

Treatment Options for Skeletal Class II Malocclusion in Growing Patients - A Review

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Abstract:

Class II malocclusion is the most common type of malocclusion seen in day to day practice. It is a condition in which the mandibular first molars occlude distal to a normal relationship with the maxillary first molar. The treatment of class II patients varies with age. While for a patient in his pubertal growth spurt, treatment goal would be to address the skeletal malrelationship using growth modification along with fixed orthodontics, for an adult patient with no growth remaining, the goal would be to camouflage the skeletal malocclusion or address the malocclusion by surgery. This article discusses the treatment modalities in the management of skeletal class II malocclusion in growing patients.

Key Word: Growth Modification, Dental camouflage, Growing patients, Skeletal correction

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I. Introduction

Classification of malocclusion has always been a challenge to orthodontists, yet it is an important tool in diagnosis and treatment planning. Angle¹ in the 1890s had proposed a classification which has stood the test of time in spite of all its limitations. He defined Class II malocclusion as one in which the mandibular first molars occlude distal to the normal relationship with the maxillary first molar Angle had differentiated malocclusion based on the occlusal relations of the upper and the lower molars and it was later noted that a Class II malocclusion had two components- one being a dental Class II and the other being a skeletal Class II.

Dental Class II is one where the distobuccal cusp of the upper first molar falls in the buccal groove of the lower first molar while a skeletal Class II malocclusion can be due to a mandibular deficiency caused by reduced size or retroposition or due to a maxillary excess or a combination of both.² The cause for Class II establishment in an individual be it skeletal or dental are so varied, that there exists a wide array of treatment options for a Class II individual.

Class II malocclusion is among the most common developmental anomalies with a prevalence ranging from 15 to 30% in most populations. Dental and skeletal Class II malocclusion carries a greater risk of dental trauma, a more negative perception of facial and dental esthetics, a negative impact on quality of life and self-esteem, a greater predisposition to periodontal diseases and tooth wear, and a reduction of oropharyngeal space and greater incidence of sleep disorders. The resulting anomaly may demonstrate various severities of class II malocclusion in different ages, which dictates the preferred approach to clinical management. The advantage of treating Class II malocclusion during growth, that is, in the mixed or early permanent dentition stage, is the possibility of changing the patient's growth pattern and reducing the risk of trauma to maxillary incisors. In addition, it increases airway space in the oropharyngeal region and results in an ideal and stable occlusion.

Two treatment modalities for a dental Class II malocclusion include - A non-extraction approach which involves the distal movement of the maxillary molars and an extraction approach involving unilateral or bilateral dental extractions. For a skeletal Class II malocclusion, three treatment alternatives exist i.e Growth modification, Dental camouflage, Orthognathic surgery. In a growing patient, all three may be possible; however, in an adult the latter two are the only options.³ For growth modification, three types of orthodontic appliances are used. They are - Extra oral force appliance, Functional appliance and Inter arch elastic traction.

II. Classification of Class II Malocclusion

MOYERS CLASSIFICATION:

Horizontal typing: Class II taxonomy recognizes six subgroups based on horizontal variables by the letters A, B, C, D, E, and F and call them "types." Types B, C, D, and E are true syndromal types of Class II; that is, they have distinctly different skeletal and dental features and their morphologic and growth patterns differ from one another. Type F, the largest subgroup of all, is less well defined, less characteristic of skeletal Class II, and yet clearly

not Class I. Finally, there is a subgroup Type A which has scarcely any Class II skeletal features but, because of its dental characteristics, was designated as Class II.

Vertical typing: Type 1: The characteristic features of vertical Type 1 are a mandibular plane steeper than normal, an even steeper functional occlusal plane, and a palate which is tipped somewhat downward. The anterior cranial base tends to be upward.

Type 2: Vertical Type 2 is essentially a square face. The mandibular plane, functional occlusal plane, and palatal plane are all flatter than normal and are nearly parallel. The gonial angle approaches orthogonality, and the anterior cranial base is more horizontal than normal. Under these conditions, the incisors tend to be vertical and in deep-bite.

Type 3: The characteristic feature of vertical Type 3 is a palatal plane which is tipped upward anteriorly. During growth, the upper face height does not keep pace with the total face height, resulting in a strong tendency to open-bite.

Type 4: In vertical Type 4 the mandibular plane, the functional occlusal plane, and the palatal plane are all tipped markedly downward (as in Type 1), leaving the lip line unusually high on the alveolar process in the maxilla and the gonial angle is obtuse.

Type 5: Vertical Type 5 is most closely related to vertical Type 2, “the square face syndrome,” and is found only in horizontal Subgroups B and E. In Type 5 the mandibular and functional occlusal planes are normal.⁴

Depending on the age of Class II patients, treatment varies. For a patient in his pubertal growth spurt, treatment goal would be to address the skeletal malrelationship by growth modification along with fixed orthodontics.⁵ The following are the treatment options for correction of class II malocclusion in growing patients-

1. Growth modification- i) Extraoral appliances (headgear), ii) Intraoral appliances-a. Removable functional appliances, b. fixed functional appliances (rigid, flexible, hybrid) iii). Combined growth modification iv). Interarch traction. **2. Dental camouflage-** i). Non Extraction (molar distalization), ii) Extraction

III. Growth Modification

EXTRAORAL FORCE OR HEADGEAR THERAPY

The most ideal indications of headgear use are Class II due to an anteroposterior maxillary excess, a normal mandibular skeletal and dental morphology. The goal of headgear use is to restrict the growth of the maxilla while allowing the mandible to ‘catch up’ growth with the maxilla. Extraoral forces not only compress the maxillary suture, inhibiting the anterior and inferior maxillary development, it also inhibits the mesial and occlusal eruption of the maxillary posterior teeth. Extra oral force must be in the range of 400- 600g per side to obtain maximum skeletal effects and minimal dental effects.¹ It should be intermittent in nature and should be used for a duration of upto 12 to 16 hours. The extra oral attachment can be cervical or occipital depending on whether a high or a low angle of force vector is required. In a cervical headgear though the distal force is favoured, it opens the bite by rotating the mandible downward and backward. The occipital headgear, on the other hand has an intrusive and a distal force on the maxillary molars. The outer bow can be shortened or raised to produce a more superior force vector.

FUNCTIONAL APPLIANCES

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 transmit forces to the dentition and the basal bone. Typically, these muscular forces are generated by altering the mandibular position sagittally and vertically, resulting in orthodontic and orthopedic changes.

Indications:

Indications include mandibular deficiency with a normal maxillary development, a normal or mildly decreased facial height, slightly protrusive maxillary incisors and slightly retrusive mandibular incisors with active mandibular growth primarily in the forward direction.

Timing of treatment:

It is prudent to make use of the most active period of facial growth and compliance together making it ideal to start treatment in the mixed dentition period.¹

Skeletal effects of functional appliances:

Apart from the speculation of the downward and forward remodeling of the glenoid fossa⁶ that leads to the skeletal Class II correction, there is also a headgear² effect that is seen in these appliances. This is because of the posterior and superior force on the maxilla caused by the stretch of the soft tissues and facial muscles that attempt to bring the mandible back from its forward posture by the appliance.⁷ Since the appliance contacts the maxilla and the maxillary teeth, it also leads to restriction of the maxillary growth.

Dental effects of functional appliances:

This includes lingual tipping of the maxillary anteriors by the labial bow or the torquing springs. This occurs when a lingual force is exerted by these components when the mandible attempts to reposition back to its original position. This is the same reason why the functional appliance would also cause mandibular incisor protrusion.⁶ It also affects the mandibular posteriors by encouraging their mesial and occlusal eruption while inhibiting the eruption of maxillary posterior teeth.²

Limitations of functional appliances:

1. Functional appliances are typically associated with maxillary and mandibular molar extrusion.
2. Individual tooth movements are difficult with functional appliances. Therefore a final phase of fixed appliance therapy should be considered to achieve bodily and rotational tooth movements and optimal functional occlusion.
3. The results of treatment are totally dependent on patient cooperation.
4. These appliances are of very limited use in the correction of anteroposterior discrepancies in nongrowing patients.

Some of the commonly used Removable functional appliances are- Activator, Bionator, Frankel functional regulator, Twin block, Bioblock and Experimental fixed appliance activator.

ACTIVATOR

It was introduced by Andresen in 1908.⁶ It is a loose fitting appliance with its acrylic body covering part of the palate and the lingual aspect of the mandibular alveolar ridge. A labial bow fits anterior to the maxillary incisors and carries U-loops for adjustment.⁸ Modifications of the activator include Herren Shaye activator, Bow activator of AM Schwarz, Wunderer's modification, Reduced activator or cybernator of Schmuth, Hyperpropulsor activator, LSU activator,⁹ Cut out orpalate free activator, Lehman activator.¹⁰

BIONATOR

It was introduced by Balters in 1960. Unlike activator, bionator modulates muscle activity thereby enhancing normal development of the inherent growth pattern and eliminating abnormal environmental factors.¹¹ It consists of a lower horse shoe shaped acrylic with posterior lingual extensions in upper arch. There are three types of bionator –Standard, Open bite, Reversed or Class III.

FRANKEL APPLIANCE

It was introduced by Rolf Frankel in 1967. Frankel philosophy is that the circumoral musculature has a restraining effect on the dentition. If the dentition is relieved of this restraining influence as done by the lip pads and the buccal shields, then an increase in the critical intercanine width can be seen.¹² The success of the appliance is its function as an exercise device (oral gymnastics) stimulating normal function while eliminating lip trap, hyperactive mentalis activity, and aberrant musculature.^{6,8} The types of FR tailored to different malocclusions include- FR 1- used for Class I and Class II div1 (FR1a- Class I with minor crowding, FR1b- Class II div 1 with overjet less than 5 mm, FR 1c- Class II div 1 with overjet greater than 7 mm), FR2- Class II div 1 and 2, FR3- Class III, FR4- Open bite and bimaxillary protrusion, FR5- High mandibular plane and vertical maxillary excess.

TWIN BLOCK APPLIANCE

It was introduced by W.J. Clark¹³ in 1977. Twin block appliances are simple bite blocks which 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.¹⁴ Modifications of twin block include Fixed twin block, Reverse twin block, Magnetic twin block and Twin block in temporomandibular joint therapy.

BIOBLOCK

It was introduced by John Mew¹⁵ in 1979. He considered the possibility of anterior collapse as the cause for crowding, just as the narrow dental arches. Hence the bio block encouraged the forward development of the labial alveolus as well as expansion of the narrow maxilla.

EXPERIMENTAL FIXED APPLIANCE ACTIVATOR

EVAA was first described by Van Der Schueren and De Smit¹⁶ in 1994. EVAA, in Dutch stands for experimental fixed appliance activator. It consists of a block of acrylic with protruding wires that are fitted into the maxillary molar tubes. This is the functional appliance most commonly used with the Begg technique.

FIXED FUNCTIONAL APPLIANCES

Fixed functional appliances are also known as Non Compliance class II correctors and they have some advantages over removable systems¹⁷:

1. They are designed to be worn 24 hour a day.
2. They are smaller in size permitting better adaptation to function
3. Reduce the need for patient compliance.
4. As they are fixed on the upper and lower arches, they transmit forces directly to the teeth.

CLASSIFICATION:

APPLIANCES PRODUCING PUSHING FORCES: These appliances deliver a push force vector forcing the attachment points of the appliance away from one another.

1. **Rigid:** (Herbst Appliance and its modifications, Mandibular protraction appliance, Ritto appliance, Biopedic appliance, Mandibular anterior repositioning appliance, Functional Mandibular Advancer)
2. **Flexible:** (Jasper Jumper, Scandee tubular jumper, Flex developer, Amoric torsion coils, Churro Jumper, Adjustable Bite Corrector, Klapper Super Spring II, Forsus nitinol flat spring)
3. **Hybrid :** (Eureka spring, Forsus fatigue resistant device, Twin force bite corrector, Sabbagh universal spring)

APPLIANCES PRODUCING PULLING FORCE: These appliances act as a substitute for elastic and create a pulling force vector between the points of attachment. Example- SAIF (Severable Adjustable intermaxillary Force) spring, Alpern class II closers, Caliberated force module.

Commonly used Fixed functional appliances are- Herbst appliance, MARS appliance, Jasper Jumper, MARA, Forsus Fatigue Resistant Device, Powerscope and Advansync.

HERBST APPLIANCE

It was introduced in Berlin in 1909 by Herbst. However it was not much in use until Pancherz¹⁸ resurrected the Herbst appliance in 1977.⁵ It consists of a bilateral telescopic mechanism attached to orthodontic bands. Each telescopic mechanism consists of a tube, a plunger, two pivots and two locking screws that prevent the telescoping parts from slipping past the pivots. It causes stimulation of mandibular growth, inhibition of maxillary growth to a limited extent, distal movement of the upper dentition, mesial movement of the lower dentition (proclination of the incisors).^{19,20}

MARS APPLIANCE (MANDIBULAR ADVANCING REPOSITIONING SPLINT)

The MARS appliance was introduced by Clements and Jacobson in 1982. It is a fixed functional device which is attached to the arch wires of a multiband orthodontic appliance. It is composed of a piston and cylinder which attaches to the lower canine and the upper molar region of the dental arch wires on each side of the jaw. The MARS appliance promotes repositioning of the mandible to a more forward or protrusive position by using the principle of compressive struts rather than via tension, as with Class II elastics, or via predominantly muscular repositioning, as with removable functional appliances.²¹

JASPER JUMPER

It was introduced by Jasper in 1987. It produces both sagittal and intrusive forces on the dentition. The system consists of two parts – the force module and the anchor units.²² Types of forces produced- Sagittal: It distalizes the posterior anchor units and applies anterior force on the mandibular dentition. Intrusive: an intrusive force acts on the maxillary posterior region and the mandibular anterior region. Buccal force: an intrusive force acting along the buccal surface causes expansion.

MANDIBULAR ANTERIOR REPOSITIONING APPLIANCE (MARA)

MARA is developed by Douglas Toll in 1991. It is a fixed device made of stainless steel crowns commonly placed over the maxillary and the mandibular first molars. The upper molar has cams made of square wire attached to the band or the crown. The extension arms of MARA prevent the patient from closing in a natural Class II position, thus requiring hyper propulsion to achieve intercuspation.²³

FORSUS FATIGUE RESISTANT DEVICE

The Forsus Fatigue Resistant Device (FRD) was designed by William Vogt²⁴ in 2001. The FRD is a three-piece, telescoping system incorporating a superelastic nickel-titanium coil spring- EZ2 Module or L-pin Spring Module. It is an Interarch push spring that produces about 200g of force when fully compressed. The FRD can intrude the maxillary first molars and thus correct a Class II malocclusion without opening the bite. Distal and intrusive movement of maxillary molars, mesial movement of mandibular molars, retrusion of maxillary incisors, labial tipping of mandibular incisors, and varying amounts of skeletal effects have been reported with this appliance.²⁵

POWERSCOPE

PowerScope is a direct derivative of the Herbst Type II appliance. Dr. Andy Hayes worked in conjunction with American Orthodontics to develop PowerScope in 2008. It is a fixed one-piece appliance available in one size suiting all Class II patients. The appliance allows the quick and easy wire-to-wire installation preventing bond failures of bracket and buccal tube.²⁶ The ball and socket joint at the two ends of the appliance allows excellent jaw movements reducing much of patient discomfort. The components of powerscope appliance include Locking nut attachment, Telescopic system, Hex-head screws, NiTi spring, Crimpable shims, Hex-head driver.

ADVANSYNC

Developed by Terry Dischinger in 2010. It is a molar to molar fixed functional assembly. As the name of the appliance suggests that mandible can be postured forward synchronously with the start of all other fixed appliance tooth movements. The appliance requires no laboratory work. The appliance is almost half the size of MiniScope Herbst appliance. It has the advantage of allowing concurrent treatment with preadjusted edgewise appliances and therefore efficient normalization of the occlusion.²⁷ The advansync appliance seems to shorten total treatment time by combining the anterior posterior correction and fixed appliance phase.²⁸

INTERARCH TRACTION

Interarch traction from the anterior part of the maxillary arch to the posterior part of the mandibular arch is commonly referred to as Class II elastics. This results in protraction of the mandibular posteriors and retraction of the maxillary anteriors. The vertical force leads to extrusion of the mandibular posterior teeth and maxillary anterior teeth that causes rotation of the occlusal plane up posteriorly and down anteriorly. There is also a transverse force that causes the mandibular molars to tip buccally.

Class II elastics is the term used to describe intraoral traction between points of attachments buccal to the lower posteriors and labial to the upper anterior teeth. More specifically, it refers to any interarch elastic that has its mandibular attachment more distal to that of the maxillary counterparts. The more distance between the points of attachments, the more horizontal is the vector of force. There are two types of traction -Latex or synthetic rubber, Metal alloy. Indications include cases which require anterior movement of the lower posteriors and where rotation of the occlusal plane and extrusion of the maxillary anteriors is not detrimental to the outcome. Most appropriate indication is a dental Class II with normal skeletal bases. It is beneficial to have slightly retrusive mandibular incisors, protrusive and slightly intrusive maxillary anterior teeth with slight constriction of the mandibular molars. At least some minimal mandibular growth potential with flat occlusal and mandibular planes where an increase in lower face height is desired.²⁹

IV. Combined Growth Modification

While headgears correct Class II skeletal patterns by maxillary restriction and functional appliances by promoting mandibular growth, the skeletal effects of the two are surprisingly similar. Hence both began to be used in combination that was developed in Europe in the 1960s. This is usually used in cases of more severe skeletal Class II problems with a vertical maxillary excess being a prominent feature. This consists of an occipital attachment connected to a face bow and inserted into headgear tubes. Since the tube is more anterior the inner bow should be short. The high pull headgear helps in additional retention of the appliance. Class II combination therapy was promoted by S Jay Bowman.³⁰ Here the orthodontic and the orthopaedic phases are not distinct but combined into a cohesive fixed orthodontic therapy.

V. Dental Camouflage

The goal of camouflage of a skeletal Class II is to disguise the unacceptable skeletal relationship by orthodontically moving the teeth to get proper buccal occlusion and reduced overjet. The candidates for camouflage would be adults or those in late adolescence who have little potential for growth.

Dental camouflage without extractions:

When sufficient space is not available in the arch, maxillary molar can be distalized bodily by a continuous headgear wear, only if second molars have not been erupted. If the patient's compliance is questionable, an intraoral molar distalizer is used. Indications for molar distalization include less than half a unit Class II posterior occlusion, mild excessive overjet with no mandibular growth potential and when there is space present in the arches.³¹ Molar distalizers are of two types- Intra arch molar distalizers that includes NiTi wires, NiTi coils, Distal jet, Pendulum appliance, Carrier distalizer, implants and Inter arch molar distalizers that includes Herbst, Jasper Jumper, MARA, Forsus Fatigue Resistant Device.

Dental camouflage with extractions:

In camouflage with extraction, the maxillary first premolars are extracted so that complete reduction of overjet can be achieved with Class II relation. The other option is to extract mandibular first or second premolars and maxillary premolars. The goal is to achieve reduction of overjet and utilize the lower space for protraction of posteriors and reduction of axial inclination of mandibular incisors in case of protrusion.³² In both cases, the maxillary anchorage would be maximum posterior anchorage and maximum anterior anchorage in mandibular arch. Once the extraction space is available, closure of spaces can be accomplished by spring like force (elastic, closing loop, closed coil spring). To bring about minimum mesial movement of the maxillary posteriors, face bow can be used which applies a posterior force that counteracts the mesial force of intra arch elastics.

VI. Conclusions

Class II malocclusions are of interest to the practicing orthodontists since they constitute a significant percentage of the cases. Thus, it is evident to any orthodontist that various treatment options exist for a patient who presents with a class II malocclusion. The key to success of treatment, is a thorough examination and diagnosis as to find out where the fault in the development process has occurred and the proper management of the same.

The possible etiology, severity, growth potential, individual variability, biomechanics used, patient cooperation, and the retention plan are some of the variables that could influence the treatment results in patients with Class II malocclusions. Among the various treatment options too, the number of appliances that an orthodontist has to choose from is far too many. Treatment success with these appliances would be attained only once he uses the appliance for the intent that it was made and by having a thorough knowledge of the modus operandi. The clinician must also be aware of the limitations and the side effects of the appliance. By doing so, we create a treatment option that is custom made to any Class II patient taking into account his age, gender and the severity of malocclusion.

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