EARLY ORTHODONTIC INTERVENTION WITH ERUPTION GUIDANCE APPLIANCES FOR CLASS II MALOCCLUSION: EVIDENCE MAPPING THROUGH A SCOPING REVIEW

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Abstract

Introduction: Class II malocclusion is a prevalent orthodontic condition in children that can cause both functional and esthetic challenges if not addressed early. The early mixed dentition period offers a critical window for interceptive treatment. Eruption guidance appliances (EGAs) are removable functional devices designed to direct tooth eruption and potentially stimulate favorable skeletal growth. This scoping review aims to map existing evidence on the use of EGAs in treating Class II malocclusion during early mixed dentition. **Methods:** Following the PRISMA-ScR framework, a comprehensive literature search was conducted in PubMed, Scopus, ScienceDirect, and ProQuest up to July 2025. Studies were selected based on inclusion criteria involving children aged 6–9 years with Class II malocclusion treated using EGAs, with reported skeletal and/or dentoalveolar outcomes. Data were extracted on study design, population, intervention protocols, outcomes, and conclusions. **Results:** Five eligible studies were included, comprising randomized controlled trials, cohort studies, and case report. Most reported significant dentoalveolar improvements such as reduced overjet, overbite, and molar relationship correction. Skeletal changes were modest but consistent, notably in mandibular advancement and ANB angle reduction. **Discussion:** EGAs demonstrated favorable outcomes by enhancing dental development and moderately influencing skeletal growth. However, study heterogeneity, limited sample sizes, and short follow-up durations were common limitations. **Conclusion:** EGAs are promising interceptive tools for early Class II correction, offering non-invasive benefits in guiding eruption and promoting mild skeletal adaptation. Further well-designed longitudinal trials are needed to confirm long-term effectiveness and establish clinical protocols.

Keywords: Class II malocclusion, eruption guidance appliance, mixed dentition, interceptive orthodontics.

Introduction

Malocclusion is a common oral health problem in children. Among the various malocclusion classifications according to Angle, Class II malocclusion is the most common type, especially during the mixed dentition phase. Class II malocclusion is characterized by a Class II molar relationship and a retrusive position of the mandible relative to the maxilla, often accompanied by excessive overjet. This condition not only impacts masticatory and phonetic function but can also affect facial aesthetics and the child's psychosocial well-being.[1]

Children experience Class II malocclusion with high frequency worldwide.[1,2] Untreated Class II malocclusion produces functional impairment, esthetic concern, and psychosocial burden across growth and adolescence.[1,2]

The global prevalence of Class II malocclusion in school-age children is quite high. Based on a systematic review by De Ridder et al. (2022), the average prevalence of Class II malocclusion was 23.8% with a standard deviation of 14.6%, and significant geographic variation was found. This prevalence rate indicates that nearly a quarter of the child population experiences Class II malocclusion, which requires early orthodontic attention.[2] At the regional level, a study in India conducted by Sivakumar et al. (2021) of 4,420 children aged 6–12 years found that the prevalence of Class II malocclusion reached 78.9%.3 Meanwhile, a local study in Yogyakarta, Indonesia, found a prevalence of 41.6% in children aged 9–11 years. These figures indicate that Class II malocclusion is a serious problem in the Indonesian child population.[3]

Orthodontists classify Class II disharmony into skeletal and dentoalveolar components. Mandibular retrusion or maxillary protrusion defines the skeletal dimension in anteroposterior terms. Incisor inclination and dental positioning characterize the dentoalveolar dimension within each arch. This distinction guides appliance selection and outcome expectations at the planning stage.[4,5]

Clinicians prioritize early, growth-sensitive management within contemporary pediatric orthodontics.[6,7] The early mixed dentition period offers a strategic window at approximately 6–9 years of age. Children demonstrate good cooperation and dental plasticity during this phase. Providers redirect eruptive pathways and occlusal development before malocclusion becomes entrenched.[6,8]

Eruption Guidance Appliances (EGAs) occupy an important niche within interceptive orthodontics. Prefabricated, elastomeric, and typically worn at night with short daytime sessions, EGAs act as functional positioners that guide erupting teeth and promote balanced orofacial muscle patterns.[7] In clinical use, EGAs aim to reduce excessive overjet and overbite, improve molar/canine relationships toward Class I, and support favorable incisor coupling—changes that may lower the burden of later comprehensive treatment.[6,7,8]

Despite promising outcomes, the literature is heterogeneous. Study designs span randomized controlled trials, prospective/retrospective cohorts, and case report; sample sizes are modest; follow-up is often short; and appliance protocols vary—complicating

direct comparison.[1,3–5,6] Moreover, while short-term stability for overjet and molar correction is encouraging, partial relapse in overbite or lower incisor alignment has been observed after active therapy, highlighting the importance of retention and long-term monitoring.[1,3,6]

This scoping review maps the breadth of evidence under PRISMA-ScR guidance.[9] The review adopts a PCC framework with the following scope: Population—children aged 6–9 years with Class II malocclusion; Concept—Eruption Guidance Appliances; Context—interceptive clinical care. This review aims to synthesize dentoalveolar outcomes (overjet, overbite, molar/canine relationships), to collate skeletal changes (SNB/ANB, mandibular length), to appraise protocol and compliance influences, and to identify research priorities for future trials.[1–9]

By consolidating and organizing this evidence, our objective is to provide an up-to-date evidence map that clarifies what EGAs can reliably achieve in early Class II correction, where the orthopedic limits lie, and how future studies should be designed to answer the remaining clinically meaningful questions.[1–7]

Method

The type of research carried out was scoping review research using the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for Scoping Reviews) instrument. The search and analysis of articles was carried out from July 2005 to July 2025. The first step taken was to develop a Population-Concept-Context (PCC) framework to assist in searching for research materials. This PCC framework will be reflected in the inclusion criteria. A search using all identified keywords (Table 1) and index terms will then be conducted across all included databases.

Table 1. Keywords

Database	**Query**
Pubmed	("eruption guidance appliance"[All Fields] OR "LM-Activator"[All Fields] OR elastodontics[All Fields]) AND ("Class II"[All Fields] OR "Angle Class II"[All Fields] OR "Class II malocclusion"[All Fields] OR "Malocclusion, Angle Class II"[MeSH]) AND ("mixed dentition"[All Fields] OR "early mixed dentition"[All Fields] OR "Dentition, Mixed"[MeSH] OR "child"[MeSH])
Scopus	("eruption guidance appliance" OR "LM-Activator" OR "Elastodontics" AND ("Class II" OR "Angle Class II" OR "Class II Malocclussion)" AND ("mixed dentition" OR "early mixed dentition" OR "child")
ScienceDirect	("eruption guidance appliance" OR "LM-Activator" OR "Elastodontics) AND ("Class II" OR "Angle Class II" OR "Class II Malocclussion) AND ("mixed dentition" OR "early mixed dentition" OR child)

Proquest	("eruption guidance appliance" OR "LM-Activator" OR "Elastodontics) AND ("Class II" OR "Angle Class II" OR "Class II Malocclussion) AND ("mixed dentition" OR "early mixed dentition" OR child)

These databases will include Pubmed, Scopus, Science Direct, and Proquest. The types of articles that are the basic material for research are articles with the inclusion and exclusion criteria (Table 2).

Table 2. Inclusion and Exclusion Criteria

Eligibility Criteria	**Inclusion**	**Exclusion**
Study Type	RCT, prospective/retrospective controlled study, clinical study, and case report	Review study, research on animal
Publication Type	Scientific published journal	Article in press, conference abstract
Language	English	-
Year Range	2005-2025	-
Data Colection	Primary and/or secondary research	-
Study Population	Children aged 6–9 years with Class II malocclusion	Patients with bad habit
Concept	Eruption Guidance Appliances	-
Context	Interceptive clinical care	-

This scoping review aims to map existing evidence on the use of EGAs in treating Class II malocclusion during early mixed dentition. The initial stage of the study involved searching for articles using four search engines with predefined keywords. A total of 110 articles were collected in the initial stage, 7 articles on PubMed, 31 articles on Scopus, 17 articles on Science Direct and 55 articles on Proquest. The next step was to remove duplicate articles which resulted in 95 articles remaining after 15 articles were eliminated. Then, further filtering was carried out based on the title and abstract, leaving 16 articles and eliminating 79 articles. The final process was filtering articles based on full-text,

resulting in five articles that met the inclusion criteria and 11 articles that did not. The selection and screening process of these articles is illustrated in the PRISMA-ScR diagram (Figure 1).

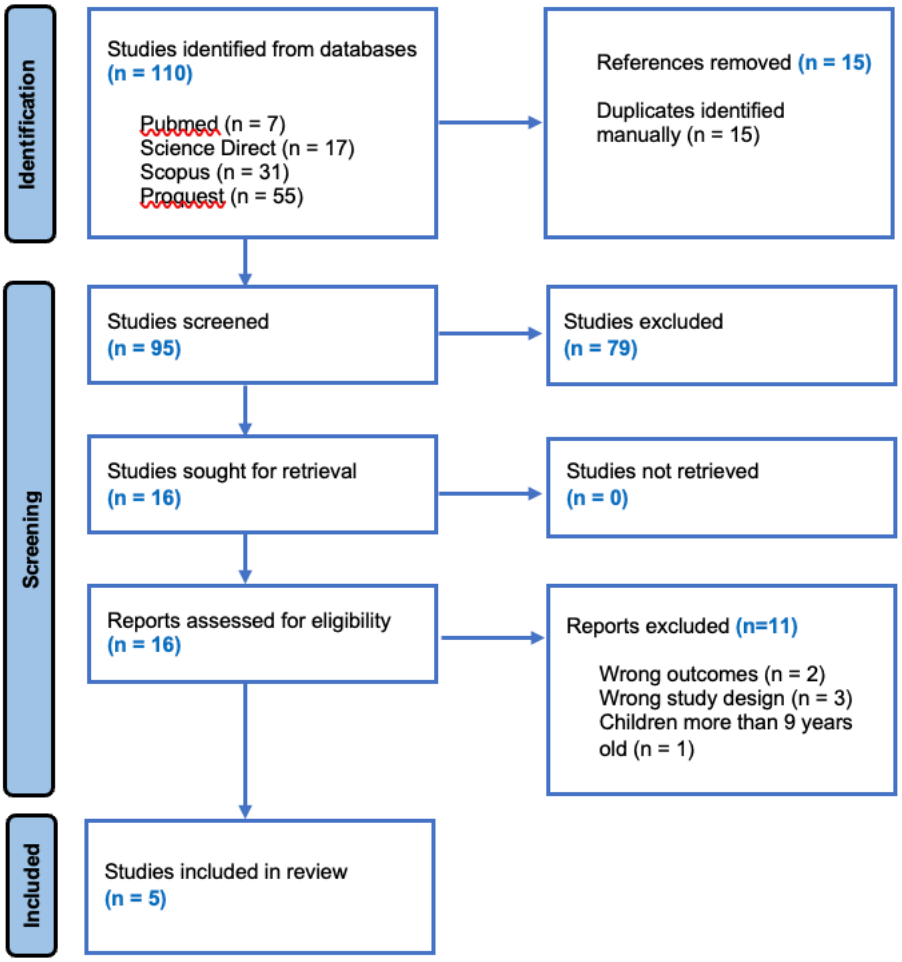

Figure 1. PRISMA-ScR diagram

Result

This scoping review limits the articles included within the last 20 years, from 2005 to 2025. Five eligible studies were included The articles studied have various types of research, three articles are cohort studies, one article is randomized experimental studies, and one article is case report (Table.3).

Most of the studies reported significant dentoalveolar improvements such as reduced overjet, overbite, and molar relationship correction. Skeletal changes were modest but consistent, notably in mandibular advancement and ANB angle reduction.

Table 3. Literature Presentation Data

No	Author (Year)	Study Design	Population	Intervention	Outcomes	Conclusion
1	Keski-Nisula et al. (2008)	Prospective controlled study	115 children (treatment) and 104 children (control), aged 5.1–8.4 years	Eruption Guidance Appliance (EGA)	Greater mandibular growth in treatment group (11.1 mm vs 7.2 mm); significant improvement to Class I molar relation; proclined mandibular incisors; no significant maxillary changes	Occlusal improvement mainly occurred through dentoalveolar changes in the mandible; increased condylar growth; no effect on maxillary position or size
2	Chen et al. (2022)	Retrospective control study	13 children (9.3 ± 0.3 yrs, Class II Div 1) with EF appliance; 13 controls (9.9 ± 0.4 yrs)	Education Fonctionnelle (EF) myofunctional appliance + muscle exercises	Significant dentoalveolar improvements (upper incisor angle decrease, lower incisor angle increase); skeletal effects limited but mandibular length increased	EF appliance therapy improved dental relationships and promoted mandibular growth; recommended as early intervention in Class II Div 1 malocclusion
3	Ciftci & Uzel (2021)	Prospective pre–post single-group study (uncontrolled cohort)	18 children, 9.97 ± 1.36 yrs, Class II Div 1	Multi-P myofunctional appliance	Reduced overjet, significant dental changes, minimal skeletal effects	Multi-P has mainly dentoalveolar effects; limited skeletal impact
4	Myrlund et al. (2019)	Follow-up RCT	46 children, early mixed dentition	LM-Activator (modified EGA)	Improved overjet, overbite, and molar relation; stability maintained	Early EGA treatment is effective and stable with good compliance
5	Guimarães et al. (2015)	Case report with 10-year follow-up	8-year-old boy with tooth ankylosis and Class II Div 1	Eruption guidance appliance + sagittal appliance	Class I molar achieved, overjet and overbite corrected, stable at 10 years	Interceptive treatment with EGA leads to long-term occlusal stability

Discussion

A clear pattern emerges that the EGA's chief mode of action is dentoalveolar, with all studies agreeing on the appliance's effectiveness in correcting overjet, overbite, and molar relationships in the short term.[10,11] However, some differences across studies are evident, often attributable to variations in sample age, treatment duration, or measurement focus. One notable contrast is in the reported behavior of the incisors. Keski-Nisula et al. found that in their cohort (treated at age ~5–8 years), the lower incisors were proclined (tipped labially) by EGA use while the upper incisors' inclination remained unchanged.[12] In Janson et al.'s older sample (mean ~9–11 years at treatment), the lower incisors moved forward largely by bodily translation with little change in their angle, whereas the upper incisors tended to tip labially/protrude slightly during EGA therapy. In fact, Keski-Nisula directly compared their findings to Janson's earlier study: they noted that their results differed from that "previous study" which had reported upper incisor proclination and unchanged lower incisor inclination after EGA. The Finnish authors suggested a compelling explanation – the younger age of their patients. Because EGA treatment in their trial commenced at the early mixed dentition (around 5–6 years, as the first incisors erupted), the appliance could guide the erupting permanent incisors into proper position, thereby avoiding the upper incisor flaring that was observed in somewhat older children. In other words, starting EGA during incisor eruption may allow the appliance to better control maxillary incisor orientation, whereas in older patients some forward tooth movement of upper incisors can occur as part of Class II correction. This age-related difference highlights that optimal timing might influence the dental side effects of treatment. Despite these nuanced discrepancies, both studies concluded that the incisor changes – whether tipping or bodily movement – serve to improve the bite and are accompanied by only minor skeletal adjustments.[10]

Another area of variation is the magnitude of skeletal effect observed. Keski-Nisula's study, with a 3.3-year treatment duration, found a statistically significant but clinically moderate increase in mandibular length (~4 mm greater than controls).[12] Myrlund's one-year trial did not include a cephalometric control comparison at T2 (to avoid unnecessary X-rays for the control group), so skeletal changes in that RCT were mainly inferred from the treated group's changes (which showed mild mandibular growth but still Class II jaw relationships in some cases).[11] Importantly, the consistency lies in that none of the studies reported any *skeletal Class II overcorrection* or dramatic jaw rotations with EGA – the skeletal differences, when present, were incremental. For instance, Huang et al. (2022) in their systematic review synthesized that EGA yields a significant but small SNB increase and essentially no change in SNA.[13] Between-study variability reflected differences in wear schedules, treatment duration, retention, cohort age at initiation, and whether outcomes emphasized occlusion or cephalometrics. Earlier initiation (as incisors erupt) was associated with more favorable incisor coupling and overjet reduction in some reports.[6,12,4] Adjunctive expansion for transverse deficiency did not negate the characteristic EGA profile of dentoalveolar correction.[11,5,4]

Where comparative data exist, outcomes with EGAs were broadly comparable to conventional functional appliances during the mixed dentition period.[11,12] Prefabricated, elastomeric EGAs—worn primarily at night—offer a practical alternative with similar occlusal improvements to the Fränkel regulator in early trials.[11] For children with Class II in the early mixed dentition, EGAs reliably improve sagittal occlusion via dentoalveolar changes while offering only incremental skeletal modification.[10-15] Expectations should be calibrated: EGAs suit dentoalveolar problems and mild skeletal discrepancies, can be timed to growth, and may reduce complexity of later comprehensive treatment when combined with appropriate retention.[4,10-12]

The literature is heterogeneous in design and sample size, with several studies lacking untreated controls and reporting short follow-up; outcome measures vary, complicating direct comparisons and precluding robust meta-analytic synthesis.[4,10-12] Compliance—critical for removable appliances—was variably measured and seldom objectively monitored.

Adequately powered, multi-center randomized or well-controlled prospective studies with standardized outcome sets are needed, with longer follow-up into the early permanent dentition.[6] Future work should incorporate rigorous compliance monitoring and explore protocol optimization (timing, wear schedules, retention) to maximize and sustain benefits.[4,6,12]

Conclusion

Early orthodontic intervention using the eruption guidance appliance (EGA) in the mixed dentition can effectively correct Class II malocclusions through both dentoalveolar and skeletal changes. The scoping review found that EGA treatment consistently reduced excessive overjet and overbite by approximately 2–3 mm, while improving molar and canine relationships toward Class I. These occlusal corrections were accompanied by modest but significant skeletal changes, notably enhanced mandibular. Collectively, such changes produced a more favorable jaw relationship and better incisor alignment in the short term, indicating that EGA can effectively guide dental eruption and jaw development during growth.

However, the current evidence is limited, and several methodological shortcomings temper these conclusions. The body of literature on EGA is relatively small and heterogeneous. Only a few high-quality studies met the inclusion criteria (including just a single randomized controlled trial), with many reports being prospective or retrospective cohort studies and case report prone to bias. Moreover, outcomes were measured using varied indices and cephalometric analyses across studies, making it difficult to standardize results or directly compare effectiveness.

To strengthen the evidence base, there is a clear need for larger, well-designed randomized controlled trials examining EGA in early mixed dentition. Future studies should incorporate longer follow-up periods extending into later adolescence to assess the permanence of skeletal and dental corrections. Standardized outcome measures should be employed to enable meaningful comparisons and meta-analyses across studies. High-

quality, long-term investigations will help determine whether the short-term benefits of EGA translate into sustained orthodontic improvements and reduced need for complex interventions in the permanent dentition. Such evidence will ultimately clarify the role of eruption guidance appliances in early Class II correction and guide orthodontists on optimal timing and use of this interceptive approach.

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