Saudi Dental Journal (2018) 30, 379–388

King Saud University

Saudi Dental Journal

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CASE REPORT

Skeletal Class III correction in permanent dentition using reverse twin block appliance and fixed mechanotherapy

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Received 12 May 2017; revised 17 May 2018; accepted 22 May 2018
Available online 31 May 2018

KEYWORDS

Skeletal Class III;
Reverse twin block;
Fixed appliance;
Permanent dentition

Abstract The orthodontic management of patients with Class III malocclusion poses numerous prognostic and treatment challenges to the clinician. Various removable, orthopaedic, myofunctional and fixed appliances have been recommended for the correction of Class III malocclusion. The Reverse Twin Block (RTB) is a simple and well tolerated appliance which has often been used for the early management of such cases in mixed dentition. Cases reporting use of RTB in permanent dentition are however, limited. This article presents an insight into the encouraging results of reverse twin block (RTB) appliance used in conjunction with fixed mechanotherapy for the successful treatment of a 12-year-old patient presenting with skeletal Class III malocclusion and a concave facial profile. The RTB appliance helped establish a favourable environment for unrestricted maxillary growth, at the same time redirecting the mandibular growth to a clockwise direction and correcting the incisal relationship. The favourable treatment outcome and long-term stability achieved substantiates the feasibility of RTB appliance in mild to moderate skeletal Class III malocclusions in permanent dentition cases.

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☆ "All authors have made substantive contribution to this manuscript, and all have reviewed the final paper prior to its submission. The authors have stated explicitly that there are no conflicts of interest in connection with this article."
Peer review under responsibility of King Saud University.

Production and hosting by Elsevier

https://doi.org/10.1016/j.sdentj.2018.05.009
1013-9052

1. Introduction

Class III malocclusion often presents with management and prognostic challenges due to complex interplay between environmental and innate factors in its genesis (Litton et al., 1970), along with deterioration of profiles associated with increased propensity for continued late mandibular growth.

Timely management of Class III malocclusion is aimed at preventing the progressively damaging soft tissue or bony changes; redirecting future growth of jaws in more favourable direction; normalizing and enhancing occlusal and orofacial function; simplifying phase II comprehensive orthodontic/surgical treatment; and preventing the development of temporomandibular joint symptoms (Ngan, 2005). Various corrective modalities that have been described in the literature include removable myofunctional appliances (Monoblock, reverse bionator, FR-3 Frankel appliance, reverse twin block), fixed appliances, double-piece corrector, chin cups, protraction headgears and skeletal anchorage systems (Seehra et al., 2012). The Reverse Twin Block (RTB) (Clark, 2002) has proven to be a simple, comfortable, well-tolerated and efficient functional appliance for the correction of developing Class III malocclusions during mixed dentition (Seehra et al., 2010). More recently, significant favourable effects of RTB on craniofacial morphology in early mixed dentition have also been reported by Fareen et al. (2017). However, to the best of our knowledge, illustrated literature reporting the use of RTB appliance for the treatment of skeletal Class III malocclusions in permanent dentition is limited.

The present article describes successful treatment of a skeletal Class III malocclusion in permanent dentition using a Reverse Twin Block and fixed mechanotherapy.

2. Case report

A 12-year-old girl presented with the chief complaint of prominent lower front teeth, protruding chin and difficulty in occluding teeth [Figs. 1a–1i]. She had very low self-esteem as she was constantly bullied for her facial appearance. Her medical and familial history was non-contributory. Extraoral examination revealed a mesoprosopic facial form, concave facial profile with apparent maxillary growth restriction, a prominent lower lip, an acute nasolabial angle, and a shallow mentolabial sulcus. End-to-end incisor relationship in retruded

Fig. 1a Pretreatment frontal view photograph.

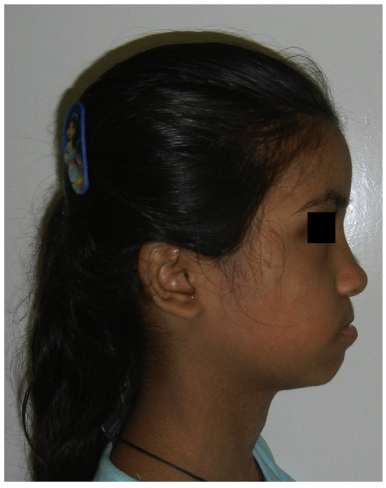

Fig. 1b Pretreatment profile photograph depicting Class III pattern.

Fig. 1c Pretreatment posed smile photograph.

Fig. 1d Pretreatment intraoral frontal view showing anterior crossbite.

Fig. 1e Pretreatment intraoral right lateral view showing Class III molar relationship.

Fig. 1f Pretreatment intraoral left lateral view.

Fig. 1g Pretreatment maxillary occlusal view photograph showing mesiolingual rotation of first molars.

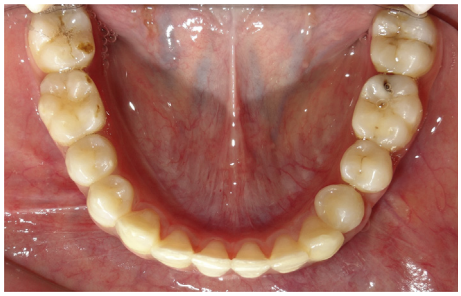

Fig. 1h Pretreatment mandibular occlusal view photograph.

contact position was observed without any CO-CR discrepancy. However, anterior displacement with slight deviation of mandible towards right was noted on jaw closure from initial contact position to habitual occlusion position. On intraoral examination, the patient demonstrated a reverse overjet of

Fig. 1i Pretreatment intraoral profile view photograph depicting Class III incisal relationship.

3 mm, an overbite of 4 mm and a bilateral Class III molar relationship in centric occlusion position. The upper dental midline was coincident with the facial midline. The lower dental midline was shifted to right by 3 mm when compared to upper dental midline. With regard to lingual function, the role of tongue in terms of its resting position, size and function was noncontributory.

Lateral cephalometric analysis revealed a moderate skeletal Class III jaw base relationship (ANB −3°, Wits appraisal −8 mm) due to maxillary retrognathism (SNA 77°), and a mild hypodivergent skeletal pattern (FMA 23°, Y-axis 61°) [Figs. 2 and 3, Table 1]. Both the maxillary and mandibular incisors

Fig. 2 Pretreatment lateral cephalogram showing Class III skeletal pattern (with retrognathic maxilla).

Fig. 3 Pretreatment panoramic radiograph.

Table 1 Cephalometric evaluation.

Measurement	Pretreatment	Posttreatment
SNA (°)	77	84
SNB (°)	80	81
ANB (°)	−3	3
SND (°)	77	77
Wits appraisal (mm)	−8	−1
FMA (°)	23	27
Y-axis (°)	61	65
UAFH (mm)	43	45
LAFH (mm)	68	70
U1 to SN (°)	107	111
U1 to FHP (°)	116	117
IMPA (°)	95	96
Mandibular length (Co-Pg) (mm)	104	106
Upper lip protrusion (mm)	1	3
Lower lip protrusion (mm)	7	1

were slightly proclined. Based on Cervical Vertebrae Maturity Indicators (CVMI) assessment, the patient was approaching the peak of the growth spurt and was in acceleration stage.

2.1. Treatment objectives

Treatment objectives were to (1) eliminate anterior mandibular displacement and overclosure, (2) correct anterior cross bite for establishing canine-guided functional occlusion, (3) improve facial profile, and (4) improve the skeletal jaw base relationship by optimizing favourable potential growth of the maxilla and redirecting mandibular growth.

2.2. Treatment alternatives

Considering the nature and severity of the patient's skeletal disharmony, various treatment approaches were discussed with the patient and her parents, including a nonsurgical camouflage approach and possible need of orthognathic surgery in the future. However, keeping in view the detrimental effects of untreated long standing anterior mandibular displacements on esthetics, occlusion, periodontium, temporomandibular joint and the potential growth of the maxilla (White, 1998), it was decided to commence non-surgical treatment in the first phase using reverse twin block therapy, followed by re-assessment at a later stage.

2.3. Treatment progress

Treatment was initiated with a RTB appliance constructed at the position of maximum possible retrusion of mandible with an interincisal clearance of 2 mm and posterior vertical clearance of 5 mm [Figs. 4a–4c]. Bite blocks were inclined at 70° to the occlusal plane in reverse configuration achieved by placing the upper block (covering the upper premolars) anteriorly and enabling the lower block (covering the lower molars) to occlude behind it. A three-pin expansion screw was incorporated in the upper component to achieve an intended upper anterior segment expansion of 0.2 mm per week.

The patient was instructed to wear the appliance full-time. The lower block was trimmed disto-occlusally to facilitate extrusion and uprighting of the maxillary molars. Increased activation was achieved by maintaining contact only on the inclined planes. Subsequent visits were scheduled at 6-week intervals to assess treatment progress, compliance, appliance retention and reactivation as necessary.

After 7 months of active treatment, the patient was asked to wear the appliance only at night to allow daytime settling of the buccal occlusion while the sagittal and transverse changes were retained. Ten months into treatment, favourable treatment results had been achieved with RTB appliance [Figs. 5a–5d], and a 0.022″ slot preadjusted edgewise appliance was bonded in both arches to initiate the second phase of treatment. Levelling and alignment was initiated using improved super-elastic 0.016″ NiTi archwires, followed by 0.017″ × 0.025″ NiTi archwires. Bilateral toe-in (compensating offset) bends were placed in 0.018″ × 0.025″ SS wire for correction of mesiolingual rotations of first molars in the upper arch. 0.019″ × 0.025″ SS wires were used as stabilizing archwires [Figs. 6a–6c]. Full time wear of 3/16″ (2 oz) short Class III intermaxillary elastics in conjunction with anterior sectional 0.021″ × 0.025″ TMA wire in upper arch and sectional 0.019″ × 0.025″ SS wire in lower arch facilitated final settling and detailing of occlusion.

After nine months of edgewise appliance treatment, Hawley retainers were placed in the maxillary and mandibular arches for day-time retention. A reverse bionator was delivered to be worn as a retention appliance only at night. Because of excellent patient compliance, it was decided to continue with Hawley retainers worn during day time for 1 year and reverse bionator worn during night for 3 years. The patient was regularly followed up every six months for evaluation of mandibular growth.

Fig. 4a Treatment progress frontal view with Reverse twin block in situ.

Fig. 4b Treatment progress right lateral view showing reverse angulation of intersecting inclines of reverse twin block.

Fig. 4c Treatment progress left lateral view.

Fig. 5a Treatment progress frontal view after completion of myofunctional appliance therapy.

Fig. 5b Treatment progress right lateral view after completion of myofunctional appliance therapy.

Fig. 5c Treatment progress left lateral view after completion of myofunctional appliance therapy.

Fig. 5d Stage cephalogram after completion of myofunctional appliance therapy.

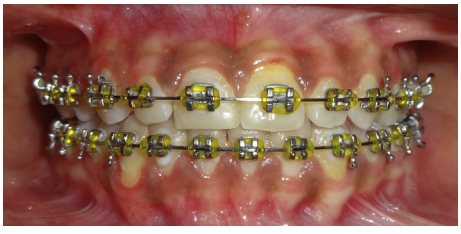

Fig. 6a Stage frontal view showing finishing and detailing with fixed appliances.

2.4. Treatment results

Post treatment final records showed significant improvement in facial esthetics along with the establishment of normal overjet, overbite and well-intercuspated occlusion with canine guidance [Figs. 7a–7i].

Cephalometric superimposition demonstrated improvement in anteroposterior relationship (ANB, $-3° \rightarrow 3°$), and sagittal position of maxilla (SNA, $77° \rightarrow 84°$) along with camouflage of mandibular growth with mild clockwise rotation of the mandibular base (FMA 27°, Y-axis 65°) [Figs. 8 and 9, Table 1]. The panoramic radiograph revealed acceptable root parallelism with no significant apical root resorption [Fig. 10].

Fig. 6b Stage right lateral view.

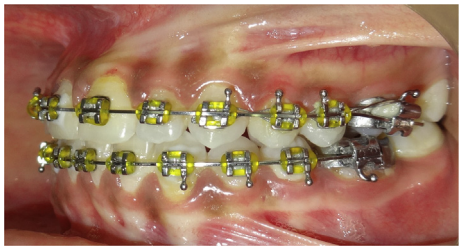

Fig. 6c Stage left lateral view.

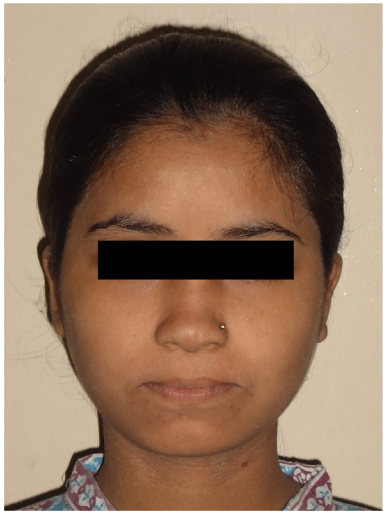

Fig. 7a Posttreatment frontal view showing improved facial esthetics.

Fig. 7b Posttreatment profile photograph showing good esthetic profile.

Fig. 7c Posttreatment posed smile photograph showing improved smile esthetics.

Fig. 7d Posttreatment intraoral frontal view depicting corrected anterior crossbite.

At three-year follow-up, the patient demonstrated stable occlusion and well-maintained acceptable facial profile without obvious relapse [Figs. 11a–11d].

3. Discussion

The management of moderate to severe skeletal Class III cases often presents as a clinical dilemma with regards to treatment timing. Also, the unpredictable results regarding the success of growth modification procedures further compound the intriguing decision making process (Kanno et al., 2007).

Factors governing the success of orthodontic treatment in moderate to severe Class III malocclusion include (Kanno et al., 2007; Oltramari-Navarro et al., 2013): (1) growth potential of the individual, (2) maxillary and/or mandibular skeletal involvement, (3) familial history, (4) genetic influences, (5) the adequate timing of the treatment, and (6) patient's compliance.

Kanno et al. (2007) reported the successful use of monoblock appliance to maximize the growth potential for early correction of developing skeletal Class III malocclusion. In the present case, since the patient had a functional mandibular shift, i.e. she could move her mandible back to edge-to-edge

Fig. 7e Posttreatment right lateral view photograph with well-intercuspated occlusion.

Fig. 7f Posttreatment left lateral view photograph showing good occlusion.

Fig. 7g Posttreatment maxillary occlusal view photograph.

Fig. 7h Posttreatment mandibular occlusal view photograph.

Fig. 7i Posttreatment intraoral profile view photograph demonstrating Class I incisal relationship.

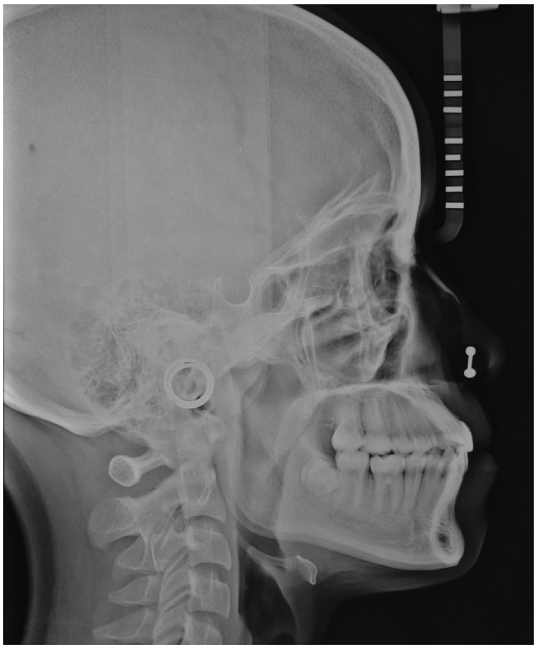

Fig. 8 Posttreatment lateral cephalogram showing correction of maxillary retrognathism.

incisor relationship in retruded contact position, the RTB appliance was used as an alternative to correct the patients' anterior cross bite in the first phase of treatment.

Reverse angulation of intersecting inclined occlusal planes in RTB appliance harnesses occlusal forces to exert a Class III traction effect on the jaws, resulting in advancement of

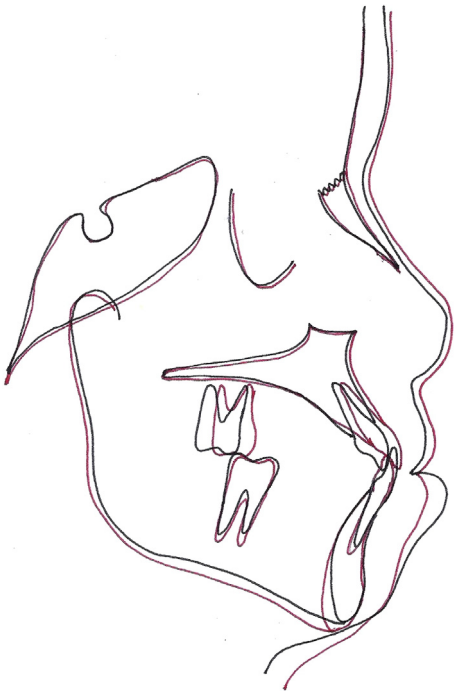

Fig. 9 Pretreatment (black) and posttreatment (red) cephalometric tracings superimposed on the sella-nasion plane at sella.

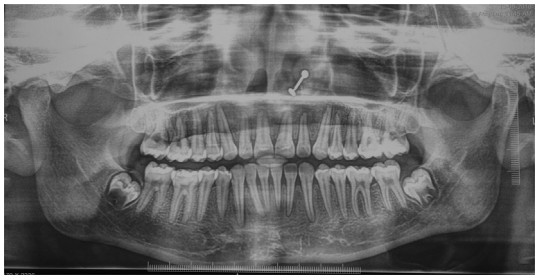

Fig. 10 Posttreatment panoramic radiograph.

Fig. 11a Three-year follow-up frontal photograph.

Fig. 11b Three-year follow-up photograph demonstrating well maintained pleasing profile esthetics.

Fig. 11c Three-year follow-up posed smile photograph.

Fig. 11d Three-year follow-up intraoral frontal view demonstrating stable occlusion.

the maxilla, while using the lower arch as an anchorage and temporarily restricting forward mandibular development (Clark, 2002). Concomitant favourable dentoalveolar effects include proclination of maxillary incisors, mesial tipping of maxillary dentition and mild distal tipping of mandibular teeth resulting in establishment of a positive overjet and overbite. The cephalometric superimposition of the present case demon-

strated these favourable changes. The treatment effects of RTB were primarily dentoalveolar, combined with minimal favourable orthopaedic changes. This is in accordance with the findings of Kidner et al. (2003) and Seehra et al. (2010). Similar favourable treatment outcomes produced by reestablishing the occlusal environment with use of RTB in mixed dentition have also been reported by Shastri et al. (2015) and Mittal et al. (2017). Moreover, RTB controlled and stabilized the growth of the overclosed mandible by eliminating lateral slide caused by occlusal interferences, thereby resulting in mild clockwise rotation of the mandibular base.

With the maximally retruded bite, distalizing force exerted on the mandibular condyles is not detrimental because the bite is hinged open with the condyles down and forward in the fossae; and the inclined planes are directed downwards and backwards on the mandibular teeth. The force vector in the mandible passes from the lower molar towards the gonial angle which best absorbs occlusal forces (Clark, 2002). Ease of fabrication, tolerability by patient, durability and cost effectiveness are other advantages of RTB.

Evaluation of each case should be based on its individual merits. Based on Wits appraisal of −8 mm (i.e. between 4 and 12 mm), severity of Class III in present case was labelled as 'yellow' category (Ngan and He, 2010). Even so, a combination of RTB appliance and fixed mechanotherapy helped establish a favourable occlusal and functional environment for the optimum growth of maxilla. The correction of the anterior crossbite during first stage of treatment with RTB benefited the maxillary growth. Furthermore, use of Class III intermaxillary elastics during the second stage of treatment with fixed appliances also helped modify the direction of the maxillofacial growth and aided in forward positioning of ''point 'A'' in the anterior concavity of the alveolar process of maxilla, thus resulting in favourable changes in values of SNA angle and Wits appraisal. Additionally, improvement in inclination of maxillary incisors by labial projection also contributed to the establishment of a positive overjet.

Regarding the lingual function, Horton et al. (1969) and, Vaz and Bai (2015) reported that the low-lying position of the tongue and its interposition between the upper and lower arches play a contributory role in the etiology of Class III malocclusions. In the present case, however, the role of tongue in terms of its resting position, size and function was non-contributory.

Singh et al. (2016) described the modification of upper anterior inclined plane for use during the support phase of twin-block therapy. The lateral flanges of the modified inclined plane restrains the lateral spread of the tongue, thus, preventing the development of lateral tongue thrust and aiding in rapid settling of buccal segment occlusion. However, considering the normal physiologic limits of tongue size, position and function, no such modification was used in the present case.

As for the midline considerations, maxillary midline position relative to the facial midline is an important diagnostic feature in orthodontic treatment planning, and a deviated upper dental midline significantly affects smile esthetics (Beyer and Lindauer, 1998). In the present case, the upper dental midline coincided with the true facial midline. The complete correction of the deviated lower dental midline would have necessitated reproximation of lower anteriors during second stage of treatment with fixed appliances. This was discussed with the patient, to which she and her parents did not agree. Also, the posttreatment lower dentoalveolar midline shift of 2 mm relative to upper dental midline did not result in esthetic compromise in our patient. Based on a 7-point categorical visual analogue scale (i.e. 'terrible', 'mostly dissatisfied', 'mixed', 'partially satisfied', 'mostly satisfied', 'pleased' and 'delighted'), the patient was delighted with the dramatic change in facial and smile esthetics achieved after completion of orthodontic treatment.

Despite the probability of surgery in few cases, timely intervention helps eliminate anterior mandibular displacements and allows maximizing the maxillary growth potential, thus subsequently reducing the extent of future surgical procedures (Ngan, 2005). Furthermore, it is not justified to deny the patient benefits of early treatment, because of apprehensions that further treatment may still be required in few cases.

4. Conclusion

In aptly selected cases, growth modification with RTB can prove to be a viable and effective camouflage treatment modality for the correction of moderate skeletal Class III malocclusion in the permanent dentition. The use of RTB in such cases not only helps in eliminating mandibular displacement, thus allowing the permanent dentition to be guided into favourable occlusal relationship, but also in promoting anterior growth of maxilla and in camouflaging mandibular growth with mild clockwise rotation of the mandibular base.

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