

The Integration of Functional and Fixed Appliance Treatment

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Abstract. *This article describes a functional appliance system to correct Class II problems, which is clipped on to bands, cemented to the teeth. This appliance has several advantages, as the patient cannot remove it. It acts on the teeth and jaws for 24 hours each day, patient co-operation is not a problem, and as a result the treatment time is short. Any fixed appliance system can be added while the functional phase is being completed so allowing full integration of the two treatment systems.*

Index words: Class II Treatment, Clip-on Fixed Functional Appliance, Functional Appliance, Twin Blocks.

Introduction

There are many different treatment methods available for correcting the Class II problem. Some of the appliances include removable functional appliances, extra-oral forces applied through headgear, and Class II elastics to fixed appliances. Unfortunately, all of these methods rely on patient co-operation to some extent. Recently, there has been a revival of interest in the Herbst appliance (Pancherz, 1985) because it enables the correction of Class II problems with reduced need for patient co-operation.

The Herbst appliance has been described as a fixed functional appliance. This is an upper and lower fixed appliance linked by a telescopic mechanism. This mechanism holds the mandible forward in a protruded position throughout treatment to modify mandibular growth. The appliance allows opening and closing movements of the mandible, and some lateral movement. The author has treated a number of cases with the Herbst appliance and the results were remarkable compared to other methods of Class II correction. It was the use of the Herbst appliance that prompted the author to develop the present appliance.

The Herbst appliance suffers from problems of breakage of the constituent parts and this is in common with many of the inter-arch appliances used to correct Class II malocclusions. The Herbst appliance is also expensive and difficult to make.

This is a preliminary report of a fixed system using acrylic occlusal blocks to protrude the mandible in a similar way to the removable twin-block appliance. The blocks are attached to bands cemented to the teeth. The Twin block appliance introduced by Clark (1988) is currently one of the most popular functional appliances used in the United Kingdom (Chadwick *et al.*, 1997)

Appliance Construction and Design

In this appliance the acrylic blocks are attached to bands on the lower premolar and upper molar teeth. The blocks of acrylic rest on and cover the occlusal surfaces.

The treatment of the severe Class II problem by the functional appliance method has a number of phases. The first

phase involves the correction of the dental bases from a Class II to Class I. This phase is usually followed by a second holding phase to maintain the Class I relationship prior to the placement of the fixed appliance. The final phase is the placement of the fixed appliance. The way in which the appliance is constructed allows the fixed appliance to be placed at the same time as the Class II relationship is being corrected so there is an overlapping of the phases. This ensures a seamless transition to the fixed phase and, therefore, significantly reduces treatment time.

First Visit

Separators are placed mesial and distal to the upper first molars, and mesial and distal to the lower first and second premolars. It is essential that tight and well-fitting bands be placed on the teeth as there is considerable force transmitted to the attachments. This means that good separation of the teeth is necessary. This is particularly important in the lower arch where considerable stress is placed on the premolar teeth.

Second Visit

Bands are selected for the upper first molars and the lower premolars. The acrylic blocks are attached to the bands by 3D lingual and buccal tube assemblies (Wilson, Rocky Mountain, Denver, Colorado; Figures 1-3). These are welded the lingual surface of the lower second premolar band and the palatal surface of the upper first molar band. Upper and lower impressions are taken over the bands in alginate impression material. The construction bite is taken with the mandible advanced to the desired position. The bands are removed from the mouth and seated accurately in the impressions. Brass separating springs are placed to maintain the separation. The impressions and the construction bite are sent to the laboratory for the fabrication of the appliance. The blocks are constructed on the models in the laboratory. A tube is soldered (Figure 1) to the lower wings of this first premolar bracket to accept the buccal retaining wire of the lower block and a lingual arch also is fitted.

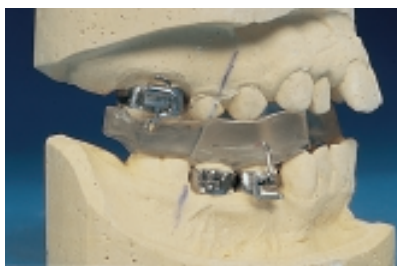


FIG. 1 Occlusal blocks with buccal tube attachments.

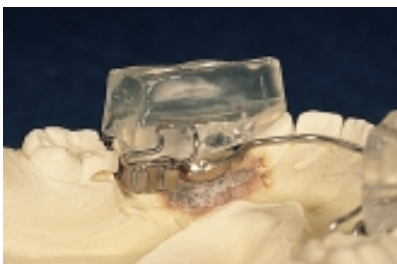


FIG. 2 Occlusal blocks with lingual tube attachments.



FIG. 3 Occlusal blocks with palatal tube attachments.

Third Visit

The block is inserted into the buccal tube and rotated to seat into the lingual tubes (Figures 4 & 5). First the bands are cemented in position and the blocks are located and checked for fit. It is important that the blocks are stable and do not rock when moved. Any slight displacement will exert too great a force on the welded attachments and the bands. The patient is then asked to close in a protruded position and the degree of opening is checked. Any adjustments can then be made to the height of the blocks to ensure that there is an even contact when the patient occludes. It is important that there should be an even contact between the blocks on one side, but also both sides should meet at the same time. Any premature contacts will increase the stress on the bands and the welded attachments. One major advantage of the acrylic blocks is their ability to distribute the vertical forces of occlusion onto the occlusal surfaces of the teeth so minimizing the possibility of breakage, which is a problem with all inter-arch appliances.

The patient should be given clear instructions about the care of the appliance. The presence of fixed blocks in the mouth makes oral hygiene difficult with the increased possibility of enamel decalcification. This means that this form of treatment should only be attempted on a patient who is



FIG. 4 Block inserted into buccal to be ready to be rotated to seat lingual inserts.



FIG. 5 Seated occlusal block.

highly motivated and where there is excellent oral hygiene. The brushing technique should be studied to check that the patient has the ability to clean the lingual and palatal areas where the blocks meet the teeth.

Fourth Visit

This visit should be scheduled for a week or 10 days after the appliance is fitted. The patient should be asked about any discomfort from the teeth or temporomandibular joint and if there are any eating difficulties. The acrylic blocks should be removed and a check made for any loose bands. The oral hygiene should be assessed and any problem areas pointed out to the patient. The blocks are then replaced and checked for stability.

The patient should be seen at 3- or 4-weekly intervals. The fixed appliance can be placed as soon as the patient is accustomed to the acrylic blocks. The fixed and functional stages of treatment can be carried out at the same time and this is clearly a major advantage.

Timing of Treatment

One major prerequisite of this appliance is the full eruption of the lower premolars to enable a well-fitting bands to be placed. The concentration of force of the occlusion on the lower premolar bands makes this a major precondition.

The most favourable time to treat patients with this appliance is during the peak of the pubertal growth spurt. So if the lower premolars have erupted before the growth spurt then full advantage can be taken of this. However, it has been shown that the growth period may not have any significant influence on the final result (Hansen *et al.*, 1991).

Case Report

A 12-year-old boy of Asian descent presented complaining that his upper anterior teeth were prominent. On examination he had a Class II skeletal pattern with an average Frankfort–mandibular planes angle and average lower face height (Figure 6a–e). Intra-orally all the permanent teeth were present with the exception of the third molars. There was mild crowding in both upper and lower arches.

In occlusion, there was an overjet of 8 mm, and an increased and complete overbite. The molar relationship was ½ unit Class II on both sides. Cephalometric analysis confirmed the Class II skeletal pattern (Table 1). The

maxillo-mandibular plane angle was reduced with both the upper and lower incisors were proclined.

The aims of treatment were to:

- (1) Correct the Class II dental base relationship.
- (2) Level and align the upper and lower arches.

The treatment plan was as follows:

- (1) To correct the Class II problem with the functional appliance.
- (2) Start the levelling and alignment with fixed appliances as the functional phase progresses.

The appliance was fitted (Figure 7) and the patient given instructions regarding care and management. A layer of glass ionomer cement was placed between the blocks and the teeth. This helped to stabilize the appliance and also

TABLE 1 Cephalometric analysis of treatment

	Pretreatment	Post-treatment
SNA	83	84
SNB	77	80
ANB	6	4
MMPA	24	23
Upper incisor to max. plane	111	114
Lower incisor to mand. plane	101	107
Md. unit length	125	129
Mx. unit length	103	104
Unit difference	22	25
Wits appraisal	-5.8	3.6
Pg to N. perp.	-7.5	1.1



FIG. 7 Fixed functional appliance in place.



(a)



(b)



(c)



(d)

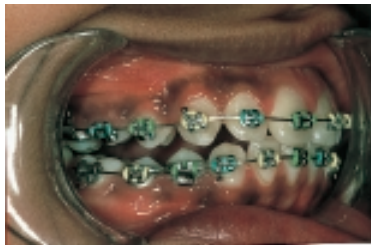


(e)

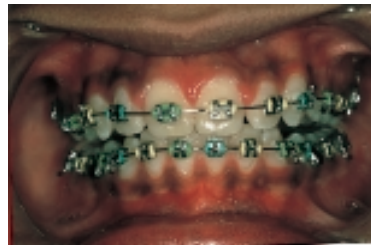
FIG. 6 (a–e) Case A pretreatment.

blocked an area where debris may accumulate. The patient was seen 2 weeks later and the acrylic blocks were unclipped to check the amount of movement. The occlusal surfaces of the teeth were cleaned and the oral hygiene checked. The blocks are easily clipped back into position and the occlusion checked. The patient was seen 1 month later and the overjet had reduced to 3 mm. Fixed appliances were bonded to the teeth in both the upper and lower arches, and aligning archwires placed. The height of the blocks was reduced. One month later the incisor relationship was edge-to-edge and it was decided to remove the acrylic blocks as the functional stage was completed. A rectangular archwire

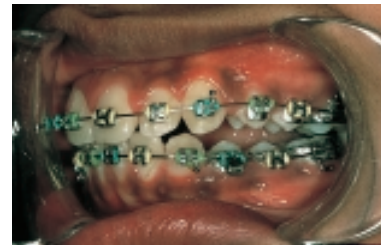
was placed in the upper arch. There was a bilateral open bite in the posterior region. The patient was seen a month later and the overjet had increased to 2 mm and the posterior open bite had reduced considerably (Figure 8a-c). The patient was seen at intervals of 4 weeks and progressed through a series of upper and lower archwires to rectangular wire. When the alignment was completed both upper and lower appliances were removed. (Figure 9a-e; Table 1). The total treatment time was 7 months with the functional phase, the time with the acrylic blocks in place, taking 3 months. Bonded retainers were fitted to the lingual surfaces of the upper and lower teeth.



(a)



(b)



(c)

FIG. 8 (a-c) Case A in-treatment records.



(a)



(b)



(c)



(d)



(e)

FIG. 9 (a-e) Case A post-treatment.

Discussion

This appliance appears to have a number of advantages over the removable system, the main one being that the appliance can be worn full-time so the variable factor, patient co-operation is controlled. The design is such that it allows full integration with any fixed appliance system. In order to correct mandibular retrusion with appliances that do not rely on patient co-operation, a link is necessary between upper and lower arches. In the case of the Herbst appliance, the Jasper Jumper and the mandibular protraction appliance (Coelho Filho, 1995) the link is fixed. The problems of breakage and restricted opening have discouraged many operators from using these powerful Class II correctors. One big advantage of this appliance is that there is no fixed link between the upper and lower parts; this allows the patient to have a good range of jaw movement. This makes it more comfortable to wear and also minimizes the possibility of breakage. The forces of occlusion of the teeth generated during biting and chewing are largely transmitted to the occlusal surfaces of the teeth. There is some force applied to the attachments, but if the blocks fit the teeth accurately this is less than that applied to the occlusal surfaces.

Advantages of the Appliance

1. Patient co-operation is not required.
2. It works for 24 hours a day.
3. A full fixed appliance can be placed at the same time as the Class II correction is being carried out.
4. Treatment time is short because of full time wear.
5. There is no transitional phase between functional phase and the fixed phase so treatment time reduced.
6. Overlap of the functional and fixed phase further reduces treatment time.
7. It is less bulky than other functional appliances.

Disadvantages of the Appliance

Breakage of the Appliance

The stress is going to be high with any appliance system that links the upper arch to the lower arch full-time. The forces generated by the occlusion are so great and constant that bands can split particularly in the lower arch.

Construction of the Appliance

The appliance needs to be made by a skilled technician and requires careful and precise fabrication. A number of different methods have been used to attach the appliance on the buccal side using the brackets or in the case of the upper molar the buccal tube. The present method using the buccal tube has resisted the heavy forces better than the early prototypes. Further development may be needed in this area.

Oral Hygiene Problems

The oral hygiene needs to be of a very high standard because of the difficulties in removing plaque and food

debris from around the appliance. Clearly, the patient cannot clean under the blocks so special instructions have to be given. The acrylic blocks interfere with cleaning especially in the lower lingual region. The occlusal surfaces of the teeth in both jaws are covered with acrylic and cannot be cleaned. It was anticipated that this would be a major problem as a stagnation area. Certainly, food debris does accumulate under the blocks, but this does not appear to be significant and less than expected. One solution to the problem is to cover the surfaces of the teeth with glass ionomer cement when fitting the appliance and this protects the occlusal surface throughout treatment. It is essential that the patient be seen at 3–4-week intervals to remove the blocks and check the occlusal surfaces, and then clip the blocks back into place.

Acceptance by the Patient

The appliance is similar to the removable Twin block described by Clark (1988) and works in the same way. The main difference is that this appliance is much smaller with elimination of the acrylic across the palate and around the lower lingual region. The adaptation to the appliance by the patient seems to be quicker than the removable version and this is because there is no opportunity to remove the appliance and the patient has to get used to it. The time taken to obtain the Class II correction was reduced when compared to other types of removable functional appliance. The reduction in treatment is due to full-time wear of the appliance and the elimination of problems associated with patient compliance. The method has so far been used in the treatment of 16 patients. All of these have been successful to a greater or lesser extent. The early appliances did suffer from breakage but these difficulties have largely been overcome. Orthodontic appliances that are in the mouth constantly do come under pressure and this is particularly so when the muscles are stretched in carrying out the Class II correction.

The other major benefit of his appliance is the complete integration of the functional stage with the fixed stage. It is possible to place the fixed appliance soon after the patient has accommodated to the acrylic blocks. The two stages of treatment can then run concurrently so producing a big saving in time.

Conclusions

This appliance does seem to offer a more predictable method of correcting Class II problems that has a shorter treatment time. The removal of the compliance factor and the complete integration of fixed system also contribute to reduced treatment times for some of the more challenging malocclusions.

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