



Research Paper

Class II Division 1 Malocclusion: Diagnosis and Contemporary Treatment Modalities—A Narrative Review

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Abstract

Background: Class II Division 1 malocclusion is a common sagittal malocclusion characterized by increased overjet and a variable combination of skeletal, dental, vertical, transverse and soft-tissue abnormalities. Its treatment therefore cannot be based solely on the molar relationship or overjet.

Objective: This narrative review summarizes the principal diagnostic features and contemporary treatment approaches for Class II Division 1 malocclusion, emphasizing individualized treatment planning according to the underlying skeletal and dentoalveolar components, growth status, anchorage requirements and facial objectives.

Review: Class II malocclusion may result from mandibular retrusion, maxillary positional abnormalities, dentoalveolar compensation, transverse discrepancy or combinations of these components. Treatment options include maxillary expansion, extraoral traction, molar and total-arch distalization, functional appliances, interarch elastics, extraction-based treatment, orthodontic camouflage and orthognathic surgery. Functional appliances can improve the sagittal relationship in growing patients, although much of the correction is dentoalveolar and the magnitude of skeletal effects is limited. Skeletal anchorage has increased the possibilities for non-extraction distalization and anchorage control. Extraction treatment remains appropriate in selected patients with significant crowding, protrusion or anchorage requirements, whereas camouflage is limited when the underlying skeletal discrepancy exceeds the patient's dentoalveolar compensatory capacity. Orthognathic surgery remains an option for severe skeletal discrepancies in non-growing patients.

Conclusion: Contemporary management of Class II Division 1 malocclusion should be diagnosis-driven rather than appliance-driven. Successful treatment requires identification of the principal skeletal and dental components, assessment of growth and vertical and transverse relationships, control of anchorage and consideration of facial soft tissues and long-term stability.

Keywords: Class II malocclusion; Class II Division 1; orthodontic treatment; functional appliances; molar distalization; extraction; orthodontic camouflage; skeletal anchorage.

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I. Introduction

Class II malocclusion represents a heterogeneous group of sagittal discrepancies rather than a single clinical entity. The Angle classification describes the molar relationship, but the same Class II dental relationship may arise from markedly different skeletal and dentoalveolar configurations. Ackerman and Proffit emphasized the need to move beyond a purely molar-based classification toward a comprehensive assessment of the malocclusion and its underlying components.¹

McNamara's evaluation of children with Class II malocclusion demonstrated substantial variation in the relative contributions of the maxilla, mandible and dentoalveolar structures.² Common findings include mandibular retrusion, maxillary positional abnormalities, maxillary dentoalveolar protrusion and increased lower anterior facial height, either individually or in combination.³ Consequently, treatment should be selected after identifying the principal source of the discrepancy rather than according to the severity of the molar relationship alone.

The objective of this narrative review is to summarize the diagnosis, clinical characteristics and contemporary treatment modalities for Class II Division 1 malocclusion, with emphasis on evidence relevant to clinical decision-making.

Diagnosis and Clinical Characteristics

Class II Division 1 malocclusion is conventionally characterized by a distal relationship of the mandibular first molar relative to the maxillary first molar, associated with proclined or normally inclined maxillary incisors and increased overjet. However, its skeletal expression is variable.

A three-dimensional diagnostic approach should assess the anteroposterior, transverse and vertical dimensions. McNamara described several recurring components of Class II malocclusion, including mandibular retrusion and transverse maxillary discrepancies.² In mixed-dentition patients, a transverse discrepancy may accompany the sagittal discrepancy and can influence the apparent severity of the Class II relationship.³

The clinical examination should therefore include:

- facial profile and degree of convexity;
- mandibular position and morphology;
- maxillary position;
- overjet and overbite;
- incisor inclination;
- molar and canine relationships;
- dental midlines;
- transverse arch relationships;
- vertical facial proportions;
- crowding and arch-length discrepancy;
- lip competence and soft-tissue balance; and
- growth status and remaining growth potential.

Cephalometric analysis should be interpreted as a component of the overall diagnosis rather than as an isolated determinant of treatment. Skeletal sagittal measurements, vertical relationships and incisor inclinations help determine whether the Class II relationship is predominantly skeletal, dental or mixed.

An important implication is that two patients with an identical molar relationship may require completely different treatment strategies. One may have a retrognathic mandible suitable for growth modification, whereas another may have a well-positioned mandible with maxillary dentoalveolar protrusion requiring distalization or extraction-based treatment.

Treatment Planning

The treatment plan should answer four sequential questions:

1. **What is the principal component of the Class II discrepancy?**
2. **Is growth modification still possible?**
3. **Can the discrepancy be corrected dentoalveolarly without exceeding biological and periodontal limits?**
4. **If not, is extraction-based camouflage or orthognathic surgery indicated?**

Treatment timing is particularly important in growing patients. Early treatment can reduce the risk of incisal trauma in children with prominent incisors, but early correction does not necessarily produce superior final occlusal outcomes compared with later comprehensive treatment. Evidence from the Cochrane review indicates that the clearest benefit of early treatment was reduction in the incidence of incisor trauma.⁴

Therefore, the decision to initiate treatment early should be based on the patient's risk profile, growth status, psychosocial considerations and treatment objectives rather than on the assumption that all Class II malocclusions require two-phase treatment.

Non-Extraction Treatment

Maxillary Expansion

Transverse maxillary deficiency may coexist with Class II malocclusion. Expansion can improve transverse relationships and, in selected growing patients, may contribute to spontaneous improvement in the sagittal dental relationship.

Recent evidence, however, indicates that maxillary expansion should not be considered a predictable method of producing substantial skeletal Class II correction. A 2025 systematic review and meta-analysis found that expansion produced changes in sagittal dental parameters but did not demonstrate convincing skeletal sagittal correction.⁵

Therefore, expansion is best considered when a genuine transverse discrepancy exists. Its use should be based on transverse diagnosis rather than as a routine method of correcting every Class II relationship.

Maxillary Molar Distalization

Distalization is appropriate primarily for patients with a dentoalveolar Class II relationship, particularly when the maxillary molars are mesially positioned and sufficient posterior space exists.

Conventional intraoral distalizers can produce molar distalization but are accompanied by anchorage loss, molar tipping and dental side effects.⁶ Skeletal anchorage has expanded the ability to distalize posterior teeth while reducing dependence on dental anchorage.

A systematic review of miniscrew-supported distalization demonstrated that treatment effects vary according to temporary anchorage device position, appliance design and force application.⁷ Total maxillary arch distalization using temporary anchorage devices has also been investigated extensively, with systematic-review evidence supporting its use for non-extraction Class II correction in appropriately selected patients.⁸

Anatomical limitations remain important. The available posterior space, third-molar status, cortical anatomy, sinus relationship, soft-tissue considerations and direction of force application influence the achievable amount of distal movement. Distalization should therefore not be interpreted as unlimited whole-arch translation.

Functional Appliances

Functional appliances are primarily indicated in growing patients with a significant mandibular component to the Class II discrepancy. Appliances include removable designs such as Twin Block and Bionator and fixed functional appliances such as Herbst and other mandibular advancement systems.

Systematic reviews indicate that functional appliances can improve the sagittal relationship through a combination of skeletal and dentoalveolar changes.⁹ However, the magnitude of true mandibular skeletal modification is generally modest, and much of the correction is dentoalveolar.^{9–11}

A randomized multicenter trial evaluating early Twin Block treatment demonstrated improvement in overjet and reduction in incisor trauma risk, but early treatment did not eliminate the need for later comprehensive orthodontic treatment.¹²

Fixed functional appliances provide an alternative when patient compliance with removable appliances is expected to be problematic. Meta-analysis indicates short-term improvements in Class II relationships, but the overall effects are predominantly dentoalveolar and long-term evidence remains more limited.¹³

Thus, the choice between removable and fixed functional appliances should consider growth potential, severity of mandibular deficiency, vertical pattern, compliance and the anticipated dentoalveolar response.

Interarch Mechanics

Class II elastics remain a simple and widely used method for correcting mild-to-moderate sagittal discrepancies, particularly during comprehensive fixed appliance treatment.

Their correction is predominantly dentoalveolar and may include mesial movement of mandibular posterior teeth, distal movement of maxillary posterior teeth and changes in incisor inclination. A systematic review concluded that Class II elastics can effectively correct the molar relationship, but their effects must be considered together with associated dental and vertical changes.¹⁴

Consequently, Class II elastics should be used with careful attention to anchorage, mandibular incisor inclination, vertical control and the patient's periodontal limits.

Extraction Treatment

Extraction treatment remains an important option when the patient's discrepancy cannot be corrected predictably through expansion, distalization or growth modification.

In Class II Division 1 malocclusion, extraction of two maxillary premolars can create space for controlled retraction of protrusive maxillary incisors while maintaining the mandibular arch. Four-premolar extraction may be considered when mandibular crowding, incisor protrusion or other factors justify treatment in both arches.

Comparative studies have demonstrated that extraction and non-extraction approaches can produce different dentoskeletal and soft-tissue changes, but long-term stability is influenced by the quality of the original correction and subsequent growth rather than by extraction alone.^{15–17}

Janson et al. found comparable long-term stability following treatment of complete Class II malocclusion with either two maxillary premolar or four-premolar extraction protocols.¹⁷ Similarly, long-term comparison of non-extraction and maxillary-premolar extraction treatment demonstrated comparable stability of overjet, overbite and molar and canine relationships in appropriately matched groups.¹⁸

Therefore, the extraction decision should be individualized according to crowding, incisor position, facial profile, sagittal discrepancy, anchorage requirements and the desired final incisor position.

Extraction Versus Non-Extraction

The extraction/non-extraction decision should not be reduced to the presence or absence of a Class II molar relationship.

In patients with significant crowding and dental protrusion, extraction can facilitate controlled incisor retraction and improve arch coordination. Conversely, patients with adequate arch length, acceptable incisor position and a predominantly dental Class II relationship may be treated without extraction through distalization or other anchorage-supported mechanics.

A recent systematic review and meta-analysis comparing extraction and non-extraction orthodontic treatment emphasizes the heterogeneity of treatment outcomes and the importance of individual case characteristics.¹⁹ Historical long-term studies also demonstrate that both extraction and non-extraction approaches can achieve stable results in appropriately selected patients.^{15, 16}

The available evidence therefore supports individualized treatment planning rather than a universal extraction or non-extraction philosophy.

Orthodontic Camouflage

Orthodontic camouflage attempts to correct the dental manifestations of a skeletal discrepancy while accepting the underlying skeletal relationship.

Camouflage may be considered in patients with mild-to-moderate skeletal discrepancies, acceptable facial proportions and sufficient dentoalveolar compensation potential. Treatment may involve controlled incisor movement, extraction or non-extraction mechanics, distalization or skeletal anchorage.

Its limitations become important as the severity of the skeletal discrepancy increases. Excessive dental compensation may compromise incisor inclination, periodontal support or facial aesthetics.

A systematic review comparing camouflage with orthodontic-orthognathic treatment in adults with skeletal Class II malocclusion found differences in several skeletal and soft-tissue outcomes, particularly in ANB, SNB and mandibular plane relationships. However, the authors emphasized that the available evidence was limited and derived predominantly from non-randomized studies.²⁰

Thus, surgery should not be regarded simply as a more aggressive alternative to camouflage; rather, the decision depends on the magnitude of the skeletal discrepancy, facial objectives, growth status and patient's treatment preferences.

Skeletal Anchorage

Temporary anchorage devices have substantially expanded the biomechanical possibilities for Class II treatment.

They can provide anchorage for anterior retraction, reduce dependence on patient compliance and permit posterior or total-arch distalization with greater control than conventional dental anchorage.^{7, 8}

However, skeletal anchorage does not eliminate biological limitations. Root proximity, cortical anatomy, sinus anatomy, soft-tissue thickness, available distal space and periodontal health continue to determine the safe extent of tooth movement.

Recent evidence on total maxillary arch distalization supports its effectiveness in selected Class II Division 1 patients, but the available studies demonstrate heterogeneity in appliance design and methodology.^{8, 21}

Class II Division 2 and Class II Subdivision: Related Diagnostic Considerations

Although this review focuses on Division 1, the broader Class II classification is clinically relevant because the phenotype can substantially modify treatment mechanics.

Class II Division 2 differs from Division 1 in incisor inclination, vertical characteristics and interincisal relationships. A systematic review found that the evidence concerning treatment and stability of Division 2

malocclusion is limited and characterized by substantial risk of bias.²² Therefore, treatment recommendations for Division 2 should not simply be extrapolated from Division 1.

Class II subdivision also requires separate consideration because the asymmetry may originate from the maxillary dentition, mandibular dentition or mandibular skeletal asymmetry. Cassidy et al. classified Class II subdivision patients according to the origin of the asymmetry and demonstrated that mandibular skeletal asymmetry represented a substantial proportion of cases.²³ This emphasizes the importance of evaluating facial and dental midlines and determining the source of asymmetry before selecting unilateral or bilateral mechanics.

Retention and Stability

Long-term stability is an essential component of treatment planning. Relapse is influenced by growth, periodontal and gingival remodeling, tooth position, occlusal forces and the magnitude and direction of orthodontic tooth movement.

Long-term studies of Class II treatment demonstrate that both extraction and non-extraction protocols can remain clinically stable when treatment objectives are appropriately achieved.^{17, 18} Stability should therefore not be attributed to the extraction decision alone.

Increased attention should be paid to mandibular incisor position, posterior tooth relationships and the maintenance of corrected overjet and overbite. Retention should be individualized according to the initial malocclusion, treatment mechanics and anticipated growth or soft-tissue changes.

Contemporary Treatment Algorithm

A practical diagnostic sequence can be summarized as follows:

Class II relationship identified

↓

Determine skeletal versus dental contribution

↓

Assess mandibular position, maxillary position and incisor inclination

↓

Evaluate transverse and vertical discrepancies

↓

Assess growth status

↓

Evaluate crowding, protrusion and anchorage requirements

↓

Select treatment pathway

- **Growing + mandibular deficiency** → functional appliance-based growth modification when appropriate
- **Transverse deficiency** → maxillary expansion when indicated
- **Predominantly dental Class II** → distalization/interarch mechanics
- **Need for enhanced anchorage** → skeletal anchorage-supported mechanics
- **Crowding/protrusion requiring space** → extraction-based camouflage
- **Severe skeletal discrepancy in non-growing patient** → orthodontic-orthognathic treatment

This approach avoids selecting an appliance before establishing the diagnosis.

II. Conclusion

Class II Division 1 malocclusion is a heterogeneous condition involving variable skeletal, dental, vertical, transverse and soft-tissue components. Contemporary diagnosis should therefore extend beyond the molar relationship to identify the principal source of the sagittal discrepancy.

Treatment options include growth modification, transverse correction, molar and total-arch distalization, functional appliances, interarch mechanics, extraction-based treatment, skeletal anchorage, orthodontic camouflage and orthognathic surgery. Current evidence indicates that functional appliances can improve Class II relationships in growing patients, although their effects are substantially dentoalveolar. Skeletal anchorage has increased the possibilities for non-extraction distalization and anchorage control, while extraction remains appropriate in selected patients with crowding, protrusion or anchorage requirements.

No single appliance or treatment philosophy is universally applicable. The most defensible contemporary approach is diagnosis-driven: identify the skeletal and dentoalveolar components, assess growth and anatomical limitations, establish realistic treatment objectives and then select the mechanics capable of achieving those objectives while respecting biological limits and long-term stability.

Tables

Table 1. Diagnostic components to be evaluated in Class II Division 1 malocclusion

Component	Important parameters	Clinical relevance
Sagittal skeletal	Maxillary and mandibular position; ANB/Wits and related measures	Determines skeletal contribution
Dental sagittal	Molar/canine relationship, overjet, incisor inclination	Determines dentoalveolar compensation
Vertical	Facial height, mandibular plane, overbite	Influences appliance selection and vertical control
Transverse	Arch width, posterior crossbite, functional shift	May modify apparent sagittal discrepancy
Crowding	Arch-length discrepancy	Influences extraction/non-extraction decision
Soft tissue	Profile, lip competence, incisor-lip relationship	Determines facial treatment objectives
Growth	Skeletal maturity and remaining growth	Determines suitability for growth modification
Anchorage	Posterior support and need for skeletal anchorage	Influences mechanics and treatment predictability

Table 2. Contemporary treatment options for Class II Division 1 malocclusion

Treatment modality	Principal indication	Main correction	Important limitation
Maxillary expansion	Transverse maxillary deficiency	Transverse correction; possible dental sagittal improvement	Limited skeletal sagittal effect
Functional appliance	Growing patient with mandibular deficiency	Sagittal correction through skeletal and dental effects	Growth-dependent; substantial dentoalveolar component
Molar distalization	Predominantly dental Class II	Distal movement of maxillary posterior teeth	Posterior anatomical limits and tipping
Total-arch distalization with TADs	Selected non-extraction Class II	Distal movement of maxillary dentition	Requires adequate anatomy and anchorage
Class II elastics	Mild/moderate sagittal correction	Predominantly dentoalveolar correction	Incisor and vertical side effects
Extraction camouflage	Crowding/protrusion or anchorage requirements	Incisor retraction and occlusal correction	Does not correct underlying skeletal discrepancy
Orthodontic camouflage	Mild/moderate skeletal discrepancy	Dental compensation	Limited by periodontal and facial constraints
Orthognathic surgery	Severe skeletal discrepancy after growth	Skeletal correction	Surgical morbidity and multidisciplinary treatment

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