Developing Class II Malocclusion: A Literature Review

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Abstract: *Class II malocclusion is the most common orthodontic abnormality encountered in children and adolescents which contributes and accounts for a substantial proportion of orthodontic cases worldwide. Class II malocclusion is a developmental anomaly with etiology of multifactorial origin, influenced by genes, environment, functions, and growth factors. Early detection of Class II malocclusion during the developing dentition allows for interceptive and growth-modifying treatments that can significantly enhance outcomes. Neglecting this condition during development may result in more severe skeletal discrepancies, compromised function, and psychosocial consequences necessitating extensive treatment, including orthognathic surgery, at a later age. The review emphasizes the prevalence, etiology, growth and developmental components, clinical presentation, diagnostic considerations, and management options of evolving Class II malocclusion. The use of functional appliances, orthopaedic treatment, and new developments in skeletal anchorage and digital technologies are addressed. Focus on evidence-based practice, timing of treatment, and the need for individualized care.*

Keywords: Class II malocclusion, growth modification, functional appliances, interceptive orthodontics, skeletal discrepancy

1. Introduction

Class II malocclusion, first described by Angle in the late 19th century, is characterized by a distal relationship of the mandibular dentition relative to the maxillary dentition, often accompanied by increased overjet, convex facial profile, and compromised function. Epidemiological studies have reported its prevalence to range between 15–25% in different populations, making it the second most common orthodontic problem after crowding.

The etiology of Class II is multifactorial and commonly a combination of skeletal discrepancies, dentoalveolar compensations, soft tissue imbalance, and environmental factors. The most common skeletal pattern for Class II is mandibular retrognathia, and second most common is maxillary prognathia.

Class II malocclusion in the developing dentition can be subtle in its presentation, with such manifestations as proclined maxillary incisors, distal step in primary molar relation, or premature development of Class II molar relation in the mixed dentition. As craniofacial growth is an important factor in its development, timing of intervention is key. It is possible to intercept Class II malocclusion in active growth stages to deflect skeletal growth, enhance facial balance, and minimize the necessity of extractions or orthognathic surgery as an adult.

This review presents an overview of the etiology, diagnosis, and management of emerging Class II malocclusion with a mention of recent advances and clinical considerations. Understanding the significance of early diagnosis and growth-directed treatment in Class II malocclusion is essential for minimizing long-term complications and ensuring functional and aesthetic outcomes. This review contributes to existing literature by integrating classical approaches with emerging technologies in orthodontic care."

Etiology of Class II Malocclusion
The etiology is multifactorial and can be broadly classified into skeletal, dental, functional, and environmental factors.

1) **Skeletal Factors**
   - **Mandibular retrognathia**: Most common cause; reduced length or deficient forward growth of mandible.
   - **Maxillary prognathia**: Excessive forward positioning of the maxilla.
   - **Vertical dysplasia**: increased lower anterior facial height or clockwise mandibular rotation can exacerbate Class II appearance.
   - **Genetic predisposition**: Familial inheritance patterns often influence skeletal Class II morphology.

2) **Dental Factors**
   - Distal step in primary dentition leading to Class II molar relationship.
   - Proclination of maxillary incisors or retroclination of mandibular incisors.
   - Premature loss of deciduous teeth leading to mesial drift discrepancies.

3) **Functional Factors**
   - Habits: thumb sucking, tongue thrusting, and pacifier use can exacerbate maxillary protrusion.

- Abnormal perioral muscle activity, particularly hyperactive mentalis or incompetent lips.
- Airway obstruction leading to mouth breathing and altered mandibular posture.

4) Environmental & Pathological Factors
- Trauma affecting growth centers.
- Temporomandibular joint disturbances.
- Chronic nasal obstruction due to adenoids/tonsillar hypertrophy.

Growth and Developmental Aspects
Growth plays a pivotal role in the development and management of Class II malocclusion. Mandibular growth typically continues longer than maxillary growth, making the pubertal growth spurt the most favorable period for orthopedic correction.
- **Primary dentition:** Distal step molar relation often predicts future Class II.
- **Mixed dentition:** Early signs include increased overjet, deep bite, and developing Class II molar relation.
- **Pubertal spurt:** Growth modification is most effective between CS3–CS4 stages of cervical vertebral maturation.
- **Post-pubertal stage:** Growth potential decreases, limiting the effectiveness of orthopedic correction.

Clinical Features and Diagnosis

Clinical Features:
a) Convex facial profile with retruded chin.
b) Increased overjet (>5 mm).
c) Deep bite in many cases.
d) Lip incompetence and mentalis strain.
e) Class II molar and canine relationships.

Diagnostic Tools:
a) **Clinical examination** of skeletal, dental, and soft tissue components.
b) **Cephalometric evaluation:**
   - ANB angle >4° suggests skeletal Class II.
   - Wits appraisal for sagittal discrepancy.
   - Mandibular plane angle for vertical growth tendency.
c) **Growth assessment:** Hand-wrist radiographs or cervical vertebral maturation index (CVMI).
d) **3D imaging:** CBCT for precise skeletal analysis (in advanced cases).

Interceptive and Preventive Strategies
a) **Habit interception:** Thumb sucking appliances, myofunctional exercises.
b) **Space management:** Space maintainers or regainers in premature tooth loss.
c) **Guidance of eruption:** Extraction of retained deciduous teeth, correction of ectopic eruptions.
d) **Myofunctional therapy:** Improving tongue posture and perioral muscle function.
e) These measures do not correct skeletal discrepancies but reduce their severity and enhance the effectiveness of future treatment.

Management Approaches

1) Functional Appliances
Used during active growth to stimulate mandibular growth and redirect skeletal development.

a) Removable appliances:
- Activator
- Bionator
- Twin-block (the latter being the most commonly used for its comfort and efficiency)

b) Fixed appliances:
- Herbst appliance
- MARA (Mandibular Anterior Repositioning Appliance)
- Forsus Fatigue Resistant Device

2) Orthopedic Appliances
- **Headgear:** Used in growing children with maxillary prognathia to restrict forward growth of maxilla.
- **Face mask (reverse pull):** Although more commonly used in Class III cases, it is also occasionally modified for vertical control in Class II cases.

3) Fixed Mechanotherapy
- Fixed appliances can be combined with growth-modifying devices for skeletal and dental correction.
- Extraction vs non-extraction therapy based on crowding, soft tissue balance, and skeletal discrepancy.

4) Orthognathic Surgery (later stage)
- Required in severe skeletal Class II cases not amenable to growth modification, usually after growth completion.

5) Recent Advances
- **Skeletal anchorage devices (TADs, miniplates):** Allow noncompliance-based distalization and mandibular advancement.
- **Clear aligners with Class II correctors:** Patient-friendly, aesthetic options.
- **3D imaging and AI:** Advanced diagnostic tools for growth prediction and individualized treatment planning.
- **Myobrace and other myofunctional training systems:** Early intervention to improve oral posture and reduce habit-related malocclusions.

2. Discussion

Treatment of growing Class II malocclusion involves a compromise between skeletal, dental, and soft tissue factors. Early diagnosis and proper timing of treatment can have a great impact on long-term stability. Functional appliances have been found to be successful when administered during growth at puberty, but although patient compliance remains a persistent challenge, Novel developments in skeletal anchorage and digital orthodontics offer noncompliance-independent possibilities with reliable results.

There are ongoing debates about the most appropriate timing for early intervention should be done—some support very early treatment (prior to 8 years), while others recommend postponing intervention until pubertal spurt begins for optimal skeletal effects. Two-phase treatment has been found

to provide little greater advantage than well-timed single-phase functional treatment in most instances.

3. Conclusion

Class II malocclusion is a common orthodontic condition with considerable clinical, functional, and psychosocial consequences. A well-established knowledge of its multifactorial aetiology, growth patterns, and treatment rationale is crucial in its successful management. Interceptive measures, functional appliances, and growth modification continue to be the mainstay of management in growing patients. New developments in anchorage systems, aligner therapy, and AI-assisted diagnostics are reshaping treatment strategies and leading to more predictable clinical outcomes. Early intervention, customized treatment planning, and diligent monitoring of growth are the hallmarks for attaining stable and aesthetic results.

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