive stress transmission/ application directly or indirectly on the structures involved (dentition and basal bone). This results in a primary alteration in function and a secondary adaptation in form.Most of functional appliance (Removable and fixed) work on the principle.
- (b) **FORCE ELIMINATION:** The appliance wear by the patient results in elimination of abnormal and restrictive muscular forces or other environmental factors which try to modify the normal function and hence the proper form of the structures.
The elimination of these abberant forces restore the normal function and aids in proper and normal development of orofacial structures.

MECHANISM OF ACTION OF FUNCTIONAL APPLIANCES:

- (a) Re-education of musculature
 - (b) Lateral pterygoid muscle stimulation
 - (c) Decreased biochemical feedback
 - (d) Unloading of mandibular condyle
 - (e) Transduction of viscoelastic forces
 - (f) Differential eruption of teeth.
- (a) **Re-education of musculature:** Continous forward positioning of mandible in skeletal Class II cases by functional appliance results in muscles learning a new functional pattern.
 - (b) **Lateral pterygoid muscle stimulation:** The functional appliance wear results in increased activity of superior head of lateral pterygoid muscle.This leads to increased activity of retrodiscal pad and subsequent growth of condylar cartilage on the postero-superior aspect which results in sagittal growth of mandible.
 - (c) **Decreased biochemical feedback:** The chondroblasts in the condyle secrete a substance that retards mitotic activity of stem cells.This retardation acts as a negative feedback.During functional appliance wear the lateral pterygoid is stimulated which causes quick maturation of chondroblasts.This results in decreased secretion of the negative feedback material.Removal of biochemical brake causes acceleration of condylar growth and this increases mandibular sagittal growth.
 - (d) **Unloading of condyle:** During normal function of chewing,swallowing and mandibular movements,the condyle is subjected to a lot of pressure and wear. During functional appliance wear,the condyle is distracted from the glenoid fossa,thereby providing an environment for matrix laying through meshwork of blood capillaries and subsequent proliferation of cellular elements.This results in growth of condyle at cartilaginous level and remodeling of glenoid fossa and consequent increase in mandibular growth.
 - (e) **Transduction of viscoelastic force:** During wear

I.Removable functional appliances	Tooth borne	Passive (Myotonic appliances)	Andersen activator,Balter’s bionator
		Active (Myodynamic appliances)	Expansion screws,springs etc in the above appliances,elastic open activator(EOA),- Bimler’s appliance,kinetor,etc.
	Tissue borne	Passive	Frankel regulator
		Active	Lip bumper,oral screen
II.Fixed functional appliances	Rigid		Herbest appliances,twin block(Clarke)
	Flexible		Jasper jumper,MARS,Churro jumper etc.
III.Can be used as both removable or fixed			Twin block appliance,Herbst
IV.Removable-fixed functional appliance or semi-fixed appliance			Lip bumper or Lip plumper,Danholtz(lip bumper of upper) and Hass appliance
Table: Overview of Functional appliances			



functional appliances harness the passive tension arising from the inherent elasticity in muscle, skin and tendinous tissues and transmits it to the dentition.

- (f) **Differential eruption of teeth:** Although functional appliances do not allow unwanted tooth eruption, the eruption pattern is modified as per the need by placing molar stops and by providing acrylic guide planes. Selective and favourable eruption of teeth is also accomplished by trimming of the appliance (In case of Activator, Bionator and Twin block).

CONSTRUCTION BITE OR BITE REGISTRATION

Construction bite is an intermaxillary dental wax that records the pre-determined intermaxillary relation of maxilla and mandible in all the three dimensions of space. The purpose of construction bite is to fabricate an appliance that has following effects:

- 1) To advance the mandible into a tolerable forward or tolerable set back position.
- 2) To 'block the bite' in such a way that lower anteriors intrude and stop their eruption, while selectively guiding and augmenting the eruption of posterior teeth.

Principles and guidelines governing the bite registration:

- 1) **Early mixed dentition:** The mandible should be advanced forward until upper primary canine relates

directly above the interproximal of lower primary canine and first primary molars. On an average, the forward movement of mandible should not exceed 4-5 mm.

- 2) **Late Mixed Dentition:** The mandible should be advanced forward until upper primary canine relates directly above the interproximal of lower cuspid and bicuspid. On an average, the forward movement of mandible should not exceed 6-8 mm.
- 3) **Anterior midline:** The upper and lower midlines should coincide during bite registration. In case of skeletal midline deviation, bite registration should coincide the dental midline (Laterognathy). In case of dental midline deviation (latero occlusion) the bite registration should not attempt to correct the midline.
- 4) **Rule of 10's:** The forward positioning and the vertical opening of mandible should follow the rule of 10's. This means that the sum total of vertical and sagittal movement of mandible should not exceed 10 mm. e.g. if vertical is 2 mm, the sagittal should be 8 mm. vertical 3 mm, sagittal should be 7 mm.
- 5) **Stepwise advancement:** In case the overjet is too large, the forward advancement should be done step wise in 2-3 phases instead of full advancement at a stretch.
- 6) **Freeway space:** Optimally the vertical opening of construction bite should be approximately 2 mm in

excess of the free way space or the resting position of mandible.

- 7) **Low construction bite and high forward positioning:** This kind of construction bite is characterized by marked forward positioning of mandible with minimum vertical opening. This type of bite registration is done for patients with severely retruded mandible Class II Div 1 malocclusion with Horizontal growth pattern during fabrication of H-activator appliance.
- 8) **High Construction bite and low forward positioning:** This kind of construction bite is characterized by lesser forward positioning of mandible and maximum vertical opening. This type of bite registration is done for patients with Class II Div 1 malocclusion with vertical growth pattern during fabrication of V-activator appliance.
- 9) **Vertical Construction bite:** This is a construction bite in which the bite is opened by 5-6 mm without any advancement of mandible. This is used in cases of vertical malocclusions like Deep bite and Open bite.
- 10) **Reverse Construction bite:** This is a construction bite in which the bite is opened and the mandible is positioned posteriorly or set-back. It is used in Class III malocclusion cases where in the bite is taken after retruding the mandible to a more posterior position. In this the vertical opening is 5 mm and posterior positioning of mandible by 2 mm.

11) Incisal Guidance

12) Molar Guidance

13) VTO

ACTIVATOR: (GROUP II)

Andersen & Haupl appliance

Andersen Appliance

Norwegian appliance

Monoblock

Vigo Andersen (1908) in Denmark modified Hawley type retainer on the maxillary arch to which he added lingual Horse-shoe shaped flang which helped in positioning the mandible forward. He used this loose fitting appliance as a retainer for his daughter who was going on a three month vacation. On her return three months later he found marked sagittal correction and improvement of the facial profile and named this appliance Biomechanical working retainer. Andersen shifted to Norway and joined Haupl to develop the activator appliance in the year 1920.

Activator can be defined as a loose fitting tooth borne type of functional appliance that positions the mandible forward by activation of mandibular propulsor muscles.

INDICATIONS

1. Class I malocclusion with deep bite.
2. Open bite.
3. Class II Div 1.
4. Class II Div 2 after alignment of anteriors.
5. Class III malocclusion (Reverse Activator).
6. For crossbite correction (trimming modified to move maxillary molars laterally, screw can also be

incorporated).

7. As habit breaking appliance.
8. As retention appliance.
9. Serves as space maintainer in mixed dentition where acrylic is extended into the space of missing tooth.
10. Used in snoring patients of Obstructive Sleep Apnea.

CONTRAINDICATIONS

1. Crowded arches/Proclined lower anteriors/Retroclined upper anteriors.
2. Extreme Vertical mandible growers.
3. Increased lower anterior facial height.
4. Patients with nasal stenosis/nasal insufficiency/mouth breathers.
5. Non Growing patients.

Mechanism of Action

Mode of Action of Activator is controversial as to different people who worked with this appliance have given their own concept of mode of action.

Andersen stated that the appliance has a stimulating effect on joint development. In Class II malocclusion when the mandible is brought forward to Class I relationship, there is a stimulation of protractor (lateral pterygoid) and elevators (masseter, medial pterygoid, temporalis) with stretching of the retractors resulting in the change of the functional pattern of the muscles. This brings about change in the bone structures as they adopt a new functional environment. For stimulating the muscles, the appliance should be loosely fitting and as patient every time tries to occlude to hold the muscle that requires swallowing, the upper and lower teeth contact resulting in jolts to the periodontal membrane. This acts as a stimuli for tissue rebuilding.

Effects on condyle: As the mandible has been brought forward and downward, the environment in the retrocondylar area becomes a low tension zone with high vascular and cellular activity. The vascular membrane laid is quickly filled with the cellular elements and the posterior superior aspect of the condyle shows condylar cartilage showing transformation into bone depositon and the resultant forward positioning of the mandible. May, in 1972 observed laminographically that horizontal growth of condyle was 3 times more than that of control.

Effect on maxilla: The effect on maxilla in activator therapy is the restriction of forward growth of maxilla by 2 mm (Vargervik and Harvolds 1985) and 1.7 mm (Panchrez 1984), and consequent decrease in SNA angle.

There is increase in posterior maxillary vertical height resulting in a backward rotation of mandible and pogonion (Melson 1982).

Effects on Mandible: Due to the condylar growth, there is an indirect effect of mandibular forward positioning which leads to the vertical development of the posterior part of mandible. Further, the glenoid fossa remodeling (bone deposition) further shifts the condylar portion downwards and forwards. There is a minor lengthening of the corpus at

the same time. All these processes put together reposition the mandible in a more favourable and harmonious relationship to maxilla.

Effect on Soft tissues: Very little study was carried out on effects of activator on soft tissues, but studies by Forsberg and Odennick 1987 observed that upper lip retrusion was significant in treated Class II group than control. The soft tissue pogonion moves forward and the lip balance is also seen.

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