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The Changes in Orthodontic Treatment Need in Children Over Time: A Longitudinal Evaluation of Self-Correcting Malocclusions

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Abstract

Objective: This systematic review aimed to synthesize longitudinal evidence on the natural changes in orthodontic treatment need among children and adolescents, with a specific focus on identifying malocclusion traits that demonstrate a potential for spontaneous correction over time. ***Methods:*** A systematic search was conducted across PubMed/MEDLINE, SienceDirect, Cochrane Library and Google Scholar from inception to November 2025, following PRISMA guidelines. Eligible studies were longitudinal cohorts assessing children and adolescents in mixed or early permanent dentition, with no prior orthodontic treatment at baseline. Outcomes included changes in treatment need measured by indices like the Dental Aesthetic Index (DAI) or Index of Orthodontic Treatment Need (IOTN), and observed self-correction of specific malocclusion traits. Risk of bias was assessed using the Newcastle-Ottawa Scale. ***Results:*** Four prospective cohort studies (n=1,253 participants) were included. The evidence revealed a non-linear trajectory of malocclusion prevalence, characterized by an initial decrease from primary to mixed dentition, followed by an increase in early permanent dentition. Despite this, a net decrease in treatment need was observed for many individuals during the transition from mixed to permanent dentition, with one study reporting decreased DAI scores for 60.8% of children. High rates of spontaneous correction were documented for specific traits: anterior open bite (87-99%), Class II malocclusion (83%), and unilateral posterior crossbite (83%). Nevertheless, a persistent, clinically significant treatment need remained, with 22% of 11.5-year-olds classified as having severe or extreme need. ***Conclusion:*** Orthodontic treatment need in children is dynamic, not static. While significant self-correction occurs for traits like anterior open bite and posterior crossbite, a substantial proportion of children develop a definitive need for intervention by early permanent dentition. These findings underscore the importance of longitudinal monitoring and cautious timing of orthodontic assessments, particularly during mixed dentition when transient traits may overestimate true long-term need.

Keywords: Orthodontic Treatment, Longitudinal Evaluation, Dental Aesthetic Index (DAI), Newcastle-Ottawa Scale.

INTRODUCTION

The management of malocclusion in children represents a cornerstone of modern orthodontics, driven by goals to improve dental function, long-term oral health, and psychosocial well-being [1]. The prevalence of malocclusion among children is notably high, with estimates ranging from 39% to over 90% globally, making it one of the most common oral health conditions in the pediatric population [2,3]. This high prevalence translates into a significant demand for orthodontic services, with treatments predominantly concentrated in children and adolescents, particularly around puberty [2]. Successful orthodontic intervention can yield substantial benefits, including a reduced likelihood of periodontal disease and tooth extractions in later life [1]. Consequently, accurately determining which children require treatment and when to intervene is a critical clinical and public health objective.

A persistent challenge in achieving this objective is the dynamic and evolving nature of the developing dentition. A child's occlusion is not a static entity but undergoes significant changes from the primary through the mixed and into the permanent dentition phases. During this transitional period, certain malocclusion traits may resolve spontaneously through physiological growth and development, while other new occlusal discrepancies may emerge. For instance, longitudinal evidence indicates high rates of spontaneous correction for anterior open bite, posterior crossbite, and some sagittal malocclusions. Conversely, traits such as deep overbite and dental crowding often develop or worsen during the same period [3,4]. This natural flux creates a fundamental clinical dilemma: the potential for unnecessary early treatment of self-limiting conditions versus the risk of delaying intervention for malocclusions that will persist or deteriorate without care.

The clinical and academic discourse on optimal treatment timing is active and sometimes polarized, often framed as a debate between early "interceptive" treatment and "watchful waiting" until the permanent dentition is established. Proponents of early intervention argue that treatment during active growth phases, such as the adolescent growth spurt, can produce more favorable skeletal changes, particularly in cases involving jaw discrepancies [5]. In contrast, advocates for later treatment emphasize that many dental alignment issues are best addressed in the permanent dentition and caution against intervening for conditions that may self-correct [5]. This debate underscores a significant gap in the evidence base: a comprehensive, longitudinal understanding of how orthodontic treatment need itself changes over time in an untreated, developing population.

Existing research has several limitations. First, many studies on malocclusion prevalence and treatment need are cross-sectional, providing only a snapshot that cannot elucidate individual developmental trajectories [3]. Second, while some longitudinal studies exist, they often focus on the outcomes of treated cohorts or mix treated and untreated individuals, complicating the interpretation of natural history [6,7]. Third, there is a recognized issue with the assessment tools themselves; indices like the Dental Aesthetic Index (DAI) or the Index of Orthodontic Treatment Need (IOTN) may overestimate need in the mixed dentition by penalizing common, transient developmental features such as midline diastema [7]. Finally, significant socio-demographic disparities in access to orthodontic care are well-documented, with treatment rates higher among females, white populations, and children from higher-income families. This highlights that treatment received is not a pure proxy for treatment need, further complicating population-level assessments.

Therefore, this systematic review aims to address this critical evidence gap by synthesizing longitudinal studies that specifically evaluate changes in orthodontic treatment need in children over time, with a focused examination on malocclusions that demonstrate a capacity for spontaneous correction. By analyzing studies that follow untreated cohorts from the mixed to the permanent dentition, this review seeks to clarify the natural history of various malocclusion traits, distinguish self-correcting conditions from those that are persistent or progressive, and provide an evidence base to inform more precise clinical decision-making regarding the timing of orthodontic intervention.

METHODOLOGY

Study Design and Protocol Registration

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines [8]. The review focused on longitudinal evidence evaluating changes in orthodontic treatment need in children over time, with particular emphasis on malocclusions that demonstrate spontaneous improvement or self-correction.

Eligibility Criteria

Studies were selected based on predefined inclusion and exclusion criteria structured according to the Population, Exposure, Comparison, Outcome, and Study design (PECOS) framework (Table 1).

Table 1: PECOS (Population, Exposure, Comparator, Outcomes, Study design) framework defining the eligibility criteria for study inclusion in the systematic review

Element	Description / Inclusion Criteria	Exclusion Criteria
P - Population	Children and adolescents in the mixed or early permanent dentition stages. Participants must have had no orthodontic treatment at the baseline assessment.	• Syndromic patients or those with craniofacial anomalies. • Individuals who had already undergone orthodontic treatment at the start of the study. • Studies focused solely on primary dentition or late adolescent/adult dentition without the specified transition.
E - Exposure	The natural process of craniofacial growth and dental development over time. This includes the longitudinal observation of the occlusion	• Studies where the cohort received systematic or interceptive orthodontic treatment as part of the study protocol.

Element	Description / Inclusion Criteria	Exclusion Criteria
	without any planned orthodontic intervention during the study follow-up period.	• Any artificial intervention aimed at modifying the occlusion during the observation period.
C - Comparator	Within-study comparison of the same individuals at different time points (e.g., baseline vs. follow-up). The comparator is the individual's own earlier occlusal status or treatment need score.	• Cross-sectional comparisons between different groups of individuals. • Studies lacking a clear longitudinal within-subject comparison.
O - Outcomes	**Primary:** 1. Change in orthodontic treatment need, assessed via validated indices (e.g., IOTN, DAI, PAR). 2. Clinically documented self-correction or change in the severity of specific malocclusion traits (e.g., anterior open bite, posterior crossbite, overjet). **Secondary:** • Factors associated with self-correction (e.g., sucking habits).	• Studies reporting only on the prevalence of malocclusion at a single time point. • Outcomes not directly related to occlusal changes or treatment need (e.g., only patient-reported aesthetics without clinical correlation).
S - Study Design	Longitudinal observational studies, including prospective or retrospective cohort studies, with a defined follow-up period sufficient to observe changes in the dentition.	• Cross-sectional studies. • Case reports, case series, or interventional trials (RCTs). • Systematic reviews, meta-analyses, narrative reviews, or opinion pieces (though their reference lists were screened).

The population of interest comprised children and adolescents in the mixed or early permanent dentition stages who had not undergone orthodontic treatment at baseline. Eligible studies were required to employ a longitudinal design, including prospective or retrospective cohort studies and longitudinal observational studies, with a minimum follow-up period sufficient to assess changes in malocclusion characteristics or orthodontic treatment need over time.

The primary outcomes of interest included changes in orthodontic treatment need assessed using validated indices such as the Index of Orthodontic Treatment Need (IOTN), Dental Aesthetic Index (DAI), Peer Assessment Rating (PAR), or comparable occlusal assessment tools, as well as clinically documented self-correction of specific malocclusion traits. Cross-sectional studies, case reports, interventional trials involving orthodontic treatment, studies including syndromic patients or those with craniofacial anomalies, and publications lacking longitudinal outcome data were excluded. Only studies published in English were considered.

Information Sources and Search Strategy

A comprehensive electronic literature search was conducted across following databases PubMed/MEDLINE, ScienceDirect, Cochrane Library and Google Scholar from inception until November 2025. The search strategy combined following Medical Subject Headings (MeSH) terms and free-text keywords using Boolean operators: "malocclusion," "orthodontic treatment need," "self-correction," "longitudinal," and "child". Reference lists of included studies and relevant reviews were manually screened to identify additional eligible studies that may not have been captured through the electronic search.

Study Selection

All retrieved records were imported into a reference management software, and duplicates were removed prior to screening. Two reviewers independently screened titles and abstracts to identify potentially eligible studies. Full-text articles of studies deemed relevant were subsequently assessed for inclusion against the predefined eligibility criteria. Any discrepancies between reviewers at either stage were resolved through discussion, and when necessary, consultation with a third reviewer. The study selection process was documented using a PRISMA flow diagram (Figure 1).

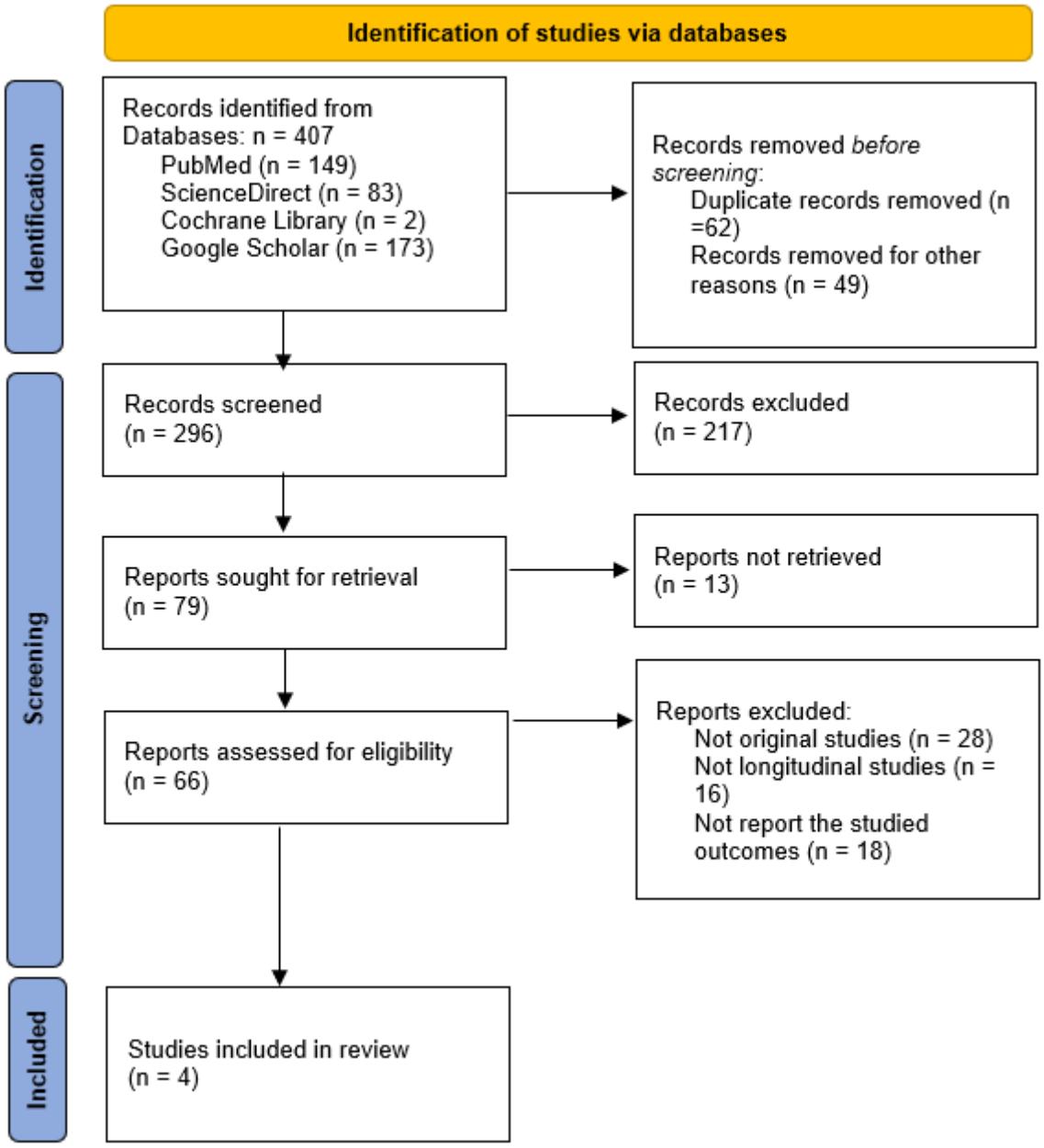

Figure 1: PRISMA flowchart showing the study selection process

Data Extraction

Data extraction was performed independently by two reviewers using a standardized, pre-piloted data extraction form. Extracted data included study characteristics such as author, year of publication, country, study design, sample size, age at baseline and follow-up, duration of follow-up, malocclusion characteristics assessed, orthodontic treatment need indices used, and main outcomes related to changes in treatment need or spontaneous improvement of malocclusion. When required, corresponding authors were contacted for clarification or to obtain missing data.

Risk of Bias Assessment

The methodological quality and risk of bias of the included studies were independently assessed by two reviewers. For longitudinal observational studies, the Newcastle–Ottawa Scale (NOS) was used to evaluate selection, comparability, and outcome assessment domains [9]. Each study was categorized as having low, moderate, or high risk of bias based on the overall score. Any disagreements in quality assessment were resolved through consensus.

Data Synthesis

Given the anticipated heterogeneity in study designs, outcome measures, follow-up durations, and orthodontic indices used, a qualitative narrative synthesis was primarily undertaken. Findings were synthesized by summarizing patterns of change in orthodontic treatment need over time and identifying malocclusion traits that demonstrated a tendency toward self-correction. Where studies were sufficiently homogeneous in terms of

outcome measures and follow-up intervals, quantitative synthesis was considered.

RESULTS

The initial electronic database searches yielded 407 records. After the removal of 62 duplicate records and 49 records for other reasons (e.g., retractions, protocol registrations), 296 unique records underwent title and abstract screening. This screening excluded 217 records that did not meet the broad eligibility criteria. The full texts of the remaining 79 reports were sought for retrieval, of which 13 could not be obtained. The 66 successfully retrieved full-text articles were assessed in detail against the predefined PECOS framework. Of these, 62 reports were excluded, primarily for not being original longitudinal studies (n=28), not reporting on the relevant longitudinal outcomes (n=18), or not employing a longitudinal design (n=16). Through this rigorous process, four studies [3,10–12] were identified as fulfilling all eligibility criteria and were consequently included in the qualitative synthesis of this systematic review. Overall, the studies were judged to be of moderate to high quality, with three studies [3,10,11] deemed to have a low risk of bias. These studies received high scores for the representativeness of their cohorts, which were drawn from community or school-based populations, and for demonstrating the comparability of cohorts by matching or adjusting for key confounders such as age and the absence of baseline treatment. They also employed secure, standardized clinical records for outcome assessment and had adequate follow-up lengths. Dimberg *et al*. [3] lost one star in the Outcome domain due to a relatively high attrition rate (39.4%) over its 8.5-year follow-up, despite a reported dropout analysis finding no significant differences between completers and non-completers. One study [12] was assessed as having a moderate risk of bias. While it demonstrated a secure outcome assessment via clinical examination, points were deducted in the Selection domain as the cohort's representativeness of the general population was not explicitly described, and in the Comparability domain for not adequately controlling for the potential confounding effect of orthodontic treatment received by 15% of the participants during the follow-up period. This factor introduces uncertainty regarding whether the observed reduction in malocclusion prevalence was due solely to natural development or was partly attributable to intervention. No studies were judged to have a high risk of bias. The results of the assessment are summarized in Table 2.

Table 2: Quality assessment of included studies using the Newcastle-Ottawa Scale (NOS) for cohort studies

Study (Year)	Selection (Max 4)	Comparability (Max 2)	Outcome (Max 3)	Total Score (/9)	Risk of Bias
Dimberg *et al*. (2013) [10]	★★★★	★★	★★★	**9**	Low
Dimberg *et al*. (2015) [3]	★★★★	★★	★★	**8**	Low
Vedovello *et al*. (2025) [11]	★★★	★★	★★★	**8**	Low
Egermark-Eriksson *et al*. (1990) [12]	★★★	★	★★	**6**	Moderate

The characteristics of the included studies, comprising a total of 1,253 participants, are summarized in Table 3.

Table 3: Summary characteristics of included studies

Study Author, Year	Country	Study Design & Follow-up	Sample Size & Age at Start	Outcome Measures (Indices)	Key Findings Relevant to Your Review
Dimberg *et al*. (2013) [10]	Sweden	Longitudinal cohort (Prospective). Follow-up: 4 years (from age 3 to 7).	N=386 at follow-up. Age: 3 years (primary dentition).	Clinical examination of specific malocclusion traits.	Overall malocclusion decreased from 70% to 58%. High self-correction for anterior open bite (87%), excessive overjet (58%), Class III (75%).
Dimberg *et al*. (2015) [3]	Sweden	Longitudinal cohort (Prospective). Follow-up: 8.5 years (from age 3 to 11.5).	N=277 at final follow-up. Age: 3 years (primary dentition).	1. Clinical exam of traits. 2. Treatment need: IOTN-DHC.	U-shaped prevalence: 71% (age 3) → 56% (age 7) → 71% (age 11.5). Self-correction of anterior open bite (99%), Class II (83%). 22% had severe/extreme need at 11.5 years.
Egermark-Eriksson *et al*. (1990) [12]	Sweden	Longitudinal cohort (Prospective). Follow-up: 4-5 years (from ages 7→11, 11→15, 15→20).	N=238. Age groups: 7, 11, and 15 years at baseline.	Clinical exam of morphological malocclusions. Primary focus on CMD, but reports	Shows longitudinal change: Prevalence of "any morphological malocclusion" decreased from 51% at age 7 to 38% at age 20. Provides evidence of reduced

Study Author, Year	Country	Study Design & Follow-up	Sample Size & Age at Start	Outcome Measures (Indices)	Key Findings Relevant to Your Review
				malocclusion data.	malocclusion burden into adulthood.
Vedovello *et al*. (2025) [11]	Brazil	Longitudinal cohort (Prospective). Follow-up: 4 years (from mixed to permanent dentition).	N=352. Age: 8-10 years (mixed dentition).	Treatment need: Dental Aesthetic Index (DAI).	DAI scores decreased for 60.8% of children. Highlights that indices may overestimate need in mixed dentition due to transient traits.

All studies employed a prospective cohort design, with follow-up periods ranging from 4 to 8.5 years, and originated from Sweden (n=3) and Brazil (n=1). The cohorts covered distinct yet overlapping developmental stages: primary dentition (starting at age 3), mixed dentition (starting at ages 8-10), and adolescence (starting at ages 7, 11, and 15), providing a composite view of occlusal development from early childhood to young adulthood.

The longitudinal data revealed a dynamic pattern of malocclusion prevalence and orthodontic treatment need over time. In the primary dentition stage, one study reported a baseline malocclusion prevalence of 70% at age 3 [10]. This prevalence exhibited a non-linear trajectory, decreasing significantly to 56% by age 7 before rising again to 71% in the early permanent dentition at age 11.5 [3]. This U-shaped curve was contrasted by evidence from a cohort followed from mixed to permanent dentition, which indicated that for a majority of children, the objective need for treatment decreased during this transition [11]. This trend of net improvement extended into later adolescence, as a separate cohort demonstrated a reduction in the prevalence of any morphological malocclusion from 51% at age 7 to 38% at age 20 [12].

A key finding across studies was the substantial spontaneous correction observed for specific malocclusion traits. Anterior open bite showed the most pronounced and consistent improvement, with self-correction rates of 87% from age 3 to 7 [10] and 99% from age 3 to 11.5 [3]. Similarly, Class II malocclusions and unilateral posterior crossbites demonstrated high rates of spontaneous resolution, at 83% and 83%, respectively, over the 8.5-year follow-up [3]. Other traits, including excessive overjet and Class III malocclusions, also showed considerable self-correction in early childhood [10].

Despite these self-corrections, a clinically significant level of orthodontic treatment need persisted into the early permanent dentition. At age 11.5, 22% of children in one cohort were classified as having a severe or extreme need for treatment according to the Index of Orthodontic Treatment Need-Dental Health Component (IOTN-DHC) [3]. Furthermore, the evaluation of treatment need was influenced by the assessment tool and developmental stage. One study reported that 60.8% of children exhibited a decrease in their DAI score during the transition from mixed to permanent dentition [11]. The authors noted, however, that the DAI might overestimate treatment need in the mixed dentition by penalizing transient, developmental traits such as midline diastema [11].

Certainty of Evidence

The overall certainty of evidence for the primary outcomes of this review was assessed using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework. The body of evidence, comprising four longitudinal cohort studies, was initially classified as low certainty due to the inherent limitations of observational study designs (downgraded for risk of bias). No serious concerns regarding inconsistency or indirectness of the evidence were identified, as the findings across studies were largely coherent and directly addressed the review question. However, the certainty was further downgraded one level due to serious imprecision. The total number of participants across all studies was 1,253, and while statistically significant trends were reported, the confidence intervals around estimates of self-correction rates for specific malocclusion traits (e.g., posterior crossbite, Class II) are likely to be wide given the sample sizes of individual studies. No publication bias was detected, though the small number of included studies limits the power of such an assessment. Consequently, the overall certainty of evidence for the conclusions that 1) specific malocclusions demonstrate high rates of self-correction, and 2) orthodontic treatment need exhibits a dynamic, non-linear trajectory from childhood to adolescence, is judged to be very low. This indicates that our confidence in the effect estimate is limited, and the true effect may be substantially different from the estimated effects reported in this review.

DISCUSSION

The findings of this systematic review underscore the dynamic, non-linear trajectory of malocclusion prevalence from childhood to adolescence, characterized by periods of significant spontaneous correction followed by the emergence of new occlusal discrepancies. The high rates of self-correction observed for anterior open bite, excessive overjet, and certain

sagittal malocclusions align with trends reported in other longitudinal investigations. For instance, Dimberg *et al*. [10] similarly documented substantial resolution of anterior open bite and Class III malocclusions between ages 3 and 7, reinforcing the notion that many early malocclusions are transient and subject to modification through physiological growth and the cessation of oral habits such as non-nutritive sucking. Furthermore, the observed decline in overall malocclusion prevalence into young adulthood, as noted by Egermark-Eriksson *et al*. [12], suggests a continuing trend of occlusal normalization beyond adolescence, even as certain traits such as crowding and deep bite become more prevalent in the permanent dentition.

The persistent orthodontic treatment need identified in the early permanent dentition within the included studies resonates with cross-sectional assessments of adolescent populations. Research by Josefsson *et al*. [13] in Swedish and immigrant adolescents, while not longitudinal, reported that approximately 37% of 12–13-year-olds exhibited a definite need for treatment (IOTN-DHC grades 4–5), a figure comparable to the 22% with severe/extreme need at age 11.5 in the present review. This consistency across study designs highlights that despite considerable self-correction during development, a significant minority of children retain malocclusions of substantive clinical concern. Moreover, the influence of assessment methodology on treatment need classification—particularly the potential for overestimation in the mixed dentition due to developmental traits—echoes observations in other settings, underscoring the importance of careful, stage-appropriate evaluation in both clinical and epidemiological contexts [14,15].

Thilander *et al*. [16], in a large cross-sectional analysis, noted variations in malocclusion prevalence across different stages of dental development, underscoring the importance of developmental timing when assessing treatment need—a key consideration in longitudinal evaluations. Vedovello *et al*. [11] highlighted how the DAI may overestimate treatment need in mixed dentition by penalizing transient traits such as midline diastema, a methodological caution echoed in the included longitudinal analysis. Meuffels *et al*. [17] examined malocclusion complexity in children with autism spectrum disorder and found significantly higher normative treatment need, reminding us that population-specific factors can influence both baseline need and the potential for self-correction. Peter *et al*. [18] demonstrated that orthodontic treatment improves oral health–related quality of life, underscoring the importance of distinguishing between normative need and patient-reported outcomes a distinction relevant when interpreting longitudinal changes in occlusal indices alone. Finally, Spalj *et al*. [19] reported weak correlations between clinician-assessed need and patient or parent perception, reinforcing that treatment need is multidimensional and not fully captured by indices such as the DAI or IOTN, which were central to the studies included in this review.

Several limitations inherent to the included studies and the review process itself should be considered when interpreting the findings. First, all included studies were observational cohort studies, which, despite providing valuable longitudinal data, are susceptible to confounding and cannot establish causality between developmental factors and self-correction. Second, the reliance on heterogeneous assessment tools ranging from specific clinical examinations to the DAI and the IOTN introduces variability in how malocclusion and treatment need were defined and measured, complicating direct comparisons. As noted in the review, tools like the DAI may overestimate need in mixed dentition. Third, the attrition of participants over the lengthy follow-up periods, particularly in the study by Dimberg *et al*. [3] which experienced a 39.4% dropout rate, raises concerns about potential selection bias, even where dropout analyses were performed. Fourth, the generalizability of the findings may be limited, as three of the four studies were conducted in Sweden, and socio-cultural, ethnic, and environmental influences on occlusal development in other global populations remain less clear. Finally, the inherent challenge of the review topic is that studies must exclude participants who undergo treatment during follow-up, which may inadvertently select for cohorts with initially less severe malocclusions, potentially skewing estimates of self-correction rates.

Future research should prioritize prospective, multi-center longitudinal studies with standardized protocols to allow for robust meta-analysis. These studies must employ malocclusion indices specifically validated or adapted for the mixed dentition stage to avoid overestimation of treatment need. Investigations should also be designed to include diverse ethnic and socioeconomic populations to improve the external validity of findings. Furthermore, there is a need for research that integrates genetic, environmental, and functional data (e.g., detailed records of oral habits, airway function) to move beyond descriptive natural history and develop predictive models. Such models would help clinicians identify which individual patients with a specific malocclusion trait are most likely to experience self-correction versus those who would benefit from early intervention.

CONCLUSION

This systematic review synthesized longitudinal evidence on the dynamic nature of orthodontic treatment need from childhood to adolescence. The findings consistently demonstrate that a significant proportion of malocclusions, particularly anterior open bite and posterior crossbite, undergo spontaneous correction during dental development. This supports a strategy of judicious observation during the mixed dentition phase, as premature intervention for

these traits may be unnecessary. However, the review also reveals a counterbalancing trend: the overall prevalence of malocclusion often follows a U-shaped curve, where self-correction in early childhood is offset by the later development of new occlusal discrepancies, such as deep bite and dental crowding. Consequently, while the objective treatment need decreases for many individuals during transition, a definitive and often severe need for orthodontic intervention persists in a substantial subset of children by early permanent dentition. These results highlight a critical clinical implication: assessment tools designed for permanent dentition, such as the DAI, may overestimate true long-term need when applied in the mixed dentition due to transient physiological traits. Therefore, orthodontic diagnosis and treatment planning should be informed by an understanding of this natural history, emphasizing longitudinal monitoring over single time-point assessments to distinguish between self-limiting conditions and malocclusions requiring definitive intervention.

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