



## INTRODUCTION TO FUNCTIONAL APPLIANCES

Orthodontic treatment is the correction of dental irregularities but inappropriate for treatment of skeletal discrepancy.

Orthopedic treatment is correction of malocclusion primarily related to skeletal disproportion

### **Orthodontic force vs orthopaedic force**

Orthodontic appliances are designed to apply light force to move a tooth or group of teeth without stimulating the mandibular growth during treatment. The force is about 28 g/ cm<sup>2</sup> of root surface, 150 g is optimum to move canine and 300 g for molars. However, higher forces may exceed the level of physiological tolerance of PDL. Additionally, orthodontic treatment can take place at any age. Unlikely, orthopaedic force is related to the tolerance of orofacial musculature rather than PDL. It is directed to change the position of mandible and correct the relationship of mandible to maxilla. This will promote the proprioceptive response in stretched receptors within the orofacial muscles and secondary bony remodeling in response to functional muscular activity. Eventually, this will provide a new functional environment for the developing dentition. Optimum age is growing age.

### **Functional appliances/myofunctional appliances**

These are removable or fixed appliances that either utilize, eliminate or guide the forces arising from muscle function and altering the position of mandible, causing stretching of the facial soft tissue, to produce a combination of dental and skeletal changes. They are most frequently used for correction of anteroposterior jaw relationship in class II malocclusion, however, class III malocclusion can be treated occasionally.

### **Classification**

They are classified as:

1. Tooth borne (like twin-block) or tissue born (like Frankle functional regulators)
2. Passive carries no active component (such as bionator) or active occasionally carries expansion screw and/or springs (such as twin-block).

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### **Indications of functional appliances**

1. Mild to moderate class II skeletal discrepancy with mandibular retrognathism
2. Growing patients during pubertal growth spurt (males 14+/-2), females (10+/-2) for ideal response.
3. Compliant patient able to tolerate wearing the appliance and attend the regular visits.

### **Mode of action of functional appliances**

These appliances correct or at least reduce the anteroposterior skeletal discrepancy in a process known as growth modification or dentofacial orthopaedics by:

1. Forcing the mandible to posture forward to reduce overjet with a reciprocal restraining force on maxilla
2. Stretching the soft tissues (muscles of mastication)
3. The force of stretched muscles is transmitted through the appliance to the teeth resulting in retroclination of upper anterior teeth and proclination of lower anterior teeth
4. Increasing mandibular length by 2-4 mm due to forced translation of mandibular condyle forward which may encourage back compensatory growth of mandible.
5. Increasing lower anterior facial height (LAFH) by molar eruption and downward mandibular growth, this is remarkably in patients with deep bite.
6. Restraining the maxillary growth especially in combination with incorporation of headgear extraoral appliance
7. The resultant correction in overjet is attributed to 70% tooth movement and 30% modification in maxilla and mandible growth (skeletal changes)

### **Timing of treatment**

Functional appliances are most effective when the patient is growing. It has been suggested that treatment should, if possible, coincide with the pubertal growth spurt.

### **What is growth spurt?**

It is defined as a periods of sudden accelerated growth rate scattered within periods of relative rest. The pubertal growth spurt is the most noticeable and more dramatic, thought to be caused by hormonal secretions.

### **How growth spurt can be predicted?**

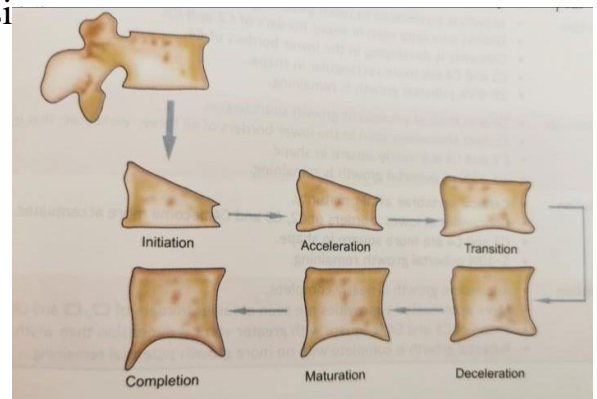
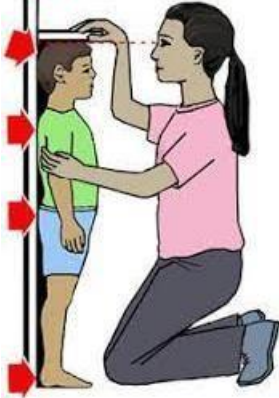
1. taking multiple body height measurements of the patient, as rapid changes in height coincide closely with the growth peak in the maxilla and mandible.]



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2. Hand-wrist x-ray: individual's skeletal maturity can be predicted from the stages of development of the phalanges and radius. Ossification of the adductor sesamoid of the thumb has been reported to precede or coincide with peak height velocity of the individual. However, this method is not recommended in current orthodontic as multiple x-rays must be obtained on regular intervals and good experience is needed to read them.

3. cervical vertebrae visible on lateral skull radiographs. During the period of maximum mandibular growth, characteristic maturation changes are visible on cervical vertebrae C2, C3 and C4 by changing the shape of vertebra from wedge to column to square, increasing the vertical dimension and



### Can functional appliance be used in childhood, earlier than pubertal growth spurt?

They can be used especially if there is a psychosocial concerns relating to the aesthetic impact of maxillary incisor prominence or there is a significant increased risk of trauma due to the increased overjet. However, they appear to have a greater effect on skeletal growth if treatment takes place during the optimum period for the following reasons:

- Skeletal growth will be optimized
- Treatment will coincide with the late mixed or early permanent dentition
- It will allow immediate placement of fixed appliances following functional appliance treatment
- It will reduce overall treatment and retention time

### Types of functional appliances

There are many types but most share the common feature of holding the mandible in a postured position. The commonest ones are the following:

#### 1- Twin-block appliance

The twin-block appliance is the most popular functional appliance in the UK. This is because:

1. it is well tolerated by patients, as it is constructed in two parts. The upper and lower parts fit together using posterior bite blocks with interlocking inclined bite-planes, which posture



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the mandible forwards. The blocks need to be at least 5 mm high, which prevents the patient from biting one block on top of the other. Instead the patient is encouraged to posture the mandible forwards, so that the lower block occludes in front of the upper block in an angle between 45-70 degree.

2. The appliance can be worn full time, including during eating in some cases, which means that rapid correction is possible.
3. It is also possible to modify the appliance to allow expansion of the upper arch by incorporating expansion screw or may be adding artificial tooth replacement.
4. An alternative modification to allow correction of Class II division 2 malocclusions is by incorporating z-spring in the upper part to procline the incisors and convert the case to class II div1.
5. It is also easy to reactivate the twin-block appliance. This means that during treatment if further advancement of the mandible is required, it is possible to modify the existing appliance rather than having to construct a new appliance.



### Disadvantage of twin-block

One of the side effects of the twin-block appliance is the residual posterior lateral open bites at the end of the functional phase. This is seen particularly in cases initially presenting with a deep overbite. The posterior teeth are prevented from erupting by the occlusal coverage of the bite blocks. Some clinicians may trim the acrylic away from the occlusal surfaces of the upper block to allow the lower molars to erupt. Any remaining lateral open bites are closed down in the fixed appliance phase of treatment.



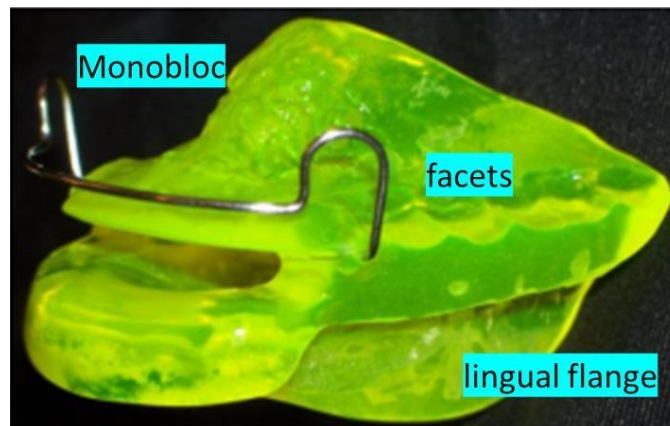




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### 2- Andresen activator

The activator was originally described by Andresen and Häupl the early 1900s. It was based upon the hypothesis of stimulating increased muscle activity in the mandibular elevator and retractor muscles to act directly on the dentition through the appliance and stimulate the condyle to allow remodelling and growth. It is a loose-fitting monobloc appliance that advances the mandible with lingual flanges. Occlusally, facets were cut into the acrylic to guide eruption of the mandibular posterior teeth mesially and the maxillary posterior teeth distally and buccally.

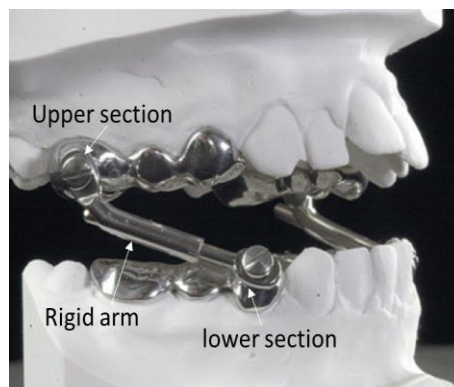


### 3- Herbst appliance

The Herbst appliance is a fixed functional appliance. Components: There is a section attached (banded or bonded) to the upper buccal molar teeth and a section attached to the lower premolar teeth. These sections are joined by a rigid arm that postures the mandible forwards. Advantage As it is a fixed appliance, it removes some (but not all) compliance factors and better tolerated than the bulkier functional appliances.

#### Disadvantage

- Increased breakages
- Higher cost

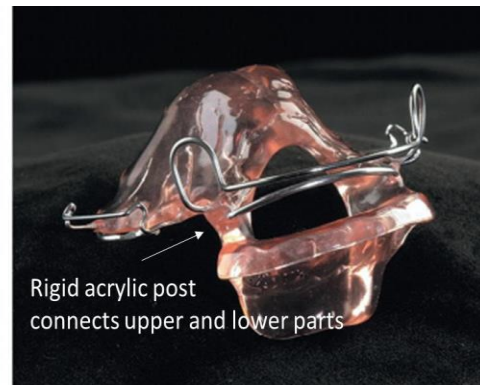
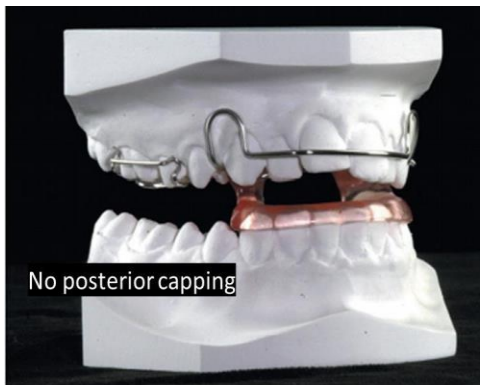


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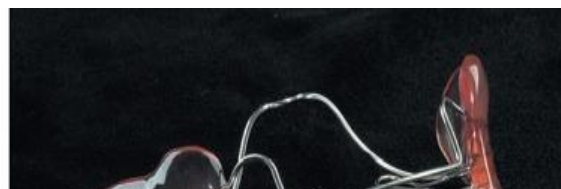
### 4- Bionator

The bionator was originally designed to modify tongue behaviour, using a heavy wire loop in the palate. The lack of acrylic in the palate makes it easy to wear. A buccal extension of the labial bow holds the cheeks out of contact with the buccal segment teeth, allowing some arch expansion.



### 6- Frankel appliance

This appliance is also called Functional Regulator (FR), it is completely tissue-borne appliance. Four types of Fränkel appliances, or functional regulators, have been described for treating class II division 1 (FR1), class II division 2 (FR2), class III (FR3) and anterior open bite malocclusions (FR4). Like other functional appliances, it postures the mandible forwards. The pressure of the cheeks can be held away by the acrylic shields to allow for passive expansion which theoretically stretching the periosteum to produce additional bony apposition laterally. This appliance is rarely used in contemporary orthodontic treatment because of several disadvantages such as difficulty in wearing and fabrication, and is troublesome to repair.



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### 7- Oral screen

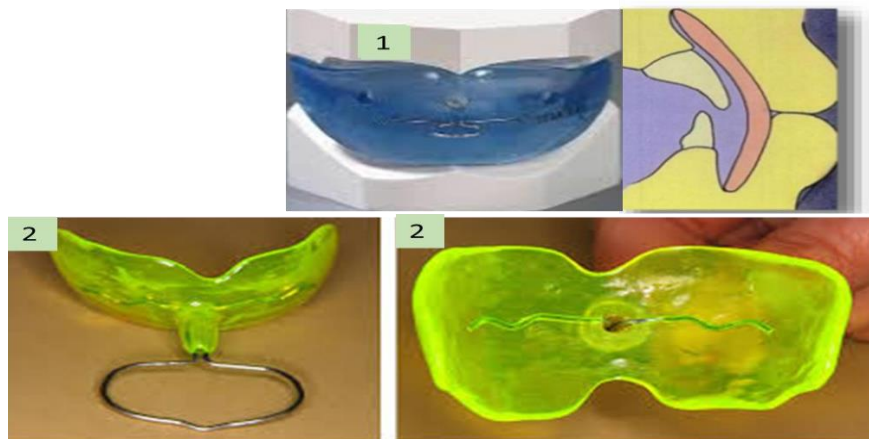
It is a curved shield of acrylic centred in the vestibule between the labial/buccal aspects of the teeth from behind and lips and cheeks from the front

#### Types

- Active: It transfers the force of circumoral musculature to the most proclined teeth
- Passive: eliminate the force exerted by circumoral musculature allowing the teeth to move labially by action of tongue.

#### Advantages

1. Act as habit breaker in patients suffering from mouth breathing, tongue thrusting, lip and cheeks biting
  2. Muscle trainer for hypotonic lip and cheek muscles
  3. To retrocline mild proclined anterior teeth
- 8- Lip bumper





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**8- lip bumper** is a combined removable-fixed functional appliance. Used in both maxilla and mandible to hold the lips away from the teeth. Also used to hold the lower molars back while allowing the lower front teeth to move forward. This provides space for overcrowded anterior teeth.

Uses:

- In patients exhibit lower lip sucking
- In patients with hyperactive mentalis
- To support anchorage
- Distalization of molars
- As a space regainer



**9- Jasper jumper** introduced by J. J. Jasper ,1980. It is a fixed tooth born functional appliance characterised by more flexibility and less rigidity in comparison to Herbst appliance.

Advantages

- 1) It produces continuous force
- 2) Does not require patient compliance
- 3) Allows greater degree of mandibular freedom than Herbst appliance
- 4) Oral hygiene is easier to manage.



### Preparing and management of the functional appliance

- 1- Detailed impressions with well-extended upper and lower alginate impressions into the lingual and labial vestibules are required.
- 2- Bite registration with the mandible postured forward, as all functional appliances work by posturing the mandible forward. If the overjet is 10 mm or less, this will generally mean the

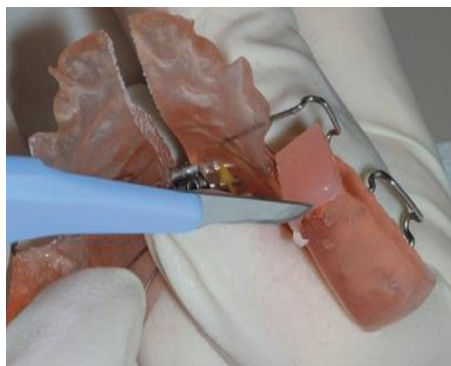




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postured bite can be taken with the incisors in an edge-to-edge relationship. While for patients with more than 10 mm overjet, protruding the patient's mandible more than 75% of their maximum protrusion can make the appliance difficult to tolerate. Then it is relatively easier to reactivate functional appliance during treatment. Bite registration with mandible postured forward

- 3- Vertically, twin blocks and activator require at least 5 mm of vertical separation in the buccal segments to allow for the inclined occlusal planes.
- 4- Activation of the functional appliance is achieved either by incremental advancement of the mandible during treatment which may make it easier to tolerate and improving patient's compliance or by fabricating a second appliance once the overjet has been partially reduced.
- 5- Light curing of the acrylic



### Insertion and reviewing the appliance

- 1- Appliances should be inserted within two weeks of the impressions being taken to ensure a good fit.
- 2- The review appointments can be made at 6–10-week intervals. At every review appointment, motivation of the patient is vital, as well as checking the fit of the appliance and treatment progress.
- 3- No wear or poor wear of appliance can be identified by some signs such as:
  - continued speech problems



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- A fresh and clean appliance with no signs of wear
- Numerous breakages due to repeated removal by the patient.

### **Duration of treatment and retention of functional appliances**

It has been suggested that the treatment time should not be less than 12 months, followed by a retention period of the same length, before the commencement of the second - phase treatment with a fixed appliance to close the posterior open bite created due to moving the mandible forward in the new position.

### **To sum up**

#### **Key points about functional appliances**

- Functional appliances posture the mandible and are used in growing patients.
- They are usually used for correction of mild to moderate Class II skeletal problems.
- In most cases, they are followed by a second phase of fixed appliances.
- They can be used alone to treat Class II division 1 malocclusions if the arches are well aligned.
- They are used in the late mixed dentition, provided the patient is still growing.
- They can be used earlier for psychological reasons if the patient is being teased, or to reduce the risk of trauma, but this means more appointments and increased overall treatment time.
- They produce predominantly dento-alveolar effects, with small skeletal changes.
- Individual patient response to functional appliances is variable.
- They can be difficult to wear initially and require encouragement and motivation from the clinician.
- They are successful in approximately 70–80% of cases—failure is usually due to problems of patient compliance.