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Fixed Functional Skeletal Class II Correctors: A Review

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Abstract

The fixed or removable orthodontic appliances mostly use intrinsic force to move teeth. The force is exerted by the appliance and is dissipated against the teeth and supporting structures. The skeletal Class II correctors evolved from the various modifications of the original activator. These appliances reposition the mandible in downward and forward direction, activating the attached and associated muscle. The resultant force thus created is transmitted not only to the teeth but also to the other structures of maxilla and mandible. Functional appliances have been broadly divided into two categories removable and fixed functional appliances. Fixed functional appliances are advised for non-compliant patients and patients nearing growth completion.

Keywords: Class II malocclusion, Facial Profile, Class II correctors, Orthopedic treatment, Growth modification

Introduction

Over the years it is a challenge for the orthodontists to alter the facial profile of a patient. Growth modification is one of the ways of correcting jaw discrepancy during growth period. It allows the correction of skeletal disharmony.[1]Functional appliances are designed to alter the arrangement of various muscle groups particularly the lateral pterygoids. The appliances influence the function and position of the mandible in order to transmit forces to dentition and basal bone.[1] Functional orthopaedic treatment corrects malocclusion and harmonize the shape of the dental arch and orofacial functions.[2] The ideal treatment time is in the permanent dentition period after the pubertal growth spurt.[3] Thesefixed functional appliances are also called non- compliance Class II correctors. However, co-operation is often required for a treatment to be successful.[4]

Historical Aspect

In 1879, Kingsley introduced a bite plate which had an inclined plane with a projection below to hold the lower incisors. The objective was to jump the bite in cases having retruded lower jaw andto prevent the protrusion the lower teeth. The term “jumping the bite” has been synonymously used today with forwarding the position of mandible with functional appliances. However, the applied term of “jumping the bite” was meant to let the mandible “jump” into the finally intended occlusion and to induce it to stay there. In 1908 Vigo Andersen developed an appliance to guide the mandible 3- 4 mm forward and to correct the deep bite tendency He modified the plate by addition of a horseshoe shaped lingual flange. He noticed an improvement in the patient profile. He andHaupl later developed the basics of a functional appliance. The first fixed functional appliance was introduced by Dr. Emil Herbst at the 5th International

Dental Congress in Berlin, Germany, 1905.[5]He presented the use of herbst appliance in a series of articles in the "ZahnaztlicheRundschau" in 1934.[5]Hans Panchez(1979) popularized the Herbst appliance with some modification. In 1981Hans Panchez showed sagittal mandibular growth was accelerated by continuous bite jumping.[6] During treatment the appliance promoted growth in mandibular length. The influence of bite jumping on maxillary growth appeared to be reversible.[6] Therefore, the SNA angle significantly gets reduced during treatment but during the follow-up period maxillary growth follows the normal genetical pattern and the SNA angle returns to almost pre-treatment values.[6]Clements & Jacobson introduced the Mandible Advancing Repositioning Splint in 1982.[7] It is a fixed functional appliance attached with the arch wires of a multi banded orthodontic appliances.[7] It helps to maintain the mandible in a protruded position 24 hours a day.[7]James J. Jasper (1987) introduced a new type of flexible, fixed tooth-borne functional appliance that allowed lateral movements of the mandible.[8]

Mode of action

The fixed functional appliance is a tooth borne appliance and exerts its effects via teeth to the underlying bone.[9]It transmits the forces by continuous forward posturing of the lower jaw.[10] The mode of action is one or a combination of the following:

a) Maxillary growth restriction,

b) Changes in neuromuscular anatomy and function,

c) Mandibular growth induction,

d) Glenoid fossa relocation,

e)Dentoalveolar changes.

The biomechanical effects of the fixed functional appliance are such that it moves the entire mandible forward and downward, with maximum displacement observed in the parasymphyseal and mid symphyseal region.[10] The displacement is more pronounced in the dentoalveolar region as compared to the skeletal displacement. All dentoalveolar structures experience tensile stress except for anterior nasal spine and the maxillary posterior teeth. Hu et al[11] and Zhou et al[12] reported tensile stress in the posterior condylar region with compressive stresses in the anterior region.The results obtained by the functional appliance in the correction of class II malocclusion consist of a combination of orthopedic (30-40 %) and dentoalveolar (60-70%) effects.Almeida et al. also confirmed in their study that the changes were mostly dentoalveolar.[13]

Indications and contraindications

Fixed functional appliances being smaller, permit better adaptation to mastication, swallowing, speech and respiration. As these appliances do not depend upon the co-operation of the patient they generate continuous stimuli for mandibular growth without any interruption. The greatest advantage is for the patients who come at the near end of their facial growth.

These appliances are absolutely contraindicated in patients with vertical growth pattern, anterior open bite and proclined mandibular incisors.

Herbst Appliance

The Herbst appliance is a rigid fixed functional appliance, introduced in 1905 by Dr. Emil Herbst of Germany. In 1982, the Herbst bite-jumping appliance had the most effective result in the treatment of class II malocclusion.[14]It stimulates mandibular growth, redirection of maxillary growth and mesial tooth movement.[6]The Herbst appliance acted as an artificial joint between maxilla and the mandible. It consists of a tube and a plunger.[5] Each axle holds the tube with a screw. The plunger is attached to the mandibular premolars in a similar manner. The length of the plunger determines the amount of forward posture of the mandible. The axles are soldered on to the molar bands.[5]

The anchorage system of the Herbst appliance is as follows[5]: In the maxillary dental arch the first premolars and the permanent first molars are banded and are interconnected on each side with a half-round (1.5 x 0.75 mm) lingual or buccal sectional arch wire. In the mandibular dental arch the first premolars are banded and connected with a half-round (1.5 x 0.75 mm) lingual sectional arch wire touching the lingual surfaces of the front teeth. This form of anchorage is called partial anchorage.[5]

Expansion can be performed in Class II cases with narrow maxillary arch by soldering a Quad helix or rapid palatal expansion device.[5] Mandibular canines can be used as anchorage teeth in cases where mandibular premolars have not erupted yet. In deciduous or early mixed dentition cases, bonded type of Herbst appliance can be used.[15, 16]

Mandibular Anterior Repositioning Appliance

This appliance was jointly created by Douglas Toll of Germany and Jim Eckhart of USA. It is a miniaturised rigid fixed functional appliance primarily attached to upper first molars on both sides. The appliance consists of cams made from 0.060-inch square wire fitted into 0.062 inch tubes attached to upper first molars. Each lower first molar has a 0.059-inch arm placed perpendicular to its buccal surface which interferes with upper cam. This guides the mandible into Class I occlusion. The stainless steel crown has been used to withstand the forces generated by the two attachments.[17] This appliance induces a significant elongation in the total length of the mandible.[18]

Mandibular Protraction Appliance

This is a rigid fixed functional appliance. It was developed to be quickly made up by the orthodontists in the laboratory. It is used in conjunction with multi- bracket appliance. It is attached distally to the maxillary molar tube with a lock pin and in the circular inter- maxillary loop in the mandibular arch wire distal to the canine bracket.[19]This appliance is fabricated using 0.045-inch stainless tube and 0.036-inch rigid stainless steel arch wire. This appliance has evolved over a series of modifications from the version I to IV. It allows rapid mandibular forward repositioning and considerable lateral movements of the mandible.[19]

Ritto Appliance

This is a rigid fixed functional appliance with telescopic mechanism.[20]It is recommended for correction of Class II malocclusion with mandibular deficiency in mixed or permanent dentition. This appliance uses conventional bands on the upper molars and two tubes on the lower molars with brackets on the lower incisors. It has been developed over a period of 12 years with the goal of creating an efficient appliance with telescopic action.[21] The appliance is fixed in the maxillary molar tubes with steel ball pin.

The lower arch should consist of 0.022-inch molar tube and 0.018-inch incisor brackets.[21] The arch wire is 0.017 X 0.025-inch stainless steel wire and should be changed every 3-4 weeks. The lock is placed distal to the incisor brackets. After insertion of the appliance, the lock should be adjusted depending upon the mandibular forward movement required.[21]

Jasper Jumper

Jasper jumper is a flexible fixed functional appliance. It consists of two parts:[21] the force module and the anchor parts. It is a stainless steel spring loaded device covered with vinyl coated tubing attached to steel caps at both ends. The caps have holes to which the anchoring parts can be attached. This force module is attached to upper molar tubes and to the lower arch wire in the canine- premolar region. The main advantage of this appliance is its flexibility which allows the patient to close in centric relation and perform lateral movements with ease.[21] Though it can cause rapid improvement of Class II molar relations, it has the disadvantage of increasing IMPA.[8] It is available in seven lengths, ranging from 26 to 38 mm.[21] The distance between the mesial of the upper molar tube and the point of insertion in the mandibular arch is measured first. It is followed by addition of 12 mm to the measurement, which finally gives the appropriate length of the jumper.[21]

Klapper Super Spring

It was introduced by Lewis Klapper in 1997. It consists of a multi- flex nickel titanium spring which is attached between the maxillary molars and the mandibular canines.[22] When activated, the length of the spring rests in the vestibule making maintenance of oral hygiene difficult. The fixing points are different. In the maxillary end, it is attached to the standard headgear tube or to a special oval tube and secured with a stainless steel ligature wire. In the mandibular end, the open helical loop of the spring is twisted like a J hook in the mandibular arch wire. It is available in two prefabricated sizes. The length of the spring can be increased or decreased by simply bending the attachment wire.[22]

Adjustable Bite Corrector

It was introduced by Richard P. West in 1995. It is composed of various pieces such as caps, closed coil springs, nickel titanium wire.[23] It can be used on either side of the mouth by simply changing the orientation of the lower end cap. In the center lumen of the spring, nickel titanium wire is placed, which is responsible for the generation of the push force.[23]

Eureka Spring

This hybrid fixed functional appliance was introduced by DeVincenzo in 1997. It can be used with fixed appliance with heavy arch wires in place.[24] It is a three-piece telescopic appliance fixed to the upper arch at the level of the molar band and to the lower arch distal to the cuspid.[24]The appliance has an open coil spring placed inside the system. The upper molars are stabilised with a transpalatal bar. The appliance has a piston and plunger assembly loaded with spring and is available in two force ranges: light (150 grams) and heavy (225 grams).[21] This appliance is effective in Class II correction which occurs almost entirely by dentoalveolar movement without increasing the vertical dimension.[21]

Twin Force Bite Corrector

This is a hybrid fixed push type, semi regid fixed functional appliance clamped to arch wires in both the upper and lower arches bilaterally.[25] Each unit is made up of two 15 mm telescopic parallel cylinders.

Nickel titanium coil springs are housed in the cylinders which are activated when the patient occludes. A plunger is incorporated at the end of each cylinder on both ends. At the end of each plunger, hex nuts are present to attach the appliance to the arch wirtes mesial to the upper molars and distal to the lower canine.[25] At full compression, a force of 210 grams is delivered on each side by compression of the coil spring. The upper molars are stabilised with a transpalatal bar. Since, the point of force application is closer to the centre of resistance of the maxillary dentition compared to other traditional appliances where the point of force application in the maxillary arch is distal the upper molar, a lesser clock wise moment is generated on the maxillary arch.[25]

Forsus Fatigue Resistant Device

This hybrid fixed functional appliance consists of a semi-rigid telescopic system consist of a nickel titanium coil spring.[26] It can be used in conjunction with full fixed appliance.[27] The appropriate length is selected by asking the patient to bring the mandible forward in Class I molar relationship and the distance is measured from the distal of the maxillary molar tube to the distal of the canine bracket.[26]The appliance is attached distal to the buccal tube of maxillary first molar and distal to the canine bracket in the mandibular arch wire. A transpalatal bar is used to reinforce the anchorage in the maxillary arch. The spring produces about 200 grams of force when fully compressed.

Conclusion

Though removable functional appliances are effective in altering profile of the patient, its success heavily depends upon the co-operation of the patient. It increases the treatment time. So to achieve the desired results in reasonable time frame, fixed functional Class II correctors are the appliances of choice.

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