



Australian Society  
of Orthodontists



THE UNIVERSITY OF  
SYDNEY

# CLASS II CORRECTION WITH FUNCTIONAL APPLIANCES

*Creating Brighter Futures*

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# CLASS II CORRECTION WITH FUNCTIONAL APPLIANCES

A functional appliance is defined as an orthodontic appliance which utilises mandibular posture to transmit forces from the muscles and soft tissues to associated dentoalveolar and skeletal structures - often described as an "orthopaedic" effect<sup>3,4</sup>. The aim is to produce a more normal occlusion by allowing for optimal tooth movement and bone remodelling.

Functional appliances are frequently used to correct Class II division 1 malocclusions by posturing the mandible forward. A Class II molar relationship is seen in approximately 25% of the population<sup>1</sup> (Fig 1) with mandibular retrognathia being the primary etiological factor in the majority.

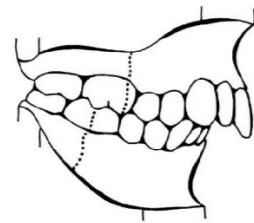


Fig 1. Demonstrates a Class II molar relationship as described by Edward Angle. Note also the protrusion of the upper anterior teeth typical of a division 1 malocclusion<sup>2</sup>.

## History

Functional appliances have been used for over a century. They were first used by Pierre Robin in 1902 in the form of a Monobloc to treat children with glossoptosis syndrome (Fig 2a). Andresen in 1908 developed the activator, a similar functional appliance. Subsequently further modifications were made such as the modified Bionator (Fig 2b) and Frankel Appliance (Fig 2c).



Fig 2a. A monobloc appliance, first described by Pierre Robin. Fig 2b. Modified Bionator. Fig 2c. Frankel appliance.

Herbst in 1909 developed a fixed functional appliance, however, he did not publish his findings until 1935. It was Pancherz in the late 1970s<sup>6</sup> whose papers and presentations promoted its benefits. (Fig 4). The 1980s saw further developments with the introduction of the Clark Twin Block (Fig 3) and Fixed Functional Springs (Fig 5).

## Types of Functional appliances

Functional appliances are either removable or fixed. The most common removable functional appliances include the Activator, Bionator, Frankel and Twin Block. Fixed functional appliances include the Herbst, MARA (Mandibular Anterior Repositioning Appliance) and various fixed springs such as the Forsus appliance. The Frankel appliance, is the only mainly tissue borne functional appliance<sup>7</sup>.



Fig 3. A patient wearing an example of a Twin Block as developed by Dr William Clark. The mandible is postured forward into a Class I canine relationship and is held into this position by the vertical ramps on the upper and lower plates.



Fig 4. A patient wearing a Herbst appliance, in this case with an RME. This is a fixed functional appliance that, unlike the Twin Block, the patient cannot remove from their mouth and so requires less cooperation.



Fig 5. A patient wearing Forsus fixed functional springs with their fixed appliances.

## Mechanism of action

The majority of the Class II correction achieved by functional appliances is dentoalveolar, however, there is some orthopaedic correction.<sup>9</sup> The dentoalveolar effects of a functional appliance involve the distalisation of the upper molars, retroclination of upper incisors, mesialisation of lower posterior teeth and proclination of lower incisors.<sup>4,10</sup> The orthopaedic effects include some favourable condylar growth and glenoid fossa remodelling, retarded forward maxillary growth, and of course, some accelerated mandibular growth.<sup>10</sup>

The current understanding of functional appliance therapy is that there is a temporary acceleration of mandibular growth during treatment. However, post treatment relapse does occur, therefore, this treatment may only have a temporary impact on mandibular growth.<sup>10</sup> Proffit demonstrated this effect showing that patients who do not undertake functional appliance treatment still appear to achieve similar mandibular growth, just at a slower rate<sup>12</sup> (Fig 6). Nevertheless, this temporary acceleration can be very useful in the treatment of a Class II malocclusion.

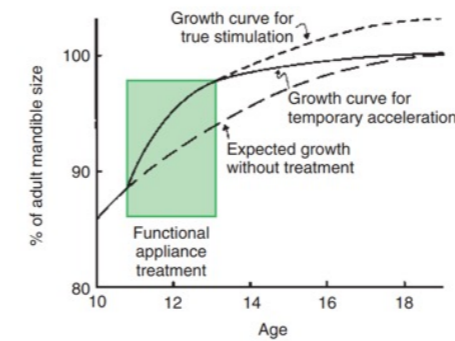


Fig 6. This graph by Proffit<sup>12</sup> suggests that there is a temporary acceleration of growth during treatment with a functional appliance.

## Patient selection and the ideal patient to treat with a functional appliance

The ideal patient for functional appliance treatment will have a Class II molar malocclusion, retruded mandibular arch, and retroclined lower incisors, allowing maximum mandibular advancement and proclination.<sup>8</sup> Proclination of the lower anterior teeth with the functional appliance may risk gingival recession and bone loss at the labial of these teeth. It is desirable that there be initially minimal or mild lower anterior crowding, as more severe lower anterior crowding will give little scope for further proclination of the lower incisors.

Another important criterion in selecting patients is the presence of a more horizontal growth pattern, rather than a vertical growth pattern. Care must be taken when designing functional appliances to control molar eruption which can cause a downward and backward rotation of the mandible. If a patient has a reduced lower facial height any backward and downward rotation usually improves their facial balance and helps resolve the deep anterior overbite commonly associated with horizontal facial growth patterns. If, however, a patient has a more vertical facial pattern, usually with a mild anterior overbite, downward and backward mandibular rotation with the functional appliance will reduce the anterior overbite further and may even produce an anterior open bite, as well as worsen their mandibular retrognathic appearance. Functional appliances can be used with vertically growing patients, often with a high pull headgear, however, their success is limited, and therefore most clinicians generally avoid functional appliance treatment for moderate to severely vertically growing patients.

If treating a Class II division 2 malocclusion with a functional appliance, the upper anterior incisors are usually initially proclined, effectively converting the malocclusion to a Class II division 1 malocclusion with an anterior overjet.

## Timing of treatment with a functional appliance

Ideally treatment with a functional appliance should coincide with the patient's peak growth during their pubertal growth spurt. For most patients, this equates to the late mixed dentition or early permanent dentition. Treatment provided during or slightly after onset of peak pubertal growth has a greater chance of some skeletal contribution to Class II correction. Patients treated in the pre and post pubertal stages of growth show fewer skeletal effects and more dental effects<sup>13</sup>.

There are two circumstances in which a clinician may consider using a functional appliances pre-pubertally. One is to attempt to negate the increased risk of upper incisor trauma due to an increased overjet, and the other is for psychological reasons when the child is self-conscious about their appearance.

Following treatment with a preliminary functional appliance in the pubertal stage of growth, most patients will be transitioned to full fixed appliances, with continuing Class II mechanics utilised to maintain the Class II correction.

This is the main argument for treating patients in the permanent dentition, as it allows for a seamless transition from a functional appliance to fixed appliances.

If however, a patient is treated in the early mixed dentition, they may require a lengthy period of retention, possibly wearing the functional appliance at night until they are ready for fixed appliance treatment.

Studies have shown that prepubertal early phase class II functional treatment is not more effective than undertaking the functional treatment in the pubertal growth phase. Early treatment did not reduce the number of patients needing extractions in phase two or the number who eventually required orthognathic surgery. In fact, early functional treatment overall takes longer, costs more, and is less efficient than the single phase later treatment.<sup>14,15</sup>

### Duration of functional appliance treatment during pubertal growth

Treatment duration can vary depending on factors such as patient cooperation, damage to the appliance, amount of pubertal growth remaining, direction of facial growth and appliance selection. Most functional appliances are used prior to fixed appliance placement, however, can be modified to be used with the fixed appliances. The Herbst and Twin Block appliances are generally used for a period of about 6 to 9 months prior to fixed appliance placement. Fixed functional springs, used during fixed appliance treatment, are generally in place for about 4 to 6 months.

### Limitations of functional appliances

As with many treatments the same appliance can produce different results in different patients. The clinician needs to monitor the progress of treatment carefully and adjust accordingly. Thorough examination and diagnosis, and appropriate treatment planning, is essential to maximise treatment progress and results.

Factors that can limit the effectiveness of functional appliance treatment include:

- **Poor case selection.** Cases with a more horizontal facial growth pattern usually respond better than patients with a more vertical growth pattern.
- **Poor Compliance** with removable appliances. Some patients neither wear the appliance for long enough nor are consistent enough with their wear, or damage or lose their appliances, resulting in insufficient or inefficient treatment.
- **Breakages** of fixed functional appliances can result from a less-than-ideal design or fabrication as well as patient abuse. Breakage or distortion necessitates an emergency appointment and sometimes more complicated repairs or remake. Repeated breakages will slow treatment and sometimes early cessation of the treatment which may be incomplete.
- **Variability of response to treatment.** Treatments with a functional appliance show a very wide range of skeletal and dental responses.<sup>16</sup> This demonstrates the unpredictability of growth and treatment response, even when patients seemingly have similar malocclusions and skeletal patterns and are treated at similar stages of maturity.

### Conclusion

Functional appliances, both removable and fixed, can be very effective and efficient in treating Class II malocclusions. However careful diagnosis is required to choose the appropriate patient, appliance, and timing, to achieve a successful and efficient result.

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