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Timing of Treatment for Class II Division one Malocclusion for Growing Patient with Myofunctional Appliances

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Abstract **Review Article**

In mixed dentition, many Class II patients present with increased overjet, compromised facial esthetics, psychosocial concerns, and risk of incisor trauma. A key clinical question is whether functional appliance therapy should begin early (8–10 years) to maximize growth potential, or be delayed until late mixed or early permanent dentition (11–13 years). Initiating treatment at the appropriate stage is essential, as unnecessarily prolonged therapy may negatively affect esthetics, compliance, and comfort.

Keywords: Functional Appliances, Class II Malocclusion, Mixed Dentition, Mandibular Retrusion, Overjet, Growth Modification.

INTRODUCTION

Functional appliances represent a group of orthodontic devices designed to modify the activity of orofacial muscles controlling mandibular posture and function, thereby transmitting forces to teeth and supporting bone. By altering the sagittal and vertical position of the mandible, these appliances influence muscular activity and produce both orthopedic and orthodontic effects [1]. Most functional appliances operate by advancing the mandible in growing patients and are particularly effective in correcting anteroposterior discrepancies, especially in cases of mild to moderate Class II malocclusion. Class II malocclusions, among the most prevalent orthodontic problems, are characterized by a forward positioning of the maxilla relative to the mandible. (Management strategies generally follow either a two-phase or one-phase approach. The two-phase protocol involves early intervention in the mixed dentition using functional appliances to address skeletal imbalances, followed by fixed appliances in the permanent dentition. Conversely, the one-phase approach addresses the malocclusion in a single comprehensive treatment during the permanent dentition. This review will explore various myofunctional and orthopedic appliances, alongside other modalities, for early correction of Class II skeletal and dental discrepancies in growing patients [2].

Class II malocclusion

Class II malocclusion is one of the most prevalent orthodontic problems, accounting for approximately one-third of orthodontic patients [3]. It is defined by a distal relationship of the mandibular dentition relative to the maxilla, often associated with an increased overjet and convex facial profile [4]. Etiology is multifactorial, involving genetic, skeletal, dental, and functional components, with mandibular retrusion being the most common skeletal characteristic [5]. Clinically, Class II malocclusion may present with compromised facial esthetics, functional disturbances, increased risk of incisor trauma, and psychosocial concerns [6]. Early diagnosis and appropriate timing of intervention are critical, as growth modification with functional appliances may help reduce skeletal discrepancy and improve treatment outcomes in growing patients [7].

Etiology of Class II Malocclusion

The etiology of Class II malocclusion is considered multifactorial, involving both genetic and environmental influences. Genetic factors contribute substantially, often expressed through an additive polygenic inheritance pattern, which predisposes individuals to skeletal discrepancies such as mandibular retrusion or maxillary protrusion [8]. The mouth breathing habit also can lead to different type of malocclusion such as class II malocclusion. The malocclusion occurs due to change in related functional demands in craniofacial musculature and their obligatory response, not due to the change in breathing pattern [9]. Premature loss of maxillary primary molars can contribute to the development of Class II malocclusion. The absence of these teeth permits mesial drifting of the maxillary first permanent molar, which, if initially in an end-on relationship with the mandibular molar, may shift into a full dental Class II relationship. This suggests that local environmental factors are more strongly implicated in dental Class II malocclusions than in skeletal cases. Therefore, accurate identification of etiological factors is essential in formulating an appropriate treatment strategy for Class II patients [10].

Growth spurt

Growth refers to the quantitative increase in cell size and number, whereas development denotes the qualitative process of cellular differentiation and functional specialization. Both are fundamental considerations in orthodontics, as they directly and indirectly influence treatment outcomes. Growth modification can be advantageous in correcting skeletal discrepancies, particularly in Class II and Class III cases. However, growth may also exacerbate certain malocclusions, necessitating treatment postponement. For instance, progressive mandibular growth can worsen a Class III skeletal pattern, and vertical growth tendencies may aggravate anterior open bite. In such situations, delaying intervention until growth completion may be more appropriate [11]. Post-treatment stability is strongly influenced by residual growth, which must be carefully considered when planning retention protocols. In Class II patients, prolonged retention is often required, as mandibular growth may continue into the late teenage years or even early twenties, whereas maxillary growth typically ceases earlier. This differential growth potential can contribute to relapse if not managed appropriately [12]. Several methods have been proposed to predict growth, particularly the onset of the pubertal growth spurt, which is critical for timing orthodontic interventions. These include chronological age, dental development staging, serial measurements of standing height plotted on growth charts, evaluation of secondary sexual characteristics, and radiographic indicators of skeletal maturation [13,14]. Richard Scammon15 proposed that the different tissues and systems of the body have different growth patterns, from the orthodontic perspective, maxillary and mandibular growth follows a pattern that is part way between neural and somatic growth, with the mandible following the somatic curve more closely than the maxilla. Growth velocity differs between sexes and is closely linked to the timing of the pubertal growth spurt. In females, the peak height velocity typically occurs between 11–12 years of age, whereas in males, occurs later, usually between 13–14 years [15]. On average, girls reach their maximum growth velocity about 2 years earlier than boys. After the pubertal spurt, growth velocity declines until growth completion, which generally occurs around 15–16 years in females and 18–20 years in males [16].

Treatment of C lass II Anomalies

Management of Class II malocclusion can be initiated at different developmental stages using a variety of treatment approaches and appliances. In skeletal Class II cases, treatment is typically directed toward either restricting maxillary growth, enhancing mandibular growth, or employing a combination of both strategies, depending on the underlying skeletal discrepancy [17]. By contrast, dentoalveolar Class II malocclusions are generally addressed through repositioning of the maxillary and/or mandibular dentition, with therapeutic options including distalization of maxillary teeth, mesial movement of mandibular teeth, or a combination of both [18].

Treatment In Early Mixed Dentition (Two Phase Approach)

Two-phase treatment represents a pediatric orthodontic strategy that integrates dental alignment with functional occlusal correction. The goal is to guide normal jaw growth, ensure proper eruption of permanent teeth, and address problems such as premature tooth loss, crowding, increased overjet, crossbite, and other developing malocclusions [3]. A central challenge in this approach is determining the optimal timing of intervention, particularly whether treatment should begin during the early mixed dentition or be postponed until the late mixed or permanent dentition. Early treatment, or Phase I, generally involves 6–12 months of active therapy aimed at modifying the dentoskeletal relationship. Following eruption of the permanent dentition, Phase II—the comprehensive “finishing” stage—focuses on final alignment and occlusal detailing [19].

Treatment In Late Mixed Dentition

By beginning treatment in the late stages, at least 90% of all growing patients can be successfully treated in only one phase. Identified mixed dentition development stage by removing all deciduous teeth except the "E"s are deciduous second molars. Implicit in this view is that there are few, if any, benefits that are unique to and dependent on earlier treatment. In addition, habit control and the use of passive appliances are implied, such as space maintainers and minor alignment of incisors for esthetics or trauma reasons, is not considered part of conventional two-phase treatment [20]. Two of the most frequent orthodontic concerns in children are dental crowding (in Class I or Class II malocclusions) and the correction of Class II discrepancies. In many cases, the leeway space provides sufficient room to achieve proper alignment of the permanent dentition. Thus, crowding can often be resolved during the mixed dentition stage by preserving and utilizing this space. This is based on the fact that the combined mesiodistal widths of the primary canine and first molar approximate those of the permanent canine and first premolar, while the difference between the primary second molar and its successor (second premolar) accounts for the so-called “E” space. If this space is preserved articularly in the late mixed dentition crowding can frequently be managed without extractions. In situations where a primary canine is lost prematurely, placement of a passive lingual arch can help maintain arch length and prevent space loss [21].

Class II Functional Appliances

The term functional appliance refers to a class of orthodontic appliances that are meant to alter the activity of the numerous muscle groups that regulate the function and posture of the mandible in order to transmit forces to the teeth and basal bone. There are many different types of functional appliances, but the majority of them work on the idea of moving the mandible forward in growing patients. They are particularly efficient in changing the anteroposterior occlusion of the upper and lower jaws, most commonly in patients with mild to moderate Class II skeletal discrepancy [1].

Type of Myofunctional Appliances

Activator

Is one of the earliest and most widely used removable functional appliances, introduced by Andresen and Häupl in the 1920s. It is primarily designed for the treatment of skeletal Class II malocclusions in growing patients. The appliance works by posturing the mandible forward, which alters neuromuscular activity and transmits forces to the dentoalveolar and skeletal structures. This functional mandibular advancement stimulates condylar growth and remodeling of the glenoid fossa, while simultaneously influencing dental eruption patterns. Clinically, the Activator is bulky and often requires significant patient compliance, as it is typically worn only at night and during home hours. Modifications of the Activator, such as the Hansa Activator**,** Balters Bionator, and Harvold Activator, have been developed to improve comfort and efficiency. The appliance has shown effectiveness in reducing overjet and improving sagittal interarch relationships, particularly in patients with mandibular retrognathism [22].

Bionator Appliance

Introduced by Balters in the 1950s, is a removable functional appliance designed primarily for the correction of skeletal Class II malocclusion in growing patients. It works by advancing the mandible forward, which alters the functional environment of the orofacial musculature and promotes adaptive skeletal and dental changes. Compared with the bulkier Activator, the Bionator is less obtrusive, easier for patients to tolerate, and permits limited speech and swallowing during wear [7].

There are three main types:

- Bionator I: Designed for Class II correction through mandibular advancement.
- Bionator II (Open-bite Bionator): Modified for anterior open bite correction by controlling vertical development.
- Bionator III: Intended for Class III cases by restraining mandibular growth and encouraging maxillary development.

Clinical studies have shown the Bionator to be effective in reducing overjet, improving sagittal jaw relationships, and enhancing facial esthetics when patient compliance is adequate [23].

Twin Block Appliance

developed by William Clark in the 1980s, is one of the most widely used and effective functional appliances for correcting skeletal Class II malocclusion in growing patients. Unlike bulky single-piece appliances (e.g., Activator, Bionator), the Twin Block consists of two separate plates-one for the maxillary arch and one for the mandibular arch—designed with occlusal bite blocks that interlock at an angle (typically 70°). This configuration postures the mandible forward during function, thereby stimulating mandibular growth, remodeling of the temporomandibular joint, and dentoalveolar adaptation. Advantages, Comfortable and less bulky, allowing better speech and compliance compared to earlier appliances, Can be worn full-time, even while eating, which increases treatment efficiency, produces both skeletal and dentoalveolar changes, reducing overjet and improving facial profile. Limitations, requires good patient cooperation for full-time wear, may cause initial discomfort and bite opening [24].

Clinical effectiveness Studies show that Twin Block therapy can significantly reduce overjet, improve sagittal jaw relationships, and enhance facial esthetics when applied during the pubertal growth spurt.

Frankel Appliance

Developed by Rolf Frankel in the 1960s, is a tissue-borne functional regulator designed to correct skeletal and dental discrepancies by modifying the functional environment of the orofacial musculature. Unlike tooth-borne appliances such as the Activator or Twin Block, the Frankel appliance acts mainly on the perioral musculature, vestibule, and soft tissues, encouraging favorable skeletal growth while reducing abnormal muscular pressures on the dentition. Promotes muscular and functional re-education, improving long-term stability, increases arch width and space by removing restrictive soft-tissue forces, efective in growing patients during mixed dentition. The disadvantages are bulky design may affect speech and require strong patient compliance, less commonly used today compared with twin block due to comfort issues [25].

There are different designs, each tailored for specific malocclusions:

- FR-I: Used for Class I cases with crowding and for mild Class II correction.

- FR-II: Specifically designed for skeletal Class II malocclusion caused by mandibular retrusion.
- FR-III: Intended for skeletal Class III correction by influencing maxillary development and restraining mandibular protrusion.
- FR-IV: Developed for open bite and vertical discrepancies.

Herbst appliance

Introduced by Emil Herbst in 1905 and reintroduced by Hans Pancherz in the 1970s, is a fixed functional appliance primarily used to correct skeletal Class II malocclusion caused by mandibular retrusion. Unlike removable functional appliances (e.g., Activator, Bionator, Twin Block), the Herbst is a non-removable, fixed device, which ensures continuous mandibular advancement and reduces reliance on patient compliance.

The appliance typically consists of bilateral telescopic mechanisms (pistons and tubes) attached to the maxillary and mandibular arches, holding the mandible in a forward posture. This stimulates remodeling of the condyle and glenoid fossa, enhances mandibular growth expression, and produces dentoalveolar changes such as proclination of mandibular incisors and retroclination of maxillary incisors. Advantages, does not rely on patient compliance (fixed), can be used in both early and late adolescence, effective in reducing overjet and improving sagittal relationships. Limitations, may cause proclination of mandibular incisors and anchorage loss, can induce soft tissue irritation or appliance breakage, bulky, may initially affect mastication.

Clinical effectiveness

Herbst therapy has demonstrated significant improvements in Class II correction, particularly when applied during the pubertal growth spurt. Pancherz's long-term studies show both skeletal and dentoalveolar contributions to correction, with stable results when followed by comprehensive fixed appliance therapy [26].

Jasper Jumper appliance

Is composed of two main components: a force module and anchorage parts. The force module consists of a flexible stainless steel coil spring encased in an opaque gray polyurethane covering, which also extends partially over the anchoring ends. Stainless steel caps are attached at both ends of the spring core. Earlier designs lacked this polyurethane overlap, which often resulted in frequent module breakages. To improve clinical adaptability, the modules are manufactured for either the right or left side of the arch and are available in seven lengths ranging from 26 mm to 38 mm, in 2 mm increments, with the size engraved on the maxillary end. Clinically, the Jasper Jumper is relatively easy to insert and activate, while also producing intrusive forces on both molars and incisors. However, disadvantages include a higher risk of breakage, reduced force delivery when the mouth is slightly open (e.g., during sleep in mouth breathers), and susceptibility to mechanical fatigue. Despite these limitations, it has been widely employed for the correction of Class II malocclusions and has been evaluated for its dentoalveolar and craniofacial effects [27].

Orthodontic Headgear

Orthodontic headgear is a type of extraoral appliance used to apply controlled forces to the dentition and skeletal bases, especially the maxilla, via connections to the teeth (often molars). It acts by anchoring to the head or neck, thereby transmitting forces externally to influence growth or tooth movement. Its primary applications include restraining forward growth of the maxilla in Class II cases, distalizing maxillary molars, or in reverse-pull (facemask) variants, protracting the maxilla in Class III cases [28].

Types and Force Directions

- Cervical pull (neck strap) headgear: applies a mostly backward and downward force to the upper molars; often used to control maxillary forward growth or distalize molars.
- High pull (parietal or helmet type) headgear: applies force vector more upward and backward, helpful in controlling vertical growth in addition to sagittal correction.
- Reverse-pull headgear (facemask / protraction headgear**)**: used in Class III or maxillary deficiency cases to pull the maxilla forward; it applies forward and often downward force on the maxilla via elastics anchored to a facemask frame [29].
  Clinical Considerations & Evidence
- Timing: Studies suggest that earlier application of headgear (during earlier mixed dentition) may yield better arch width maintenance and dental arch outcomes compared to delayed use. For example, Hannula *et al.*, (2023) found that earlier cervical headgear treatment resulted in longer maintenance of maxillary arch width gains versus later intervention.
- Compliance: Patient adherence remains a key determinant of success. A recent study using a "Smartgear" system to monitor compliance in headgear wear reported average actual daily wear of ~6.7 hours (versus recommended longer durations), and showed that informing patients of monitoring marginally improved wear time.
- Effectiveness in Class II: Headgear continues to be effective for distalizing maxillary molars and restraining maxillary growth in Class II patients, but its usage has declined, partially due to compliance challenges and the advent of intraoral alternatives (e.g., miniscrew-based anchorage, fixed functional appliances).
- Recent innovations: A 2025 study introduced a 3D-printed J-hook headgear variant, comparing its

advantages and limitations relative to conventional methods and temporary anchorage devices [30].

CONCLUSION

Different types of devices and their innovative adaptations that have demonstrated their effectiveness in the early therapy of developing class II patients are included in myofunctional appliances for class II malocclusion, nevertheless, the selection of the choice of one appliance over another is heavily influenced by the cause of the malocclusion and the orthodontist's accurate assessment of each situation.

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