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Twin block appliance: A review on skeletal and dental aspects on short-term treatment outcome

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Abstract

Class II malocclusion in growing individuals presents with both skeletal and dento-alveolar malocclusion components that are frequently treated by functional appliance therapy. These appliances should aid in correction of skeletal deficiencies without compromising dental and soft tissue components by holding at its position to allow postural changes. Twin block is a simple bite block appliance with occlusal inclined plane that induces rapid functional correction of class II malocclusion with mandibular retrusion by transmitting favorable occlusal forces to the occlusal inclined planes covering the posterior teeth and guiding the mandible forward into defined occlusion. Various modifications have been in introduced over the period of time that facilitate simple activation, adjustment, tolerability, flexibility, adaptability, effectiveness and ease of incremental mandibular advancement without changing the appliance with independent control in vertical, sagittal as well as transverse directions. Several studies were carried out over the years to evaluate the skeletal, dental and soft tissue changes associated with twin-block functional appliance therapy nonetheless only few studies focusing on short-term treatment outcome and advantages were discussed in the past. The present review was aimed to briefly describe the clinical significance and potential short-term dental, skeletal, and soft tissue effects of treatment with Twin-block appliance. The study observed skeletal, dental and soft tissue changes associated with a Class II correction were of limited clinical significance. Nonetheless recent studies evaluated short-term effects of treatment performed with Twin-block appliance however long-term changes which benefits patients in all age group right from early childhood to young adulthood need further assessment.

Keywords: Condylar growth, Dental changes, Malocclusion, Overjet Reduction, Treatment effects

Introduction

Class II malocclusion in growing individuals presents with both skeletal and dento-alveolar malocclusion components that are frequently treated by functional appliance therapy. The skeletal class II malocclusion component can have clinical variations such as mandibular retrognathism, maxillary protrusion or both, increased size of anterior cranial base resulting in mid-face protrusion while posterior cranial base contributing in more retrusive position of the temporomandibular articulation region [1, 2]. The functional appliances in skeletal Class II malocclusion should aid in correction of mandibular deficiencies like retrognathia by holding at its position to allow postural changes. During this forward and/or downward mandibular stationary phase the soft tissues and muscular components are stretched to create pressure around the dental and skeletal structures bringing about tooth movement and altered skeletal development respectively [3]. Fixed functional appliances are often preferred over removable appliances however successful outcome depends on several factors such as patient's cooperation, satisfaction, nature and type of appliance and acceptability [4].

Among various functional appliances used to improve skeletal deficiencies, Twin-block is widely accepted owing to its patient's tolerability, comparatively smaller size, minimal speech interference and ability to induce mandibular elongation with higher success rate than other appliances [5]. It is made of upper and lower acrylic bite blocks with occlusal inclined plane angled to guide forward and downward movements. This appliance induces rapid functional correction of class II malocclusion with mandibular retrusion by transmitting favorable occlusal forces to the occlusal inclined planes covering the posterior teeth and guiding the mandible forward into defined occlusion [6]. Several studies were carried out over the years to evaluate the skeletal, dental and soft tissue changes associated with twin-block functional appliance therapy nonetheless only few studies focusing on short-term treatment outcome and advantages were discussed in the past [7-10]. The present review was aimed to briefly describe the clinical significance and potential short-term dental, skeletal, and soft tissue effects of treatment with Twin-block appliance.

Methodology

A structured literature search for articles written in the English language in PubMed/MEDLINE, EBSCO host, Google Scholar, Scopus, and Web of Science databases was retrieved by using MeSH terms “Twin block appliance” OR “Orthodontics” AND “Dental”, “Dentistry” AND “Functional appliance therapy” "Class II malocclusion treatment, Dental" OR “Orthodontics” OR “Skeletal Malocclusion” OR "All Metadata", “Dental, Twin block”, “Skeletal, Growing patients”, “Functional Modified Twin Block Appliance, Systematic Review”.

Appliance and Mechanism of action

Twin-block functional appliance is made of upper and lower acrylic bite blocks with occlusal inclined plane angled to guide forward and downward movements. Dr William J Clark introduced Twin-block in 1977 as a simple bite-block protrusive functional appliance that effectively alter the occlusal inclined plane. It consist of double acrylic resin base plate anchored with delta clasp and ball end clasp, a vestibular arch from the right canine to the left one and bite block [11]. The lower resin base plate has a delta clasp to be placed in first molar and ball end clasp placed in the interproximal areas anteriorly routinely to lower canines and in the upper premolar or deciduous molar regions for excellent retention. The inclined plane on the lower bite block is angled from the mesial surface of the second premolar or deciduous molar and does not extend distally to the marginally ridge on the lower second premolar. This allows the edge of the incline plane on the upper appliance to be positioned mesial to the lower first molar thus eliminating obstruction during eruption. These inclined planes are mostly angled at 65 degree to 70 degrees to the occlusal plane thus creating mandibular advancement [12].

The appliance is constructed using bite registration. The mandible is positioned protruded approximately 3mm distal to the most protrusive position while vertically the bite is registered within the limits of the freeway space. The bite block are placed mesial at the distal marginal edge of the second premolars. These separate plates make the twin block appliance different from other removable functional appliances, which are basically monoblocks [13]. Other related components like transverse sagittal springs, transverse expansion screws, and extra-oral traction devices can be added to aid in skeletal correction. In normal dentition, cuspal inclined planes guide the eruption relationship with growth phase and alteration of trabecular supporting bone to determine the ideal occlusion contact. In skeletal class II cases unfavorable cuspal contacts inhibit transmission of occlusal forces through tooth and its supporting structures thus preventing constant proprioceptive stimuli to influence the growth pattern and occlusion.

With Twin-block appliance placed in the mouth, mandible is guided to follow anterior and lateral excursions, protrusive bite with inclined planes in occlusion bringing about favorable proprioceptive contacts of the twin block inclined planes, altering the malocclusion and releasing the mandible from its unfavorable fixed distal functional position. Fixed functional appliances are often preferred over removable appliances however successful outcome depends on several factors such as patient’s cooperation, satisfaction, nature and type of appliance and acceptability. Removable appliances can be fixed for first week or 10 days of treatment to ensure that the patient adapts fully to wearing them 24 hours per day. It is designed to adapt masticatory functions, speech without restricting movement of tongue, lips or mandible [1-4, 14].

Recent advances and Twin Block modifications

Twin block appliance is ideally recommended for class II division 1 malocclusion individuals with well aligned upper and lower arches, having overjet of 10-12 mm, deep bite with horizontal growth pattern, and mandibular retrognathism. Patient should preferably be in early stage of pubertal growth or initial growth spurt and have a positive Visual treatment objective (VTO). However the standard twin block could not adapted to the individuals needs of all the patients. To overcome this problem, various modifications have been in introduced over the period of time that includes Twin block appliance for transverse and sagittal development, twin block crozat appliance, Magnetic twin block appliance, Twin block with a spinner to control tongue thrust, fixed twin block, reverse twin block, hybrid appliance twin block, neuromuscular twin block, twin block with concorde facebow, incorporating bite jumping screw for progressive advancement and implant supported twin block. These modifications facilitate simple activation, adjustment, tolerability, flexibility, adaptability, effectiveness and ease of incremental mandibular advancement without changing the appliance with independent control in vertical, sagittal as well as transverse directions [15, 16].

Skeletal changes associated with Twin-Block appliance

Twin block appliance induce skeletal changes in mandible with no apparent restraining effect on maxillary growth. Increased growth at the condylar cartilage, increased mandibular length, increased SNB Cephalometric plane angle, with good vertical control are well-established fundamental functional appliance outcome. Studies had also concluded that skeletal changes at the condylar cartilage are biological events attributed to peak of pubertal growth phase whereas dental changes are seen as a result of appliances placed slightly after the peak pubertal growth phase [2, 9, 17, 18]. Ehsani et al in a systematic review summarized that restricted or minimal maxillary growth, vertical growth control, forwardly placed mandible, mandibular body elongation and increased anterior facial dimension were significant skeletal findings associated with Twin-Block appliance [2]. An extensive Cochrane review by Thiruvenkatachari et al suggested that minor favorable changes in skeletal patterns were seen with Twin block functional appliances in negligible cases of no clinical significance [3]. An earlier similar review by Marsico et al also noticed minor beneficial changes in skeletal patterns that were not clinically important [19].

Baccetti et al in his cephalometric analysis study evaluated the skeletal changes in class II malocclusion cases using Twin-block appliance and observed increased mandibular length, height of ramus, skeletal induced molar correction, reduced forward displacement of the condyle and favorable posterior condylar growth. However no changes in sagittal position of maxilla or in vertical facial relationships suggestive of predominant mandibular orthopedic effect. It was also noted late onset of the pubertal peak or during pubertal peak in growth velocity as an optimal stage for initiation of Twin-Block appliance [9]. Lund and Sandler [20] similar to Baccetti et al. [9] also observed skeletal changes primarily in the mandibular bone with increase in SNB Cephalometric plane angle, increased mandibular size,

mandibular length and improved sagittal relationship. However, SNB angle does not explain the rotational changes of mandible and changes of lower anterior face height. Therefore, changes in face height have possibly diminished or exaggerated the exact sagittal changes in relation with position of mandible. Changes in lower face height that includes increase in anterior/posterior facial height, lower anterior facial height along with occlusal plane inclination varied in several cases, suggesting that vertical dimension can be influenced in patients who would benefit from lower molar extrusion.

Modification with different twin block appliance approaches that include increasing bite plane to provide vertical control, trimming of the posterior acrylic bite blocks to allow lower molar extrusion, and addition of occlusal rests to prevent molar eruption in high angled cases were carried out based on individual findings. All these modifications showed negligible skeletal changes with increase in lower facial height (1.8mm per year) and good vertical growth control. Singh and Hodge modified twin block appliances with an extra oral traction device and illustrated growth modulation in specific regions of mid-facial complex with change in anterio-posterior position of mandible [21]. Very few studies postulated that skeletal mandibular changes induces headgear effect by remodeling of cephalometric point A anteriorly by retroclination and labial tipping of maxillary incisors resulting in slight inhibition of forward maxillary growth. Based on these observations significant reduction in SNA cephalometric plane angle points and minimal changes in maxillary base length were reported nonetheless controversies still exist on maxillary skeletal effects due to inconclusive evidences supporting headgear effect with Twin block functional appliance [20-23].

Dental changes associated with Twin-Block appliance

Significant overjet reduction, decreased overbite and increase facial height caused by clock-wise rotation of mandible are well-established dental changes outcome. Dental changes like proclination of lower incisors, retroclination of upper incisors, eruption of lower molars, headgear like effect, distal movement of upper molars and/or mesial movement of lower molars, increase in mandibular length, and/or forward movement of the mandible were also consistently reported [2, 17, 24]. Mills and McCulloch [25], Jena et al [17], and O'brien et al [12] illustrated significant overjet reduction (59% to 73%) with predominant dental changes than skeletal changes with use of functional twin block appliance. Lund and Sandler used distance between cephalometric points S and N (SN) with SN perpendicular and found that Twin-block appliance did not hinder the maxillary molar eruption despite skeletal changes primarily seen in the mandibular bone however this could be due to purely distal tipping followed by mesial cusp extrusion rather than a pure extrusion of the upper molar [20]. Ehsani et al demonstrated decrease in upper incisor proclination and increase of the lower incisor inclination were significant dental findings associated with Twin-Block appliance [2].

Modifications to twin block appliances attempted to minimize dentoalveolar tipping and maximize skeletal changes by including the use of headgear to maximize maxillary restriction and torqueing to upper labial segment have shown better results. Higher incidence of retroclination and/or retrusion of maxillary incisors are found in several cases owing to headgear effect exerted by labial bow. The headgear effect on dentition could be due to additional contact of labial bow during sleep with maxillary incisor or by pressure exerted by upper lip musculature during functional treatment in absence of labial bow. In contrast, proclination and/or protrusion of mandibular incisors were also reported in cases where either a lower labial bow or an acrylic extension covering edges of lower incisors was used. This reverse pull effect on dentition could be attributed to application of mesial force or absence of pressure exerted by lower lip during functional treatment using Twin-block [17, 23-26]. Reverse twin-block is used for correction of class III malocclusion by reversing the occlusal inclined planes placed at 70 degree angulation. The bite blocks are placed on maxillary deciduous molars and mandibular first molars that pushes forward movement of maxillary teeth by occlusal forces and restrict forward mandibular development [27].

Soft-Tissue changes associated with Twin-Block appliance

Soft tissue landmarks showed changes following functional appliance treatment despite these changes are negligible with less clinical significance. Few soft tissue changes such as change in lower lip position, slight reduction of facial convexity, decreased skeletal convexity with opening of the nasolabial angle and labiomental fold, anterior and inferior movement of chin, increase of the labiomental angle, stretching of the lower lip, and reduction of lower lip prominence were seen following twin block appliance therapy [21, 28]. Studies by Varlik et al [29] and Morris et al [30] concluded these changes could be elucidated by the retraction of upper lip as a result of upper incisor retroclination.

Conclusion

Twin block appliance are simple bite blocks with occlusal inclined planes recommended for individuals with class II division 1 malocclusion with a horizontal growth pattern and mandibular retrognathism. It consist of separate upper and lower blocks that can be easily adjusted, activated with reduced chair side time. Increase in SNB angle, lower anterior facial height with forward growth, repositioning of the mandible are the key skeletal changes. Dental changes includes overjet reduction, retroclination of the upper incisors, proclination of the lower incisors, distal movement of the upper molars, and lower molar eruption in anterio-superior direction. Effective and favorable soft tissue changes are also seen. Modifications to twin block appliances attempted to minimize dentoalveolar changes and maximize skeletal changes have shown better results. Thus, facial harmony and balance are of equal importance to attain ideal dental occlusion. Several studies evaluated short-term effects of treatment performed with Twin-block appliance however long-term changes which benefits patients in all age group right from early childhood to young adulthood need further assessment.

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