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RESEARCH ARTICLE

FUNCTIONAL APPLIANCES- A REVIEW

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ABSTRACT

The purpose of this review is to evaluate the previous studies that describe the effects of functional appliances and their efficiency in treating class II malocclusion. This review is limited to two appliances: activator and twin-block appliances.

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INTRODUCTION

The term "functional appliance" refers to a variety of removable appliances designed to alter the arrangement of various muscle groups that influence the function and position of the mandible in order to trasmit forces to the dentition and the basal bone. Class II malocclusion is one of the most common orthodontic problems and it occurs in about one-third of population (Kelly, 1977; McLain, 1985; Proffit, 1998). Class II malocclusion can result from many contributing factors, both dental and skeletal. Although maxillary protrusion and mandibular retrusion are both found to be possible causative factors, it has been reported that the most common component in a class II sample population is mandibular retrusion (McNamara, 1981). For class II patients in whom the mandible is retrognathic, the ideal treatment is to target the source and try to alter the amount or direction of growth of mandible. The primary treatment for this is functional appliance therapy (Chen *et al*., 2002). Functional appliances include removable and fixed devices that are designed to alter the position of the mandible, both sagittally and vertically and to induce supplementary lengthening of the mandible by stimulating increased growth at the condylar cartilage (Johnson, 1986; Wieslander, 1979; Moss, 1969; Fränkel, 1969). Functional appliances have been used since the 1930s.Despite this relatively long history, there continues to be much controversy relating to their use, method of action, and effectiveness. Although there are a number of functional appliances used by clinicians. This review will emphasize the activator and twin block used to correct Class II malocclusions.

Activator: The original monobloc designed by Robin in 1902 was a one-piece removable appliance (Robin, 1902). This appliance positioned the mandible forward in patients with severe mandibular retrognathism. Later, Viggo Andresen in 1908 developed a mobile, loose-fitting appliance that transferred functioning muscle stimuli to the jaws, teeth, and supporting tissues; it is called biomechanic working retainer. Later, Andresen and Haupl called their appliance activator because of its ability to activate the muscle force. According to Andersen and Haupl, the activator is effective in exploiting the interrelationship between function and changes in internal bone structure. Activator induces musculoskeletal adaptation by introducing a new pattern of mandibular closure. The adaptations in functional pattern caused by activator also affect condyles. Condylar adaptations consist of growth in an upward and backward direction to maintain the integrity of temporomandibular joint structures (Graber *et al*., 2017). The appliance advances the mandible and generates a biomechanical force as the muscles attempt to return the mandible to its normal position (Graber, 1984). Since it was designed to be loose fitting and required the patient to actively hold the appliance in place, it was often described as an exercise appliance (Bishara, 1989).

Skeletal Effects of Activator: Activator inhibits the horizontal growth of the maxillaand results in increased growth of the mandible anterior and relocation of the glenoid fossa (Vargervik, 1985). Kahl-Nieke and Fischbach (Kahl-Nieke, 1998) found that activator appliance therapy in hemifacialmicrosomiapatients showed improvement of function and occlusion and facial asymmetry was reduced. When the construction bite is taken in such cases, the mandible is kept in a slightly forward and overcompensated position which caused change in muscle activity that can lead to enhanced bone apposition and optimal growth direction of the condyle. Horizontal activator produces increase in SNB angle, mandibular plane angle and reduces SNA angle, ANB angle, and increase in mandibular length (Al-Bustani, 2008). Mehta *et al*. (2013) reported that activator corrects class II malocclusion by increasing condylar growth and mandibular base length. According to Luder's hypothesis, a great interocclusal height of an activator would lead to improvement in mandibular retrognathism, no change in maxillary prognathism, clockwise rotation of occlusal plane and low construction bite results in reduction in maxillary prognathism, clockwise mandibular rotation, anterior tipping of lower front teeth (Luder, 1982; Lima *et al*., 2013). Some clinical studies found no significant increase in mandibular length with the use of this device (Forsberg, 1981; Pancherz, 1984), but other authors reported a significant increase in the length or protrusion of mandible using the activator (Sari, *et al*., 2003; Basciftci *et al*., 2003; Cozza, 2004). Treatment with activator headgear combination resulted in restricted maxillary growth reduced soft-tissue facial convexity with downward and forward mandibular growth (Sari, 2003).

Dental Effects: Bjork, (1951) Calvert, (1982) Pancherz, (1984) and Wieslander and Lagerstrom (1979) observed significant dentoalveolar change. Class I occlusion is achieved through distal tipping of the maxillary teeth and a mesial, vertical movement of the mandibular dentition. Overjet reduction also occurs mainly due to dentoalveolar changes that are retroclination of maxillary incisors and proclination of mandibular incisors (Al-Bustani, 2008; Pancherz, 1984). Pancherz, (1984) found that >70% of the overjet corrected by incisor tipping. Vargervik and Harvold (Vargervik, 1985) found that activator results in inhibition of mesial migration of maxillary teeth, inhibition of maxillary alveolar height increase and also causes extrusion of mandibular molars, mesial movement of mandibular teeth. Harvold and Vargervik (Harvold, 1971) also observed that the appliance causes 1.4 mm of maxillary incisor lingual tipping and 0.5 mm of mandibular incisor labial tipping. Appliance achieved a Class I occlusion by inhibiting maxillary dentoalveolar vertical development while encouraging mandibular dentoalveolar mesial and vertical development.[17] Activator with headgear combination resulted in upper incisor retrusion, upper molar distalization, and mesial movement of lower molars.[19,22]

Twin Block: This appliance developed by Dr. William J. Clark in Scotland. Twin-block appliances are based on the same principle as the protrusive functional appliances used on monkeys by McNamara (McNamara, 1973). In normal development, cuspal inclined planes play important role in determining the relationship of teeth as they erupt into occlusion. Occlusal forces transmitted through dentition provide constant proprioceptive stimuli to influence the growth rate and adaptation of trabecular structure of thesupporting bone.

Twin blocks are simple bite blocks that effectively modify the occlusal inclined plane. This appliance achieves rapid functional correction of malocclusion by transmitting favourable occlusal forces to the occlusal inclined planes covering the posterior teeth and guiding the mandible forward into correct occlusion. With the appliance in the mouth, the patient cannot occlude comfortably in former distal position, and the mandible is encouraged to adopt a protrusive bite with inclined planes in occlusion. Thus, unfavorablecuspal contacts of distal occlusion are replaced by favorable proprioceptive contacts of the inclined planes of the twin blocks, correcting the malocclusion and freeing the mandible from its locked distal functional position.

Skeletal Effects of Twin Blocks: Twin-block appliances produce both skeletal and dentoalveolarchanges for correction of class II malocclusion. Twin-block appliance treatment resulted in increased mandibular length, increased SNB angle, and no significant restraining effect on maxillary growth.[30]However, some studies observed some headgear effect resulting in slight inhibition of forward maxillary growth.[31]Singh and Hodge also concluded that twin-block appliances along with extraoral traction cause growth modulation in specific regions of midfacial complex and change in position of the mandible (Mills, 2000). Siara-Olds *et al*.demonstrated good vertical control on mandibular plane angle with twin-block appliance therapy as compared to Herbst, bionator, and MARA appliances.

Soft-tissue Changes: There was found to be decreased skeletal convexity and H angle, increased mentolabial angle and reduction in the prominence of lower lip after treatment. Lower lip, lowerlip sulcus, and soft-tissue pogonion moved anteriorly after twin-block treatment. Singh and Morris *et al*. reported anterior and inferior movement of chin (Singh, 2003; Varlik, 2008).

Dental Effects of Twin Blocks: Overjet reduction with twin-block appliances is mostly due to dentoalveolar changes. Many attempts have been done to minimize tipping of lower incisors. The best results achieved using Southend clasps and acrylic cover for lower incisors. Various studies showed dental changes caused by this appliance that are proclination of lower incisors, retroclination of upper incisors, lower molar eruption and mesial movement of lower molars and headgear-like effect resulting in distal movement of upper molars. The proclination of mandibular incisors was probably due to mesial force on mandibular incisors induced by protrusion of the mandible (Yaqoob, 2012; Clark, 1995). McNamara concluded that lingual tipping of the maxillary incisors is due to the contact of the lip musculature during twin-block treatment and labial wire in bionator and twin-block appliances, which might come into contact with the incisors during sleeping, causing them to retract. However, Yaqoob *et al*. found that twin blocks showed similar results in terms of dentoalveolarand skeletal change when designed with or without a labial bow, indicating no effect of labial bow (Yaqoob *et al*., 2012).

Conclusion

All removable functional appliances increase mandibular length so useful in correction of skeletal class II malocclusion. Both skeletal and dentoalveolar changes can be achieved in activator functional appliance therapy. Depending on timing, technique, and trimming, significant facial and occlusal

changes can be achieved. Twin block has separate upper and lower appliances with occlusal bite blocks, so the appliance gives greater freedom of movement in anterior and lateral excursions and causes less interference in normal function. The patient can eat comfortably with the appliances in mouth, and the patient can learn to speak normally with twin blocks.It can also be used to correct transverse discrepancy by incorporating midline jackscrew. Therefore, the twin-block appliances due to its acceptability, adaptability, versatility, efficiency, and ease of incremental mandibular advancement without changing the appliance have become one of the most widely used functional appliances in correction of class II malocclusion.

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