Third Edition

JAYPEE

# Twin Block

# Functional Therapy

## Applications in Dentofacial Orthopedics



William J Clark

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# Chapter 2

# Introduction to Twin Blocks

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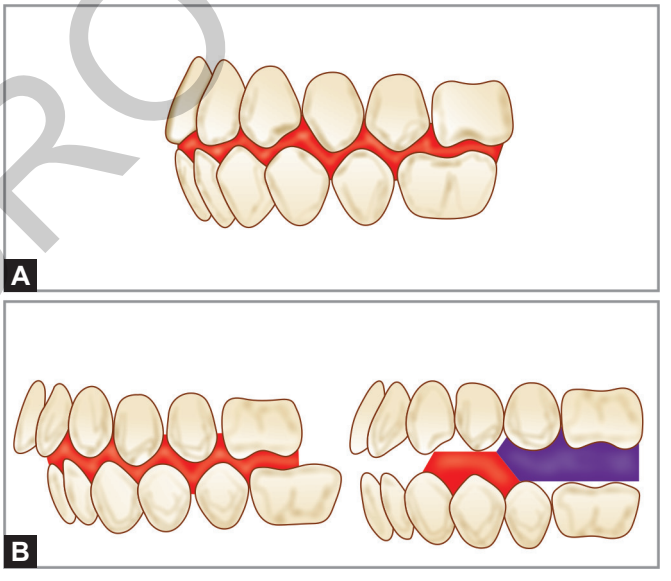
## THE OCCLUSAL INCLINED PLANE

The occlusal inclined plane is the fundamental functional mechanism of the natural dentition. Cuspal inclined planes play an important part in determining the relationship of the teeth as they erupt into occlusion.

If the mandible occludes in a distal relationship to the maxilla, the occlusal forces acting on the mandibular teeth in normal function have a distal component of force that is unfavorable to normal forward mandibular development. The inclined planes formed by the cusps of the upper and lower teeth represent a servomechanism that locks the mandible in a distally occluding functional position.

Twin Block appliances are simple bite blocks that are designed for full-time wear. They achieve rapid functional correction of malocclusion by the transmission of favorable occlusal forces to occlusal inclined planes that cover the posterior teeth. The forces of occlusion are used as the functional mechanism to correct the malocclusion (Figs. 2.1A and B).




**Figs. 2.1A and B:** The occlusal inclined plane is the functional mechanism of the natural dentition. Twin Blocks modify the occlusal inclined plane and use the forces of occlusion to correct the malocclusion. The mandible is guided forwards by the occlusal inclined plane.

## PROPRIOCEPTIVE STIMULUS TO GROWTH

The inclined plane mechanism plays an important part in determining the cuspal relationship of the teeth as they erupt into occlusion. A functional equilibrium is established under neurological control in response to repetitive tactile stimulus. Occlusal forces transmitted through the dentition provide a constant proprioceptive stimulus to influence the rate of growth and the trabecular structure of the supporting bone.

Malocclusion is frequently associated with discrepancies in arch relationships due to underlying skeletal and soft-tissue factors, resulting in unfavorable cuspal guidance and poor occlusal function. The proprioceptive sensory feedback mechanism controls muscular activity and provides a functional stimulus or deterrent to the full expression of mandibular bone growth. The unfavorable cuspal contacts of distal occlusion represent an obstruction to normal forward mandibular translation in function, and as such do not encourage the mandible to achieve its optimum genetic growth potential.

## Transverse Maxillary Development

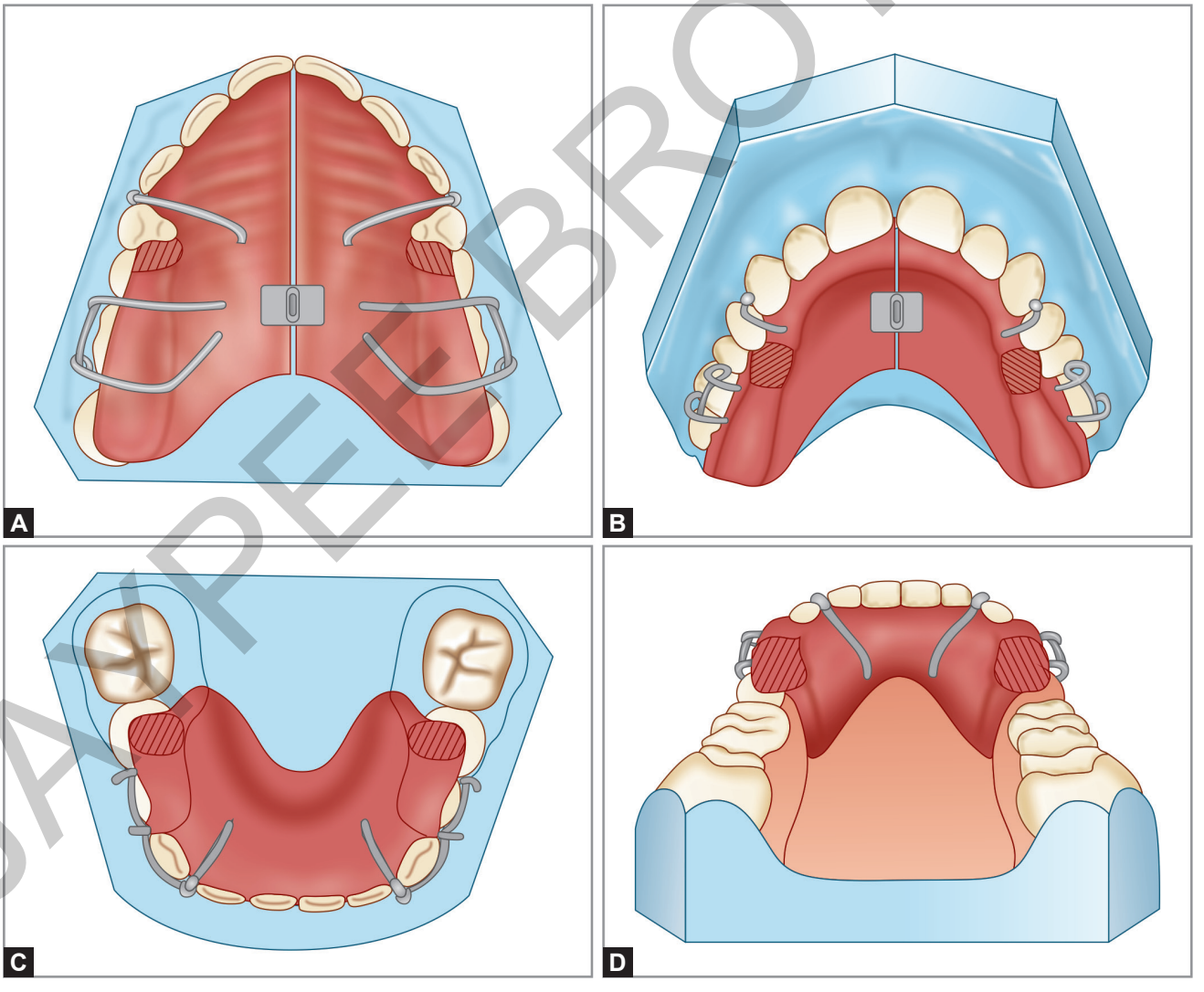
Transverse maxillary development is restricted as a result of a distally occluding mandible. In a retrusive mandible the lower dentition does not offer support to the maxillary arch, therefore the maxillary intercanine width and intermolar width is reduced accordingly. The constricted width of the maxillary dentition has the effect of locking the mandible in a distal occlusion and prevents normal mandibular development.

Functional appliance therapy aims to improve the functional relationship of the dentofacial structures by eliminating unfavorable developmental factors and improving the muscle environment that envelops the developing occlusion. By altering the position of the teeth and supporting tissues, a new functional behavior pattern is established that can support a new position of equilibrium.

## TWIN BLOCKS

The goal in developing the Twin Block approach to treatment was to produce a technique that could maximize the growth response to functional mandibular protrusion by using an appliance system that is simple, comfortable and aesthetically acceptable to the patient.

Twin Blocks are constructed to a protrusive bite that effectively modifies the occlusal inclined plane by means of acrylic inclined planes on occlusal bite blocks. The purpose is to promote protrusive mandibular function for correction of the skeletal Class II malocclusion (Figs. 2.2A to F).




**Figs. 2.2A to D:** (A and B) Upper Twin Block—occlusal and frontal; (C and D) Lower Twin Block—occlusal and rear views.

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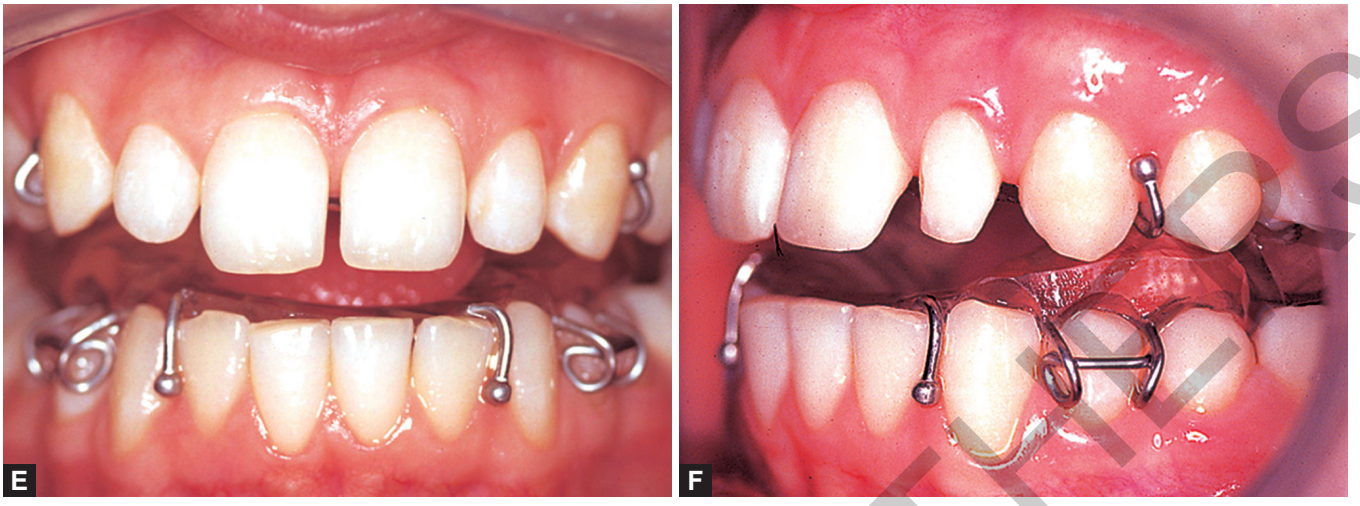

**Figs. 2.2E and F:** Twin Blocks.

The occlusal inclined plane acts as a guiding mechanism causing the mandible to be displaced downward and forward. With the appliances in the mouth, the patient cannot occlude comfortably in the former distal position and the mandible is encouraged to adopt a protrusive bite with the inclined planes engaged in occlusion. The unfavorable cuspal contacts of a distal occlusion are replaced by favorable proprioceptive contacts on the inclined planes of the Twin Blocks to correct the malocclusion and to free the mandible from its locked distal functional position.

Twin Blocks are designed to be worn 24 hours per day to take full advantage of all functional forces applied to the dentition, including the forces of mastication. Upper and lower bite blocks interlock at a 70° angle when engaged in full closure. This causes a forward mandibular posture to an edge-to-edge position with the upper anteriors, provided the patient can comfortably maintain full occlusion on the appliances in that position. In treatment of Class II malocclusion, the inclined planes are positioned mesial to the upper and lower first molars with the upper block covering the upper molars and second premolars or deciduous molars, and the lower blocks extending mesially from the second premolar or deciduous molar region.

In the early stages of their evolution, Twin Blocks were conceived as simple removable appliances with interlocking occlusal bite blocks designed to posture the mandible forward to achieve functional correction of a Class II division 1 malocclusion. This basic principle still applies but over the years many variations in appliance design have extended the scope of the technique to treat a wide range of all classes of malocclusion. Appliance design has been improved and simplified to make Twin Blocks more acceptable to the patient without reducing their efficiency.

In the treatment of Class II division 2 malocclusion, appliance design is modified by the addition of sagittal screws to advance the upper anterior teeth. Control of the vertical dimension is achieved by sequentially adjusting the thickness of the posterior occlusal inclined planes to control eruption (Figs. 2.3A to C).

Treatment of Class III malocclusion is achieved by reversing the occlusal inclined planes to apply a forward component of force to the upper arch and a downward and distal force to the mandible in the lower molar region. The inclined planes are set at 70° to the occlusal plane with bite blocks covering lower molars and upper deciduous molars or premolars, with sagittal screws to advance the upper incisors (Figs. 2.4A to C).

The first principle of appliance design is simplicity. The patient's appearance is noticeably improved when Twin Blocks are fitted. Twin Blocks are designed to be comfortable, aesthetic and efficient. By addressing these requirements, Twin Blocks satisfy both the patient and the operator as one of the most "patient friendly" of all the functional appliances.

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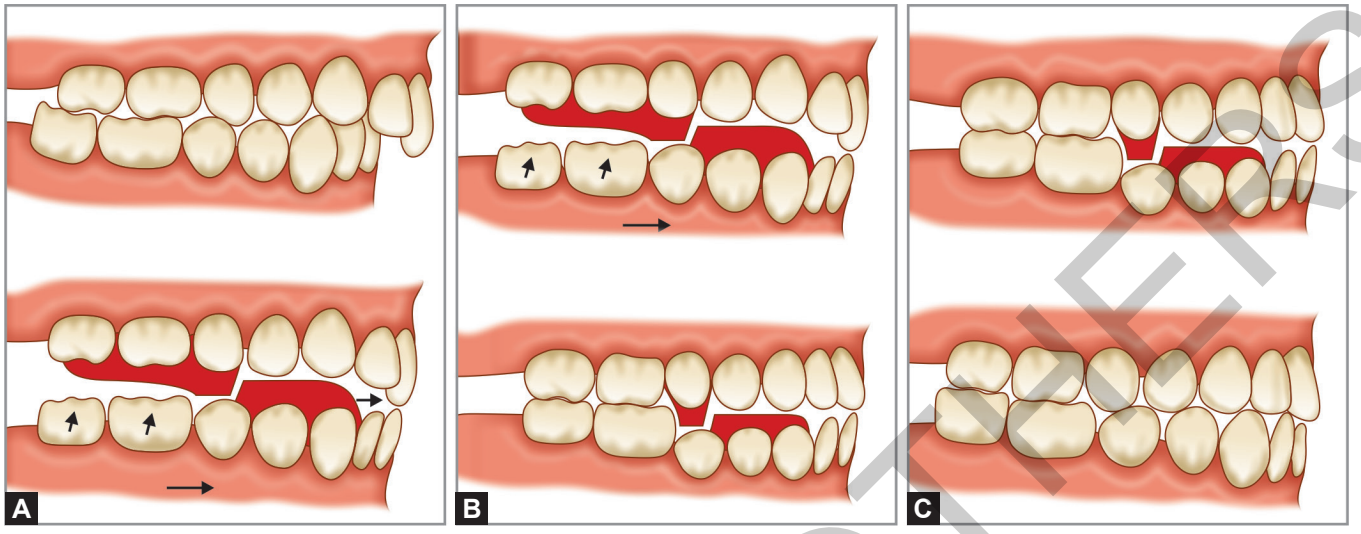
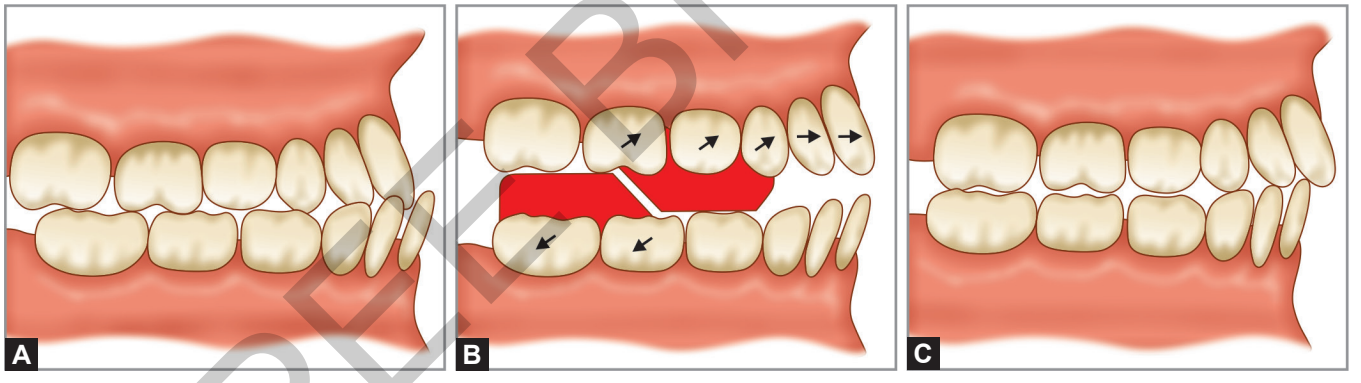
## Treatment of Class II Division 2 Malocclusion




**Figs. 2.3A to C:** Correction of Class II division 2 malocclusion by advancing the mandible and proclining the upper incisors with sagittal screws. Vertical control is important in management of Class II division 2 malocclusion. The bite registration for this type of malocclusion is edge to edge on the upper and lower incisors. The overbite is reduced by progressive trimming of the upper blocks to allow eruption of lower molars. At the end of the Twin Block phase the molars are in Class I occlusion and the overbite is fully reduced.

## Treatment of Class III Malocclusion




**Figs. 2.4A to C:** Reverse Twin Blocks for correction of Class III malocclusion with sagittal screws to advance upper incisors. The upper block may also incorporate an occlusal screw for progressive activation.

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## DEVELOPMENT OF TWIN BLOCKS

### Case Report: CG Aged 7 Years 10 Months

It is true that 'necessity is the mother of invention'. The Twin Block appliance evolved in response to a clinical problem that presented when a young patient, the son of a dental colleague, fell and completely luxated an upper central incisor. Fortunately, he kept the tooth, and presented for treatment within a few hours of the accident. The incisor was reimplanted and a temporary splint was constructed to hold the tooth in position (Figs. 2.5A to L).

Before the accident the center line was displaced to the right and the luxated incisor had a pronounced distal angulation with a central diastema of 3 mm. When the tooth was reimplanted the socket was enlarged to reposition the incisor as near as possible to the midline. Complete correction of the midline was not possible, recognizing that enlarging the socket too much might reduce the prognosis for reattachment of the tooth.

After 6 months with a stabilizing splint, the tooth had partially reattached, but there was evidence of severe root resorption and the long-term prognosis for the reimplanted incisor was poor.

The occlusal relationship was Class II division 1 with an overjet of 9 mm and the lower lip was trapped lingual to the upper incisors. Adverse lip action on the reimplanted incisor was causing mobility and root resorption. To prevent the lip from trapping in the overjet it was necessary to design an appliance that could be worn full time to posture the mandible forward. At that time no such appliance was available and simple bite blocks were therefore designed to achieve this objective. The appliance mechanism was designed to harness the forces of occlusion to correct the distal occlusion and also to reduce the overjet without applying direct pressure to the upper incisors.

The upper and lower bite blocks engaged mesial to the first permanent molars at 90° to the occlusal plane when the mandible postured forward. This positioned the incisors edge-to-edge with 2 mm vertical separation to hold the incisors out of occlusion. The patient had to make a positive effort to posture his mandible forward to occlude the bite blocks in a protrusive bite. Fortunately, the young patient was successful in doing this consistently to activate the appliance for functional correction. Had he not made this effort the technique may have been stillborn.

The first Twin Block appliances were fitted on 7 September 1977, when the patient was aged 8 years 4 months. The bite blocks proved comfortable to wear and treatment progressed well as the distal occlusion corrected and the overjet reduced from 9 mm to 4 mm in 9 months.

During the course of treatment radiographs confirmed that the reimplanted incisor had severe root resorption and an endodontic pin was placed to stabilize this tooth after 4 months of treatment. This was successful in stabilizing the incisor.

At a later stage, in the permanent dentition, a simple upper fixed appliance was used to complete treatment. It was not possible to correct the centre line fully in replacing the luxated tooth, and the central incisor ankylosed during the process of reattachment. Consequently, a slight displacement of the center line had to be accepted. The reimplanted incisor was crowned successfully, and the result is stable at age 25 years.

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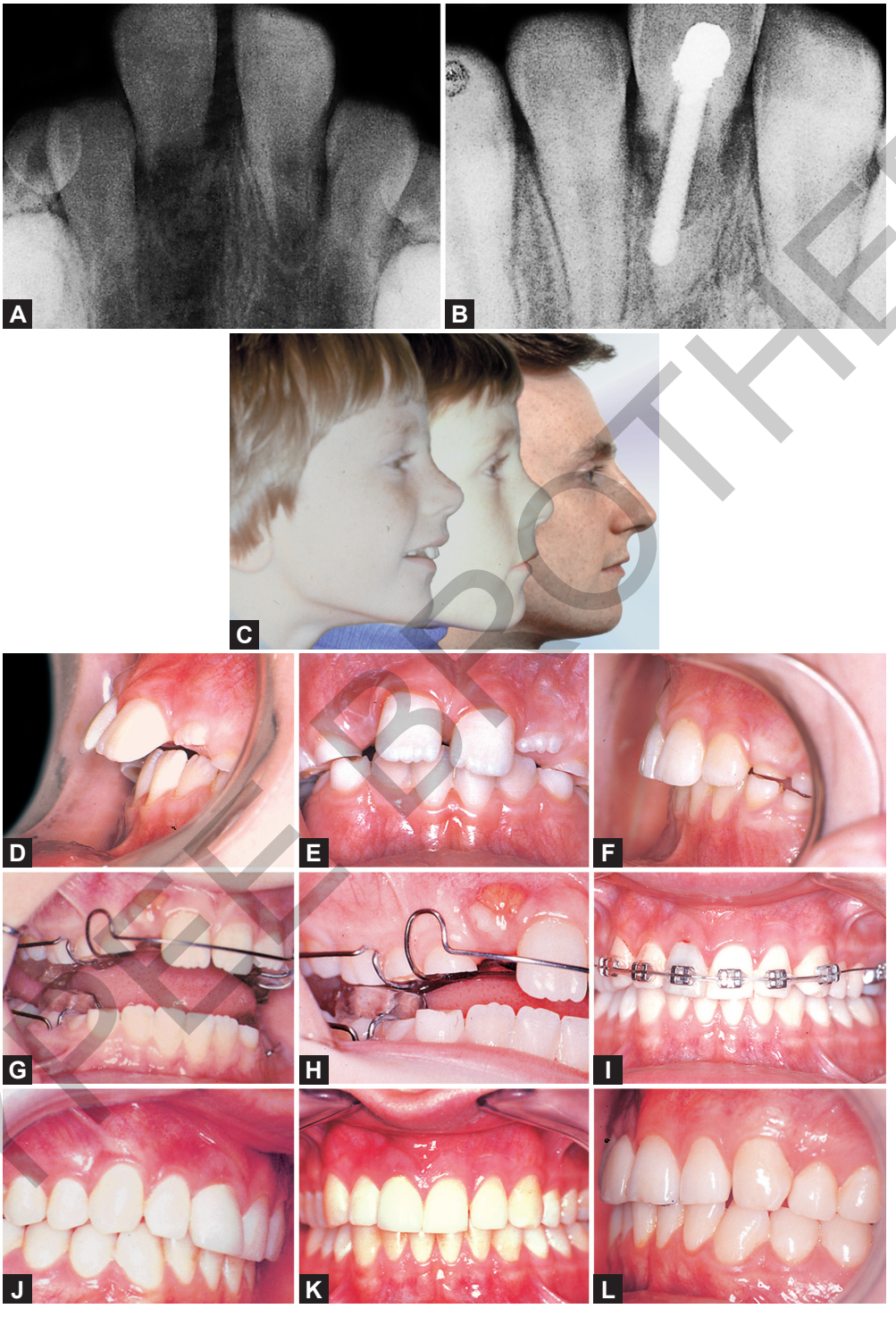
## Case Report: CG




**Figs. 2.5A to L:** Treatment: (A and B) Before treatment: $\underline{1}|$ was completely luxated and was reimplanted. An endodontic pin was fitted to stabilize the incisor. This was successful in achieving bony reattachment; (C) Profiles at ages 7 years 10 months (before treatment), 9 years 7 months (after 9 months of treatment) and 24 years; (D and E) Dental views before treatment at age 7 years 10 months; (F) After 9 months of treatment, the overjet has reduced, and the distal occlusion is corrected; (G and H) The first Twin Blocks were simple bite blocks occluding in forward posture. The blocks were angled at 90° to the occlusal plane; (I) A simple fixed appliance is used to improve alignment in permanent dentition. The damaged upper incisor is now ankylosed; (J to L) The occlusion remains stable 5 years out of retention.

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## MODIFICATION FOR TREATMENT OF CLASS II DIVISION 2 MALOCCLUSION

### Case Report: AK Aged 11 Years 1 Month

Two years later, having developed a protocol for Twin Block treatment of Class II division 1 malocclusion, attention was turned to Class II division 2 malocclusion. The first patient of this type presented a severe malocclusion with an excessive overbite and an interincisal angle approaching 180° (Figs. 2.6A to I). As an indication of the depth of the overbite the intergingival height from the gingival margin of the upper incisors to the gingival margin of the lower incisors was 7 mm, suggesting that the upper incisors were impinging on the lower gingivae. The lower archform was good but the mandible was trapped in distal occlusion by the retroclined upper incisors.

The original Twin Block prototype appliances were modified from the standard design for correction of Class II division 1 malocclusion by the addition of springs lingual to the upper incisors to advance retroclined upper incisors. At the same time the mandible was translated forwards to correct the distal occlusion and the appliance was trimmed to encourage eruption of the posterior teeth to reduce the overbite.

The Class II division 2 Twin Blocks were worn for 6 months, at which stage brackets were fitted on the upper anterior teeth and activated with a sectional archwire to correct individual tooth alignment. This combination fixed/functional appliance treatment continued for 6 months. Completion of treatment was then effected with a simple upper fixed appliance.

**Case Report: AK**




**Figs. 2.6A to I:** A patient with a Class II division 2 malocclusion treated with Twin Blocks: (A to C) Excessive overbite and severely retroclined incisors; (D and E) After 8 months the distal occlusion is corrected and the overbite is reduced; (F) A simple upper fixed appliance to correct alignment; (G to I) The occlusion is stable 3 years later. A diagrammatic interpretation of the treatment is given on case report AK.

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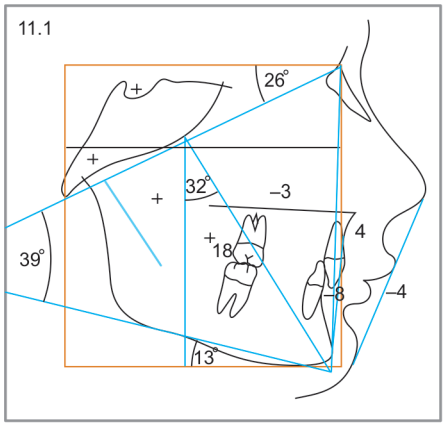
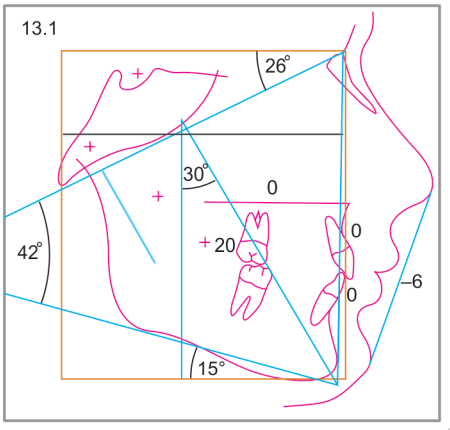
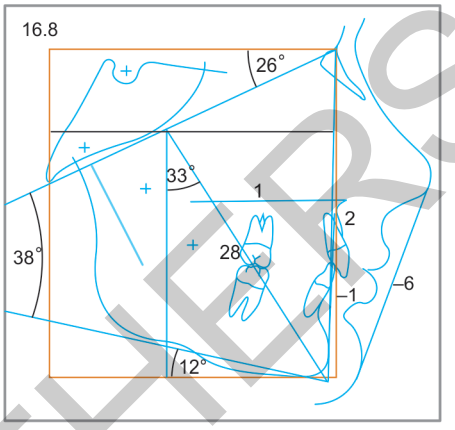
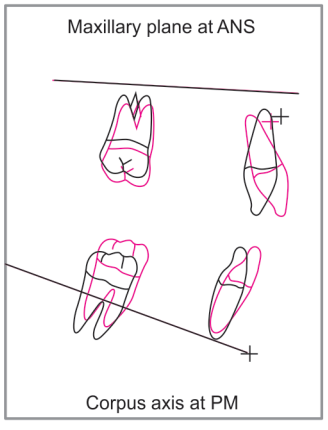
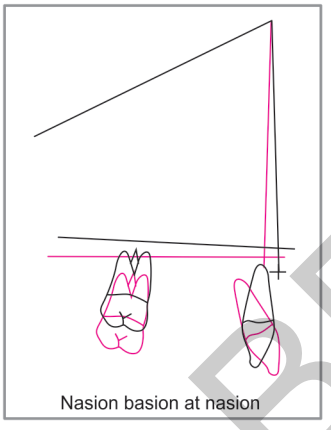
## Case Report: AK

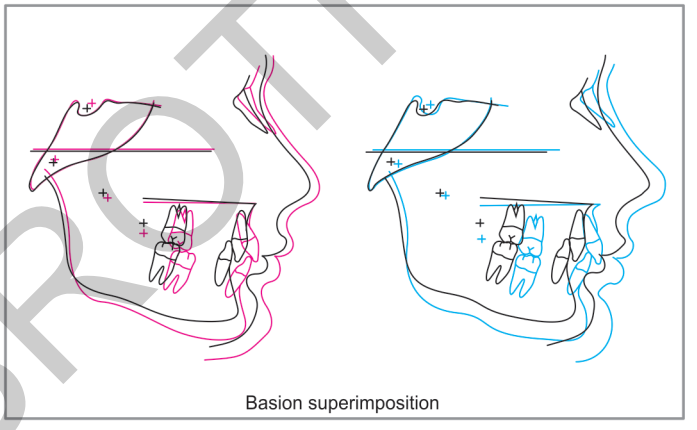


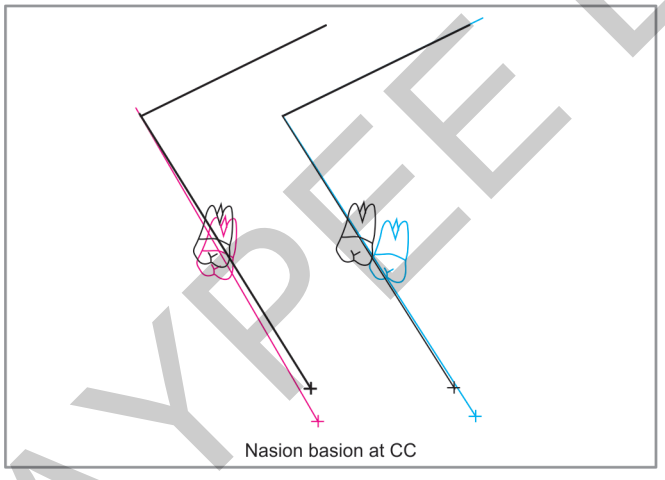




| AK | Age | 11.1 | 13.1 | 16.8 |
|---|---|---|---|---|
| Cranial Base Angle | | 26 | 26 | 26 |
| Facial Axis Angle | | 32 | 30 | 33 |
| F/M Plane Angle | | 13 | 15 | 12 |
| Craniomandibular Angle | | 39 | 42 | 38 |
| Maxillary Plane | | –3 | 0 | 1 |
| Convexity | | 4 | 0 | 2 |
| U/Incisor to Vertical | | –5 | 22 | 17 |
| L/Incisor to Vertical | | 16 | 29 | 26 |
| Interincisal Angle | | 169 | 129 | 137 |
| 6 to Pterygoid Vertical | | 18 | 20 | 28 |
| L/Incisor to A/Po | | –8 | 0 | –1 |
| L/Lip to Aesthetic Plane | | –4 | –6 | –6 |

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## Angulation of the Inclined Planes

During the evolution of the technique, the angulation of the inclined plane varied from 90° to 45° to the occlusal plane, before arriving at an angle of 70° to the occlusal plane. An angle of 45° may be used for patients who have more difficulty in maintaining a forward mandibular posture.

The earliest Twin Block appliances were constructed with bite blocks that articulated at a 90° angle, so that the patient had to make a conscious effort to occlude in a forward position. However, some patients had difficulty maintaining a forward posture and, therefore, would revert to retruding the mandible back to its old distal occlusion position, occluding the bite blocks together on top of each other on their flat occlusal surfaces. This was detectable at an early stage of treatment when it could be observed that the patient was not posturing forwards consistently. A significant posterior open bite was caused by biting on the blocks in this fashion. This complication was experienced in approximately 30% of the earliest Twin Block cases. It was resolved by altering the angulation of the bite blocks to 45° to the occlusal plane in order to guide the mandible forwards. This was immediately successful in eliminating the problem.

An angle of 45° to the occlusal plane applies an equal downward and forward component of force to the lower dentition. The direction of occlusal force on the inclined planes encourages a corresponding downward and forward stimulus to growth. After using a 45° angle on the blocks for 8 years, the angulation was finally changed to the steeper angle of 70° to the occlusal plane to apply a more horizontal component of force. It was reasoned that this may encourage more forward mandibular growth. If the patient has any difficulty in posturing forward, it is preferable to reduce the angulation of the inclined planes to 45° to guide the mandible forward and make it easier for the patient to maintain a forward posture.

## Bite Registration

The Exactobite or Projet Bite Gauge (the name differs in the USA and the UK) is designed to record a protrusive wax in wax for construction of Twin Blocks (Fig. 2.7). Typically, in a growing child, an overjet of up to 10 mm can be corrected on the initial activation by registering an incisal edge-to-edge bite with 2 mm interincisal clearance (Figs. 2.8A and B). This is provided that the patient can comfortably tolerate the mandible being protruded so the upper and lower incisors align vertically edge-to-edge. Larger overjets invariably require partial correction, followed by reactivation after the initial partial correction is accomplished.

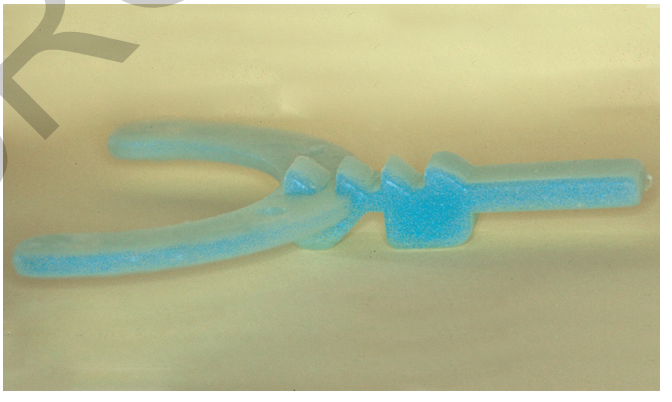
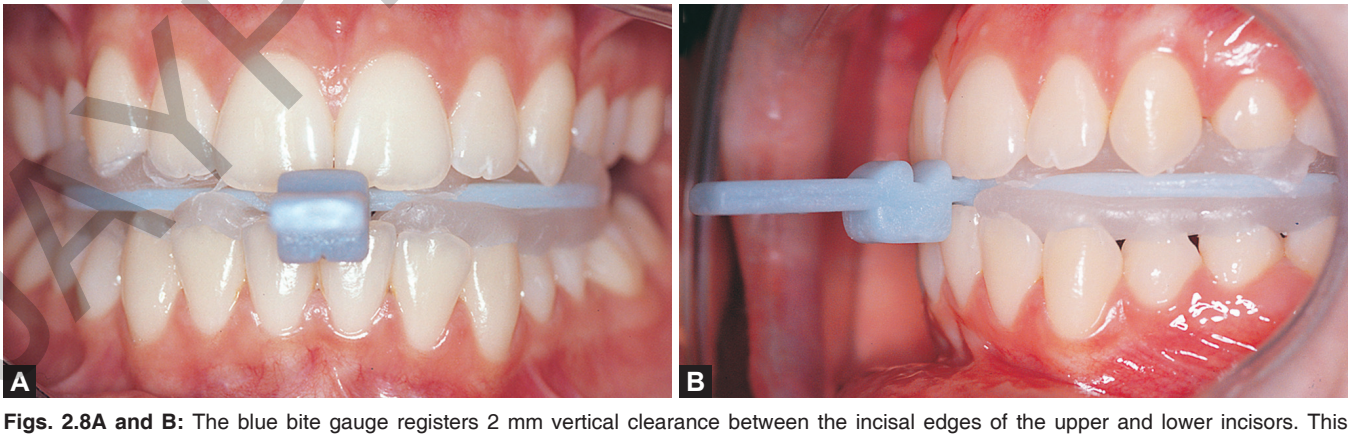


**Fig. 2.7:** Projet bite gauge.




**Figs. 2.8A and B:** The blue bite gauge registers 2 mm vertical clearance between the incisal edges of the upper and lower incisors. This generally proves to be an appropriate interincisal clearance in bite registration for most Class I division 1 malocclusions with increased overbite.

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## Appliance Design—Twin Blocks for Correction of Uncrowded Class II Division 1 Malocclusion

It is usually necessary to widen the upper arch to accommodate the lower arch in the corrected protrusive position. The upper appliance incorporates a midline screw to expand the upper arch.

Delta clasps are placed on upper molars, with additional ball-ended clasps distal to the canines, or between the premolars or deciduous molars.

The lower appliance is a simple bite block with delta clasps on the first premolars and ball clasps mesial to the canines (Figs. 2.9A and B).

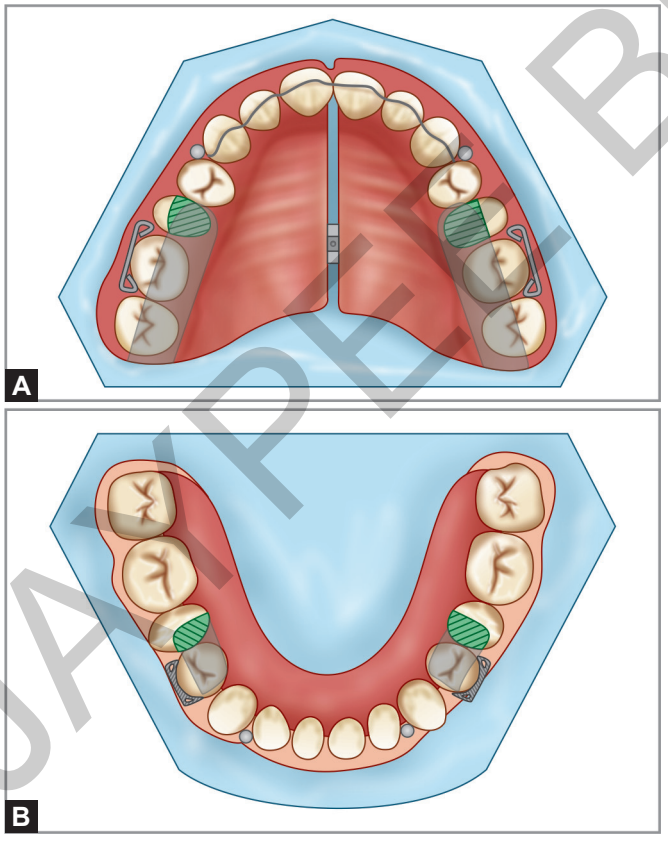
## THE TWIN BLOCK TECHNIQUE—STAGES OF TREATMENT

Twin Block treatment is described in two stages. Twin Blocks are used in the active phase to correct the anteroposterior relationship and establish the correct vertical dimension. Once this phase is accomplished, the Twin Blocks are replaced with an upper Hawley type of appliance with an anterior inclined plane, which is then used to support the corrected position as the posterior teeth settle fully into occlusion.

## Stage 1: Active Phase

Twin Blocks achieve rapid functional correction of mandibular position from a skeletally retruded Class II to Class I occlusion using occlusal inclined planes over the posterior teeth to guide the mandible into correct relationship with the maxilla. In all functional therapy, sagittal correction is achieved before vertical development of the posterior teeth is complete. The vertical dimension is controlled first by adjustment of the occlusal bite blocks, followed by use of the previously mentioned upper inclined plane appliance.

In treatment of deep overbite, the bite blocks are trimmed selectively to encourage eruption of lower posterior teeth to increase the vertical dimension and level the occlusal plane (Fig. 2.10). Throughout the trimming




**Figs. 2.9A and B:** Twin Blocks for correction of uncrowded class II division 1.

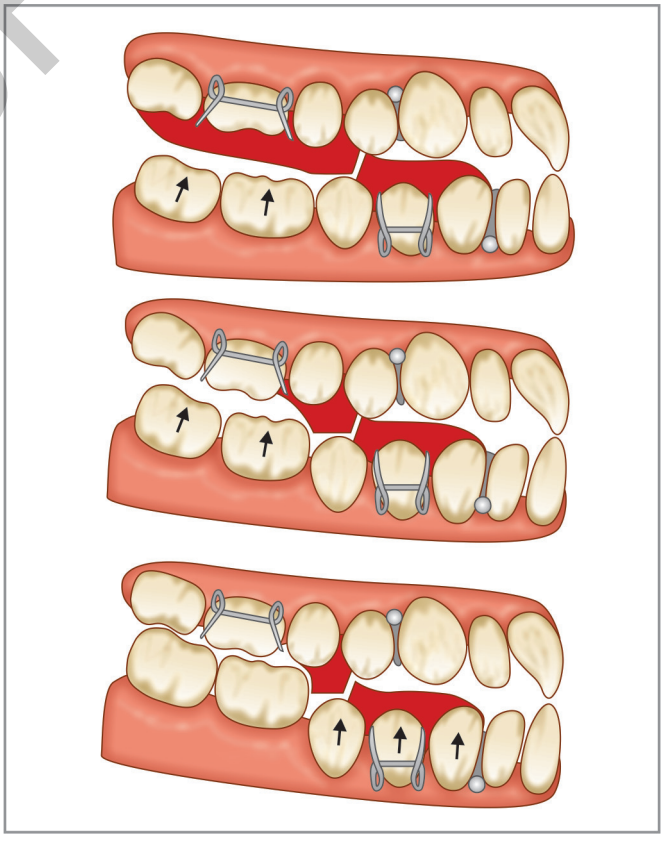


**Fig. 2.10:** Sequence of trimming blocks.

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sequence it is important not to reduce the leading edge of the inclined plane, so that adequate functional occlusal support is given until a three-point occlusal contact is achieved with the molars in occlusion.

The upper block is trimmed occlusodistally to leave the lower molars 1–2 mm clear of the occlusion to encourage lower molar eruption and reduce the overbite. By maintaining a minimal clearance between the upper bite block and the lower molars the tongue is prevented from spreading laterally between the teeth. This allows the molars to erupt more quickly. At each subsequent visit the upper bite block is reduced progressively to clear the occlusion with the lower molars to allow these teeth to erupt, until finally all the acrylic has been removed over the occlusal surface of the upper molars allowing the lower molars to erupt fully into occlusion.

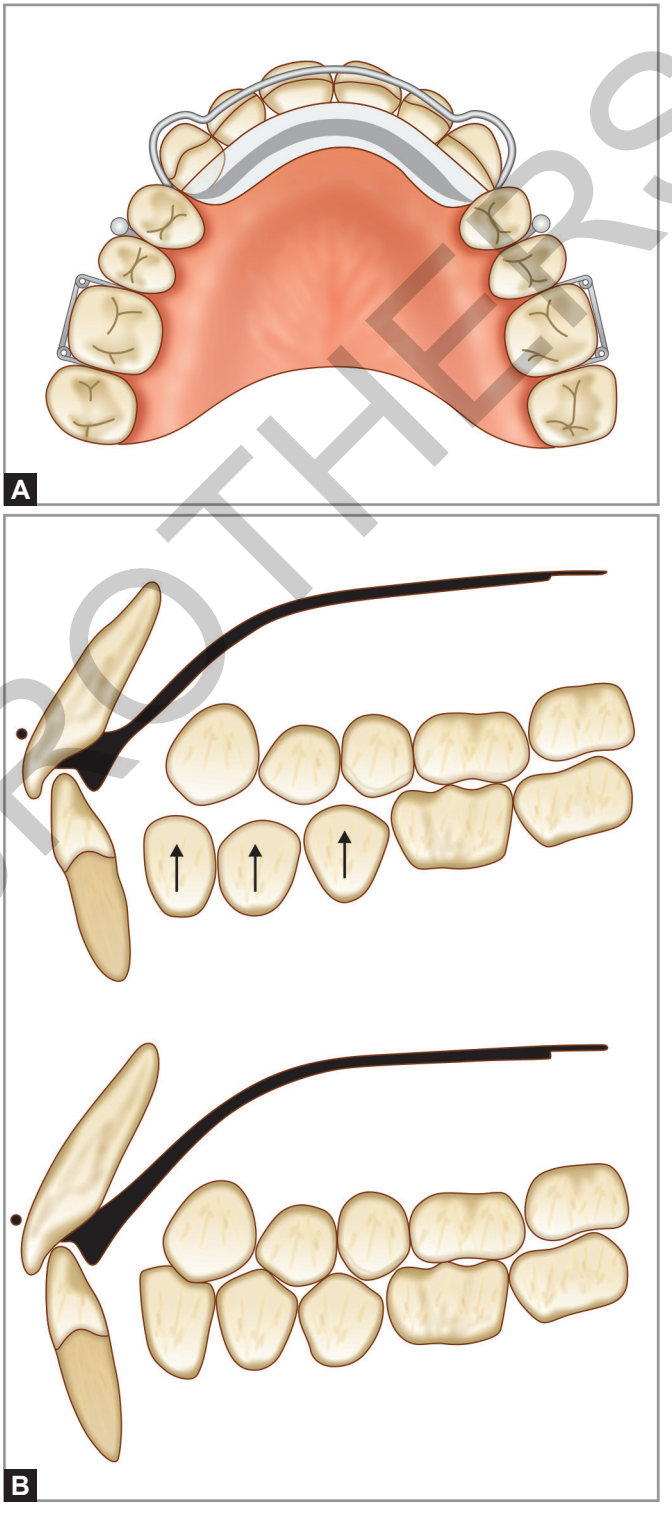
Conversely, in treatment of anterior open bite and vertical growth patterns, the posterior bite blocks remain unreduced and intact throughout treatment. This results in an intrusive effect on the posterior teeth, while the anterior teeth remain free to erupt, which helps to increase the overbite and bring the anterior teeth into occlusion.

At the end of the active stage of Twin Block treatment the aim is to achieve correction to Class I occlusion and control of the vertical dimension by a three-point occlusal contact with the incisors and molars in occlusion. At this stage the overjet, overbite and distal occlusion should be fully corrected.

## Stage 2: Support Phase

The aim of the support phase is to maintain the corrected incisor relationship until the buccal segment occlusion is fully interdigitated. To achieve this objective an upper removable appliance is fitted with an anterior inclined plane with a labial bow to engage the lower incisors and canines (Figs. 2.11A and B).

The lower Twin Block appliance is left out at this stage and the removal of posterior bite blocks allows the posterior teeth to erupt. Full-time appliance wear is necessary to allow time for internal bony remodelling to support the corrected occlusion as the buccal segments settle fully into occlusion.




**Figs. 2.11A and B:** Support phase—anterior inclined plane.

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## RETENTION

Treatment is followed by retention with the upper anterior inclined plane appliance. Appliance wear is reduced to night time only when the occlusion is fully established. A good buccal segment occlusion is the cornerstone of stability after correction of arch-to-arch relationships. The appliance-effected advanced mandibular position will not be stable until the functional support of a full buccal segment occlusion is well established.

### Timetable of Treatment: Average Treatment Time

- *Active phase*: average time 6–9 months to achieve full reduction of overjet to a normal incisor relationship and to correct the distal occlusion.
- *Support phase*: 3–6 months for molars to erupt into occlusion and for premolars to erupt after trimming the blocks. The objective is to support the corrected mandibular position after active mandibular translation while the buccal teeth settle fully into occlusion.
- *Retention*: 9 months, reducing appliance wear when the position is stabilized.

An average estimate of treatment time is 18 months, including retention.

## RESPONSE TO TREATMENT

Rapid improvements in facial appearance are seen consistently even during the first few months of Twin Block treatment. These changes are characterized by the development of a lip seal and a noticeable improvement in facial balance and harmony. Lip exercises are not necessary to achieve this change in soft-tissue behavior. The patient develops a lip seal naturally as a result of eating with the appliances in the mouth. When the mandible closes in a forward position it is easier to form an anterior oral seal by closing the lips together than to support the lips with an anterior tongue thrust. In growing children, the facial muscles adapt very quickly to an altered pattern of occlusal function. The changes in appearance are so significant that the patients themselves frequently comment on the improvement in the early stages of treatment.

The facial changes are soon accompanied by equivalent dental changes and it is routine to observe correction of a full unit distal occlusion within the first 6 months of treatment. The response to treatment is noticeably faster compared to alternative functional appliances that must be removed for eating.

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**William J Clark** BDS, DDO, DDSC, FDS (Eng) has 50 years' experience in orthodontic practice. In 1977 he developed Twin Blocks for mandibular advancement, and in 2004, TransForce appliances for lingual arch development. His courses on "New Horizons in Orthodontics" offer practical advice on diagnosis, treatment planning and clinical management in fixed and functional appliance therapy. Dr Clark is the first recipient of an award of distinction from the British Orthodontic Society for an outstanding contribution to the specialty of orthodontics. In 2008 he received an award from the International Functional Association for personal outstanding international service to functionalism and orthodontics. He is the author of three new e-books: *Advances in Fixed Appliance Technique, Advances in Functional Therapy and Dentofacial Orthopaedics,* and *Faces and Braces.*


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