

## REVIEW ARTICLE

### Fixed functional appliances – A Review

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#### ABSTRACT

Functional orthopedic treatment seeks to correct malocclusions and harmonize the shape of the dental arch and oro-facial functions. Conventional orthodontic appliances use mechanical force to alter the position of teeth into a more favorable position. Functional appliances have been used since the 1930s. Despite this relatively long history, there continues to be much confusion relating to their use, method of appliances alter the arrangement 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. Typically these muscular forces are generate orthodontic and orthopedic changes. It is important to note that functional appliance therapy is to be generally followed by the traditional full banded techniques for optimum results; since they deal more with the gross changes in the intermaxillary relations and are not designed for precise individual tooth movement.

**Key words:** Fixed functional, Forsus, Herbst.

#### INTRODUCTION

Fixed functional appliances are normally described as “Noncompliance Class II correctors”. The mechanism of correcting the defect consists of forwarding the mandible to a forced anterior front class I position to stimulate growth and thus harmonize skeletal defects and also by eliciting the correction of dentoalveolar effects. They also improve the soft tissue profile.<sup>1</sup> Fixed functional appliance was introduced first in dentistry by Dr. Emil Herbst of Germany.<sup>2</sup> The fixed functional appliances help in modifying morphologic adaptations which help in altering the muscle tonicity and thus bringing about a change in the direction of the traction, which is exerted by the masticatory muscles of jaw, thus ensuring skeletal changes. But the entire neuromuscular adaptation mechanism is a complex mechanism because of bone and muscle interaction, Andresen and Häupl stated that a myostatic reflex is produced which leads to isometric contractions because of the activity of the jaw which include closing muscles, which thus stimulates the protractor muscles and inhibits the mandibular retractor muscles.<sup>4-6</sup>

#### THE CLASS II PROBLEM DEFINED

In the 1890s, Angle provided the first formal definition of normal occlusion in the natural dentition. Angle’s definition was based on the upper first molar, which was the “key to

occlusion. The mesiobuccal cusp of the upper first molar should occlude in the buccal groove of the lower first molar on a smooth curving line of occlusion. Angle also described three classes of malocclusion, one of which was the class II.<sup>7,8</sup> This was illustrated as the lower molar distally positioned relative to the upper molar. After World War II, cephalometric radiography became more commonly used in orthodontic treatment planning. With this new method of diagnosis, it was more apparent that the jaw relationship as well as the dental relationship contributed to the class II malocclusion.

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### **INDICATIONS OF FIXED FUNCTIONAL APPLIANCES<sup>1</sup>**

It is a quite known fact that for successful completion of fixed functional appliance therapy patient's compliance is must. The fixed functional appliance, is the most important weapon against non-compliance offered by the patient.<sup>10</sup>

- 1) The correction of skeletal anomaly in young developing individuals.
  - a) In skeletal class II cases with retrognathic mandible.
  - b) In skeletal class III cases with retrognathic maxilla.
- 2) Making use of the residual growth left in neglected post-adolescent patients who have passed the maximal pubertal growth and are too old for removable functional appliances.
- 3) In adults patients - Used in upper molars distalization to correct dental class II molar relationship. -Used to enhance anchorage. -Used as mandibular anterior repositioning splint in patients having Temporomandibular joint disorders. -Post-surgical stabilization of class II / class III malocclusion.
- 4) Functional midline shifts can be corrected by using the appliance unilaterally.

### **CONTRAINDICATIONS FOR FIXED FUNCTIONAL APPLIANCE USE**

There are some clinical situations in which the clinician needs to avoid the use of mandibular protraction appliances namely<sup>11</sup>

- Periodontally compromised patients.
- Patients with gingival overgrowth in anterior region of mandibular teeth.
- Patients with mandibular teeth proclination or excessively tipped.
- Patients with excessive gingival display or overgrowth.
- Patients with skeletal or dental base towards an open bite.
- Efficacy of fixed functional appliances (FFA) in class II correction
- Functional orthopaedic treatment seeks to correct malocclusions and harmonize the shape of the dental arch and orofacial functions.

Removable functional appliances are normally very large in size, have unstable fixation, cause discomfort, lack tactile sensibility, exert pressure on the mucous (encouraging gingivitis), reduce space for the tongue, cause difficulty in deglutition and speech and very often affect aesthetic appearance. The alteration in the mandibular posture creates added difficulties.<sup>12</sup> These adverse effects make the adaptation and acceptance of these appliances more difficult.

Fixed functional appliances (FFA) first appeared in 1900 when Emil Herbst presented his system at the Berlin International Dental Congress. Since then and up to the ninety seventies, very little was published on this appliance. It was at that time that Hans Pancherz brought the subject back into discussion with the publication of several articles on the Herbst.<sup>13-15</sup> A number of fixed appliances have gained popularity in recent years to help achieve better results in non-compliant patients, so they are normally known as "non-complained class II correctors" as no co-operation of the patient is needed as in removable appliance. Fixed functional systems have some advantages over removable systems. They are designed to be

used 24 hours a day, which means that there is a continuous stimulus for mandibular growth. They are smaller in size permitting better adaptation to functions such as a mastication, swallowing, speech and breathing. As these appliance demands minimal patient co-operation, they are able to treat class II malocclusions successfully, thus reducing overall treatment time. It is possible to treat this type of malocclusion with minimal effort. Just as the name implies, what distinguishes them from removable appliances is that it is impossible for the patient to remove them.

**Classification of fixed functional appliances:** By Ritto A. Korrodi (2001)

**A} Rigid Fixed Functional Appliances (RFFA)**

1. The Herbst Appliance and its modifications.
2. The Mandibular Protraction Appliance (MPA)
3. The Mandibular Anterior Repositioning Appliance (MARA)
4. The Ritto Appliance
5. The IST-Appliance
6. The Biopedic Appliance

**B} Flexible Fixed Functional Appliances (FFFA)**

1. The Jasper Jumper
2. The Adjustable Bite Corrector
3. The Churro Jumper.
4. The Amoric Torsion Coils.
5. The Scandee Tubular Jumper
6. The Klapper Super Spring
7. The Bite Fixer

**C} Hybrid Fixed Functional Appliances (HFFA)**

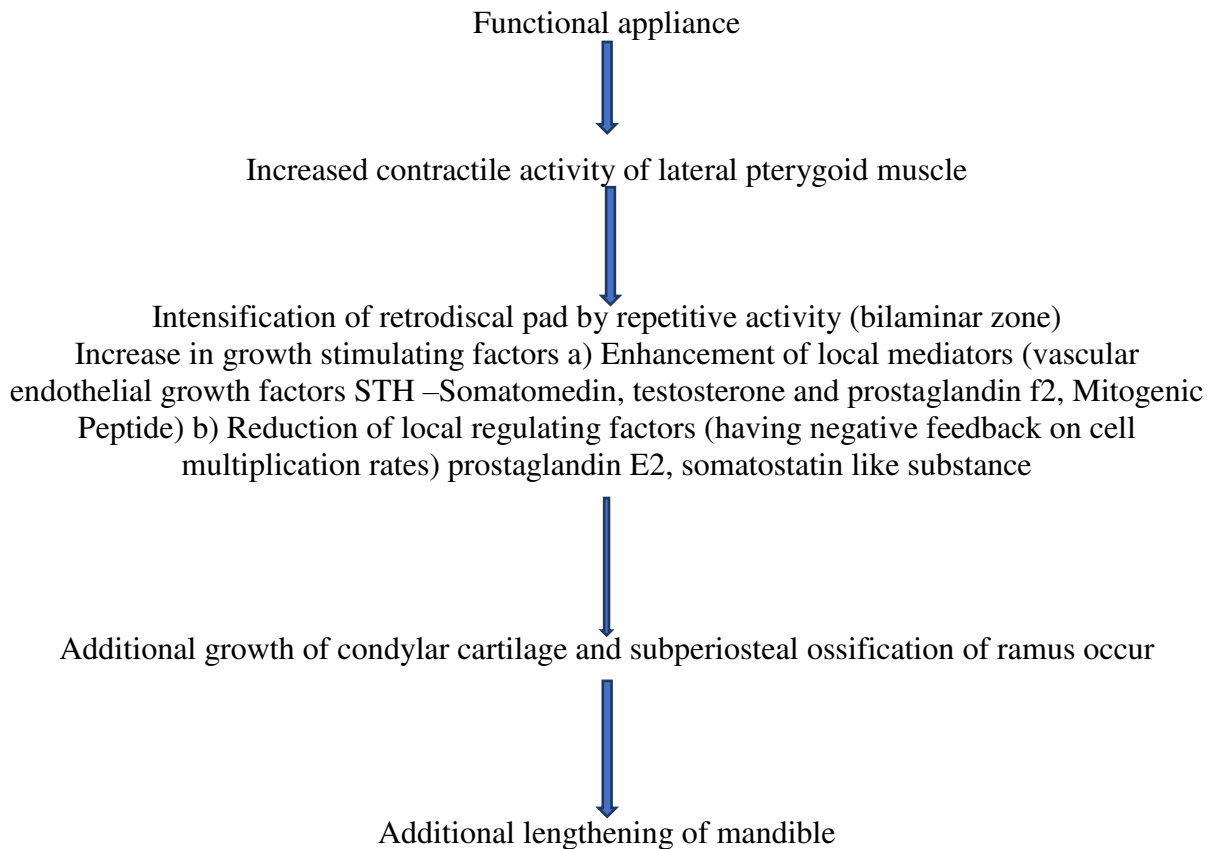
1. Eureka Spring
2. FORSUS- Fatigue Resistant Device
3. The Twin Force Bite Corrector.
4. Alpern Class II Closers
5. The Calibrated Force Module

**MODE OF ACTION<sup>1</sup>**

The mechanism of mandibular adaptation to the forward posturing by fixed functional appliance is the similar as that seen in removable functional appliance.<sup>16</sup> The appliance is tooth borne and exerts its effects to the underlying bone via teeth by transmitting the forces developed as a result of the continuous forward posturing of the lower jaw. (Graber *et al.*, 1997) - In spite of the various disparity in concept, the general mode of action is one or combination of the following.

- Mandibular growth stimulation
- Maxillary growth restriction
- Dentoalveolar changes
- Adaptive changes occur in Glenoid fossa location to more vertically and anterior.
- Changes in neuromuscular structure and function that induce bone remodelling.

Typically, the outcomes obtained by functional appliance in correction of class II malocclusion consists of combination of dentoalveolar (60-70%) and orthopedic (30-40%) effects. (Graber *et al.*, 1997)<sup>17</sup>



### **BIOMECHANICAL EFFECTS OF FIXED FUNCTIONAL APPLIANCE ON CRANIOFACIAL STRUCTURES**

- 1) Fixed functional appliances move the entire mandible anteroinferiorly, with maximum displacement observed in the parasymphyseal and midsymphyseal regions. The anteroinferior displacement of the mandibular dentition was most pronounced in the incisor region, while the maxillary dentition was displaced posterosuperiorly.
- 2) The displacement was more pronounced in the dentoalveolar region as compared to the skeletal displacement.
- 3) All dentoalveolar structures experience tensile stresses, except for anterior nasal spine and the maxillary posterior teeth.
- 4) Maximum tensile stress and von Mises stresses occurred in the condylar neck and head. (Panigrahi and Vineeth, 2009)

### **CLINICAL CONSIDERATION**

Mandibular incisor proclination is the most common dentoalveolar side effect seen with fixed functional appliance treatment. This is of concern because it increases relapse tendency and also limits skeletal and soft tissue correction. This could be prevented by securing the mandibular archwire and laceback within the mandibular arch and by incorporating progressive lingual crown torque within the mandibular anterior segment.<sup>18-23</sup> Unwanted proclination of the anterior teeth could be prevented by including the second molar in the treatment for better anchorage<sup>9,24-27</sup>. In high angle patients, fixed functional appliances should be avoided, as this might increase the vertical dimension due to dextrorotation of the mandible.

## COMPLICATIONS WITH USE OF FIXED FUNCTIONAL APPLIANCES

Certain complications are seen with the use of fixed functional appliances which are as follows -

- Bands or splints fracture or when they break.
- Telescopic mechanism fracture
- Bands or splints loosen down because of wearing out of flexibility or structure defect.
- Buccal mucosa injured or traumatised<sup>26,27</sup>

## CONCLUSION

Functional appliances do not replace fixed attachments. Definitely combined use of brackets, bands and extraoral force has the potential for the best possible and most stable long term results. When correctly used, they can be valuable additions to the armamentarium of the experienced orthodontic clinic.

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