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CLINICAL SECTION

A preliminary report of a new design of cast metal fixed twin-block appliance

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The present paper describes a cast metal fixed twin-block appliance utilized to correct a Class II malocclusion, which is designed for full-time wear. The object of the present paper is to achieve rapid functional correction of Class II malocclusions by transmitting favourable occlusal forces to inclined planes which are cemented to the posterior teeth. In the meantime, pre-adjusted fixed edgewise appliances can be placed on the anterior teeth to correct their malpositions. This new functional appliance design may shorten the total treatment duration and reduce the need for patient compliance.

Key words: Class II malocclusion, fixed functional appliance, twin-block appliance, Herbst appliance

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Introduction

Two of the most commonly used functional appliances for correcting Class II malocclusion are the Herbst appliance (developed by Emil Herbst[1] in the early 1900s and reintroduced by Hans Pancherz[2] in the late 1970s), and the twin-block appliance, developed by William Clark[3,4] in the late 1970s.

The twin-block appliance consists of maxillary and mandibular removable parts retained with Adams clasps on the first permanent molars and first premolars. This effective method of treating Class II malocclusion needs extensive patient cooperation, but the level of non-cooperation with the twin-block appliance is disappointing. For example, in a prospective cohort study of British children treated with twin-blocks, the non-compliance rate was reported to be 17%.[5] Another randomized controlled trial demonstrated a 33% non-compliance rate.[6] It therefore seems that for a fairly high proportion of patients undergoing twin-block treatment, the treatment will not be successful. Read has introduced a modified version of the twin-block appliance: a clip-on fixed functional appliance (COFF). The COFF has several advantages over the removable twin-blocks, as the patient cannot remove it. It works 24 hours a day, and patient cooperation is not a problem. As a result the treatment time is short. However, the COFF has some disadvantages due to its construction: breakage of the appliance (particularly the bands in the lower arch); intricate fabrication, and the difficulties in removing plaque and food debris from around the appliance.[7]

The Herbst appliance has been described as a fixed functional appliance. The effectiveness of this appliance is probably related to its reduced demand on patient compliance as compared with the twin-block appliance. This has resulted in a higher rate of patient acceptance. However, a major problem with the Herbst appliance is that the link between the mandibular and maxillary dentitions is fixed. This might lead to high levels of stress in the components, particularly in lateral excursions, resulting in fracture or debonds.[8] Importantly, the mean number of visits needed to repair the Herbst appliances in a previous study was 4.3,[9] and the chairside time needed for repair can be excessive.

The extra visits for Herbst appliance repair and the additional cost of appliance construction will ultimately counteract its reduced demand on patient tolerance and operator acceptance.

The authors considered that a method of solving these problems was to develop a fixed functional appliance in two separate parts. As a result, the authors decided to modify the twin-block appliance so that it could be fixed to the teeth.

Appliance construction and design

This modified twin-block appliance is a cast cobalt chromium design (Figure 1a–c). It consists of maxillary

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(a) (b) (c)

Figure 1 (a–c) New design of the cast metal fixed twin-block appliance

and mandibular fixed appliances cemented to the first permanent molars and second premolars directly through the use of cast crowns. The active components are hollow cast blocks with steeply inclined planes interlocked at approximately 70° to the occlusal plane resting on and covering the occlusal surfaces that posture the mandible forward when the patient is in occlusion. Anchorage in the upper dental arch consists of a cast palatal bar connecting crowns on both sides. Anchorage in the lower dental arch consists of a cast lingual arch touching the lingual surface of the anterior teeth and extending to the crowns of the second premolars.

After fitting of this functional appliance, fixed appliances can be placed as soon as practicable. The two stages of treatment can then be run concurrently, therefore, reducing treatment time significantly.

Bite registration

For Class II problems, the jaw registration is taken with the mandible forward so that the incisors are edge to edge, and the teeth are 6–7 mm apart in the buccal segments. For patients who have limited mandibular forward posture and patients with large initial overjet, the mandible should be advanced step by step. The inter-occlusal clearance is increased where there is increased overbite. Bite registration should also allow for correction of the midlines in cases in which they are displaced by functional occlusal interference or guidance into habitual occlusal. The upper and lower alginate impressions are taken in the usual way and then sent with the construction bite to the laboratory for fabrication of the appliance.

Clinical management

First the two parts of the appliance are tried on intra-orally and the patient is asked to close in a protruded position; then 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 cast crowns, therefore increasing the possibility of loosening or breakage. Thereafter the fixed appliance is cemented in position with glass ionomer cement.

The patient should be given clear instructions about the care and management of the appliance. The way in which the appliance is constructed makes it easy to maintain good oral hygiene, thus decreasing the possibility of enamel decalcification. However, the brushing technique should also be monitored to ensure that the patient has the ability to maintain excellent oral hygiene.

The next 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.

After that, the patient should attend the clinic at eight-week intervals. The fixed appliance can be placed as soon as the patient is accustomed to the cast blocks. The amount of overjet reduction should be checked if the appliance has become loose, and, when the sagittal arch relationships are fully corrected (giving a normal incisor relationship with the buccal segment out of occlusion), the blocks can then be removed. The treatment can then be completed with full fixed appliances. However, should significant proclination have occurred, for example, the lower incisors leading to an excessively reduced inter-incisal angle, then at this stage extractions may be required to correct this. The overlapping of the functional phase and fixed phase reduces treatment time significantly, which is clearly a major advantage.

Figure 2 Pre-treatment photographs: (a,b) extra-oral and (c–e) intra-oral

Timing of treatment

The optimal time to correct Class II malocclusions with this appliance is during or even slightly after the onset of the pubertal peak in growth velocity. As stated by Pancherz,[5] late functional/orthopedic therapy of Class II malocclusion just after the onset of the peak in growth velocity is recommended to favour maximum treatment effect and reduce the time of post-treatment retention.

Case report

A 14-year-old Chinese boy complained about his prominent upper anterior teeth and spaces in the lower arch. Intra-oral examination showed all the permanent teeth were present with the exception of the third molars. While the overjet was only 4.0 mm and the overbite was average and complete to tooth, the molar and canine relationships were half a unit Class II on both sides (Figure 2a–e). Space closure in the lower arch only would have exacerbated these features. The cephalometric analysis confirmed that the patient had a Class I skeletal pattern with an ANB value of 3.0°; the maxillary–mandibular planes angle was 11.4°. The inter-incisor angle was 107.2° and the lower incisors were proclined (Figure 3a,b; Table 1).

The aims of treatment were to:

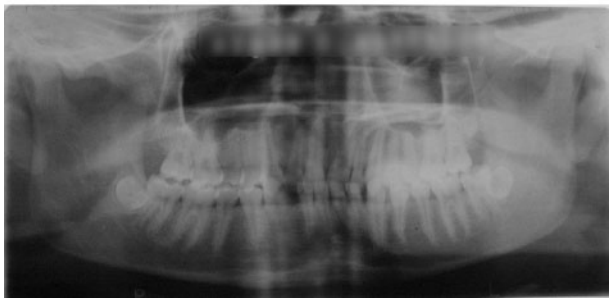
- correct the Class II molar and canine relationships and establish a Class I dental relationship;
- level and align the upper and lower arches;
- close the spaces in the lower arch.

The treatment plan was as follows:

- to correct the Class II problem with the fixed functional appliance;
- to commence the levelling and alignment with fixed appliances as the functional stage progresses.

The appliance was fitted and the patient was given instructions about the care of the appliance. The patient was seen two months later and fixed pre-ajusted edgewise appliances were bonded to the teeth from left to right first premolars on both the upper and lower arches (Figure 4a–c). Five months later the incisor relationship was edge-to-edge and the mandible could not move back. The cast blocks were removed, thus completing the seven months of functional appliance treatment. There was a bilateral open bite in the

(a)



(b)

Figure 3 Pre-treatment radiographs: (a) cephalometric and (b) panoramic

posterior region. Four first molars were banded and 0.016-inch Australian wires were used. The patient was instructed to wear Class II elastics to maintain the corrected incisor relationship (Figure 4d–f).

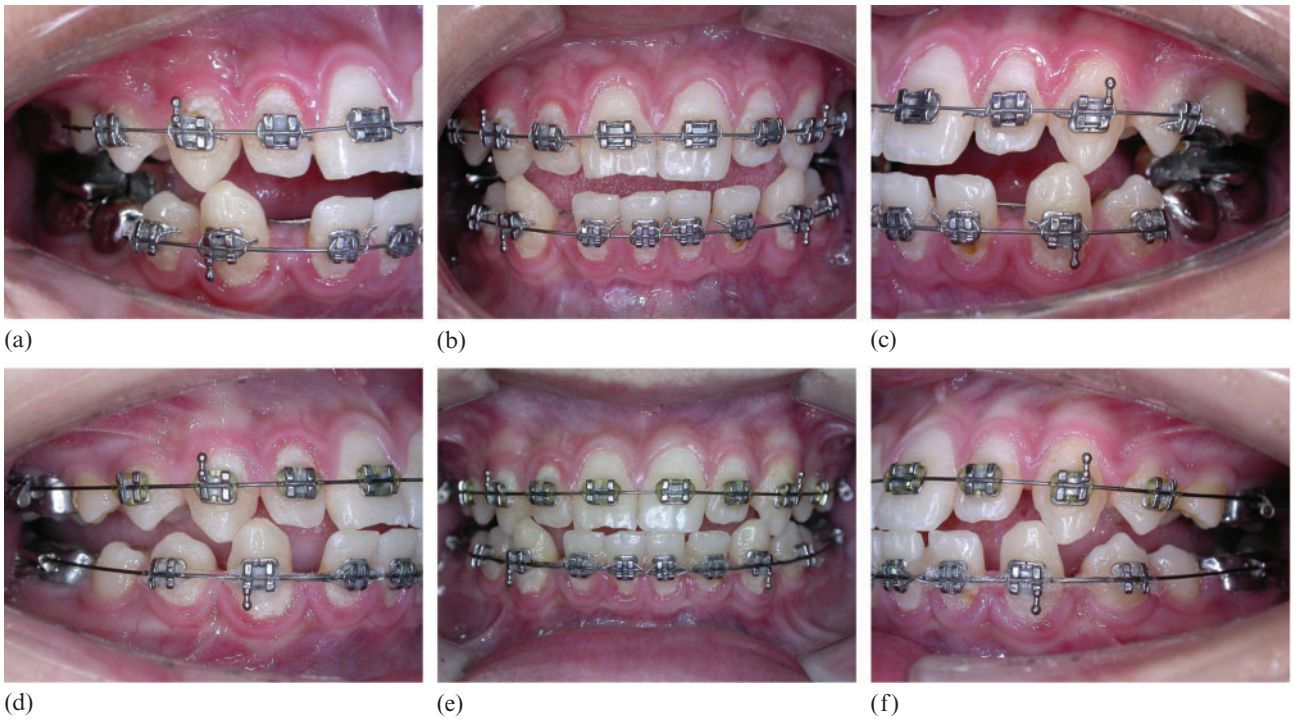
After four weeks the patient attended once more and the canine and molar relationships were still Class I. The four second premolars were bonded. The regular aligning and levelling phase was started by using NiTi archwires. The posterior open bite decreased spontaneously. The pre-adjusted edgewise treatment time was 12 months (Figures 5a–e, 6a,b, 7; Table 1).

Discussion

This appliance is similar to the removable twin-block introduced by Clark[4] and works in the same way. The main difference is that this appliance is designed for direct fixation to the teeth using cement, and patient cooperation is no longer a problem, which is one of the important factors influencing the choice of orthodontic treatment. The adaptation to this appliance by the patient seems to be quicker than with the classic twin-block because there is no opportunity to remove it and the patient has to get used to it. Another reason is that the appliance is much smaller and less intrusive. After removal of the appliance there is always an open bite in the buccal segments, but this can be corrected easily by normal means. If the mandible could not be moved forward to an edge-to-edge relationship in one step, it can be achieved using a step-by-step technique, by applying self-curing acrylic on the posterior parts of the

Table 1 Cephalometric analysis.

Variable	Pre-treatment	Post-treatment
SNA	82.9°	83.3°
SNB	80.5°	82.9°
ANB	2.4°	0.4°
Wits appraisal	2.7 mm	−0.2 mm
Upper incisor to maxillary plane angle	125.5°	121.6°
Upper incisor to sella–nasion plane angle	117.5°	110.9°
Lower incisor to mandibular plane angle	108.2°	99.2°
Interincisal angle	115.0°	130.0°
Maxillary–mandibular planes angle	11.4°	9.2°
Upper anterior face height	56.9 mm	60.0 mm
Lower anterior face height	61.8 mm	66.7 mm
Face height ratio	52.1%	52.6%
Lower incisor to A–Po line	1.4 mm	0.1 mm
Lower lip to Ricketts E Plane	2.5 mm	−0.7 mm



(a) (b) (c)

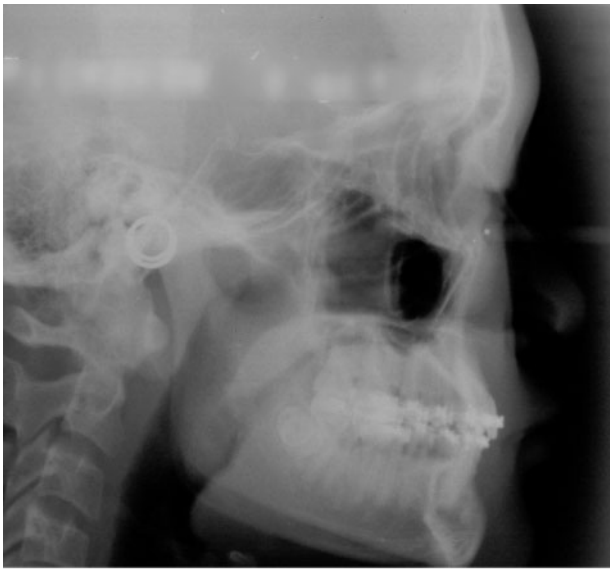
(d) (e) (f)

Figure 4 Mid-treatment intra-oral photographs: (a–c) the twin-block appliance *in situ*, (d–f) just after the removal of twin-block appliance

(a) (b)

(c) (d) (e)

Figure 5 Post-treatment photographs: (a,b) extra-oral and (c–e) intra-oral



(a)

(b)

Figure 6 Radiographs at the end of treatment: (a) cephalometric and (b) panoramic

lower blocks to lengthen them. This procedure can be completed with care both in and out of the mouth.

As compared with the COFF, this appliance is not expected to be broken owing to its cast cobalt chromium design. The construction of this appliance is less complicated than that of the COFF, so the fabrication is easier, and is more favourable to oral hygiene.

In contrast with the Herbst appliance, there is no fixed link between the upper and lower parts of this appliance, this allows the patient to have a good range of jaw movement and makes it more comfortable to wear. Another advantage of this appliance is that it is strong enough to sustain the pressure produced by the stretched muscles and the occlusal forces generated during biting and chewing. This minimizes the opportunity of breakage or loosening and reducing the number of visits needed for repairing or rebonding the appliances. It appears that, when the appliance becomes loose, the rebond is fairly straightforward, and often it is not necessary to rebond as patients feel nothing uncomfortable and hold the blocks in place without difficulty.

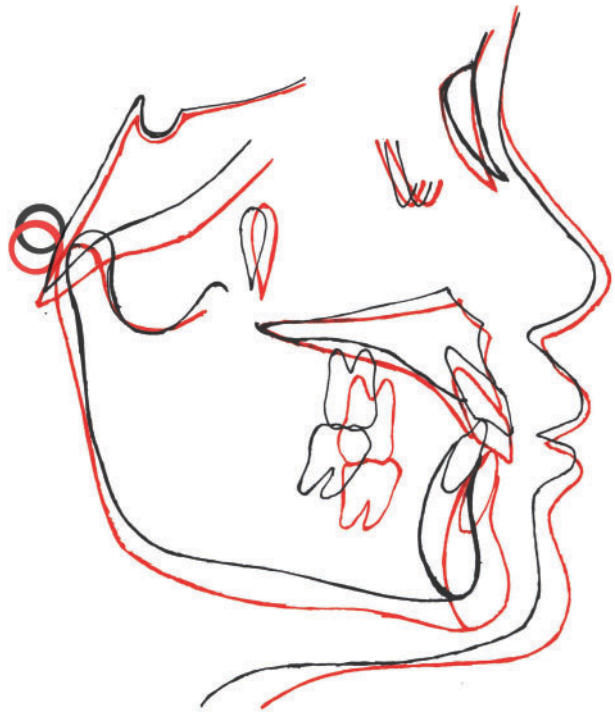


Figure 7 Cephalometric superimposition (black: pre-treatment; red: post-treatment)

To maintain good oral hygiene is a major problem when the orthodontic appliances are in the mouth. The design and fabrication of this appliance make it easy to remove plaque and food debris from around it, which decreases the opportunity of enamel demineralization. Moreover, simple laboratory technology and relatively low costs are needed in the appliance construction, and the hollow cast block is less bulky, lighter and more tolerable.

Another major benefit of this appliance is that pre-adjusted edgewise treatment can be carried out at the same time as the functional treatment. It is possible to place pre-adjusted edgewise appliances as soon as the patient get used to the cast blocks. This seamless transition of the two stages reduces treatment time significantly.

Characteristics of this appliance

- Patient co-operation is not a problem, and the appliance allows full-time wear.
- Its strength.
- Saves chairside time and is easily operated.

- Minimizes the influence of oral function and hygiene.
- It is possible to overlap the functional and fixed phases so that treatment time is reduced.
- Simple laboratory technology and low cost.

Conclusion

It seems that this fixed twin-block appliance is an effective method of treating Class II malocclusion and may reduce treatment time. As the patient cannot remove it, the main theoretical advantages of this appliance over the removable twin-block are that patient cooperation is not a problem and the appliance is active for 24 hours a day. Furthermore, there is no transition phase between the functional and pre-adjusted edgewise appliance phases, and it is easy to fabricate.

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