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Original Article

A Impact of Malocclusion on Articulation Disorders in Deciduous and Mixed Dentition: Comprehensive Review

Agung Endro Nugroho[1], Hesty Utami Ramadaniati[1*]

[1] Faculty of Humanities, Universitas Andalas, Padang, Indonesia.

***E-mail** ✉ Huramadaniati1970@yahoo.com

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ABSTRACT

The association between malocclusions and speech sound disorders (SSDs) remains only partially clarified, particularly in children within the deciduous and mixed dentition phases. Through a structured scoping review, this research investigates current findings to better understand how dental misalignments influence phonetic precision and speech articulation. This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) framework. Relevant publications were retrieved from PubMed, Scopus, Web of Science, and The Cochrane Library. Inclusion criteria comprised studies involving pediatric patients in the deciduous or mixed dentition stage exhibiting both malocclusion and SSDs. Of the 1880 articles initially identified, 44 passed the preliminary screening, and 12 met all inclusion parameters for this analysis. Findings demonstrate broad agreement that malocclusions can affect speech patterns, though the specific characteristics and degree of these influences differ among studies. Anterior open bite is frequently linked to articulatory challenges, as it interferes with tongue posture and airflow patterns. The review underscores the importance of interdisciplinary management and emphasizes the need for further studies exploring the causal pathways connecting malocclusions and SSDs.

Keywords: Deciduous dentition, Dyslalias, Malocclusion, Mixed dentition, Pediatric patients, Speech sound disorder

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Introduction

Malocclusion refers to irregular alignment or contact of teeth and discrepancies in how the upper and lower arches meet. This term covers a range of abnormalities—from mild crowding to complex skeletal discrepancies involving jaw development [1]. Such conditions are prevalent in children and adolescents worldwide and are regarded as a global oral health issue caused by both hereditary and environmental influences [2]. Contributing factors include growth direction, muscle activity, breathing patterns, and premature tooth loss or extraction [3, 4]. Disruption of normal muscle forces on the dental arches can also result from deleterious oral behaviors such as non-nutritive sucking (NNS) or residual orofacial dysfunctions like improper tongue posture and open-mouth breathing, particularly during the primary and mixed dentition periods, which typically span ages 3 to 12 [4]. A well-known example is the anterior open bite (AOB), a complex malocclusion with multifactorial origins related to eruption patterns, alveolar development, neuromuscular imbalance, and tongue malfunction [5].

Malocclusions often coexist with atypical swallowing—a condition marked by the persistence of infantile swallowing mechanisms after permanent teeth have erupted. However, the directional link between these two issues remains uncertain [5, 6]. Oral habits and tongue thrusting may intensify malocclusion [7-9], while orofacial dysfunctions can alter occlusal development [3, 10]. Moreover, atypical swallowing patterns have been associated with post-surgical relapse in orthognathic cases [11].

Existing literature confirms that malocclusion impacts more than aesthetics—it affects oral function and health [4]. Among school-aged children, it can result in poor tongue placement, unattractive dental appearance, and altered speech production, influencing overall quality of life [12, 13]. Evidence also connects specific swallowing behaviors, notably tongue interposition, to lisping or distorted sibilant sound production [5, 6].

Speech requires finely coordinated neuromuscular control and is deeply influenced by oral cavity structure. The connection between articulatory disorders and oral anomalies is multifaceted, involving both anatomical and language-specific components [14]. According to the Balance Theory, proper tooth alignment helps stabilize the forces between the tongue and the lips or cheeks [15]. Any impairment in these structures can disturb phoneme articulation, resulting in conditions such as dyslalia, stuttering, or hoarseness. Malocclusion is strongly correlated with speech difficulties [1], though the intensity of impairment does not always correspond to the degree of dental misalignment [16]. Speech sound disorders, frequently seen in childhood, are recognized as neurodevelopmental disorders (NDDs) [17-19]. Their origins may be idiopathic, genetic, or acquired [19], and deviations in the anterior oral structures can interfere with tongue and lip positioning essential for accurate sound formation [20-22]. Among various malocclusions, AOB remains the most frequently associated with articulatory issues, particularly in pediatric cases [18, 19, 23-27].

Finally, the investigations carried out by Fymbo [25, 26], Snow [28], and Bloomer [29], as synthesized in Johnson's comprehensive review [23], have played a significant role in clarifying the interplay between malocclusions and variations in oral anatomy. Their collective work demonstrates that the preservation of proper dental arch form is essential for normal phonetic function, revealing how both the maxillary and mandibular arches contribute meaningfully to articulation. This evidence reinforces the strong association between dental misalignment and speech irregularities.

The purpose of the current scoping review is to consolidate existing research that explores whether a causal link exists between malocclusions and speech sound disorders (SSDs) in children during the deciduous and mixed dentition periods. A secondary goal is to determine which categories of malocclusion exert the greatest effect on speech clarity and articulation.

Materials and Methods

This review adhered to the framework of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) [30]. The review was not preregistered. To guide the process, the main research question was defined as follows:

"Is there evidence of a causal relationship between malocclusion and Speech Sound Disorders in children who do not present with other syndromic factors?"

An extensive literature search was performed on 16 December 2024 using PubMed, Scopus, Web of Science, The Cochrane Library, and OpenGrey databases. The applied search terms and strategy are outlined in **Table 1**.

Table 1. Search strategy

Research Database	Query Terms	Search Yield
Cochrane Database	("dental misalignment" OR "anterior open bite" OR "open bite" OR "AOB" OR "anterior crossbite" OR "posterior crossbite" OR "crossbite" OR "deep bite") AND ("speech impairment" OR "speech" OR "phoneme" OR "articulation issue" OR "sound" OR "affricative" OR "fricative" OR "sibilant" OR "dyslalia" OR "affricate") AND ("primary teeth" OR "deciduous teeth" OR "early mixed teeth" OR "late mixed teeth" OR "mixed teeth" OR "pediatric" OR "child" OR "children" OR "school-aged")	44
PubMed Database	("dental misalignment" OR "anterior open bite" OR "open bite" OR "AOB" OR "anterior crossbite" OR "posterior crossbite" OR "crossbite" OR "deep bite") AND ("speech impairment" OR "speech" OR "phoneme" OR "articulation issue" OR "sound" OR "affricative" OR "fricative" OR "sibilant" OR "dyslalia" OR "affricate") AND ("primary teeth" OR "deciduous teeth" OR "early mixed teeth" OR "late mixed teeth" OR "mixed teeth" OR "pediatric" OR "child" OR "children" OR "school-aged")	505
Scopus Platform	("dental misalignment" OR "anterior open bite" OR "open bite" OR "AOB" OR "anterior crossbite" OR "posterior crossbite" OR "crossbite" OR "deep bite") AND ("speech impairment" OR "speech" OR "phoneme" OR "articulation issue" OR "sound" OR "affricative" OR "fricative" OR "sibilant" OR "dyslalia" OR "affricate") AND ("primary teeth" OR "deciduous teeth" OR "early mixed teeth" OR "late mixed teeth" OR "mixed teeth" OR "pediatric" OR "child" OR "children" OR "school-aged")	696

Web of Science Core	("dental misalignment" OR "anterior open bite" OR "open bite" OR "AOB" OR "anterior crossbite" OR "posterior crossbite" OR "crossbite" OR "deep bite") AND ("speech impairment" OR "speech" OR "phoneme" OR "articulation issue" OR "sound" OR "affricative" OR "fricative" OR "sibilant" OR "dyslalia" OR "affricate") AND ("primary teeth" OR "deciduous teeth" OR "early mixed teeth" OR "late mixed teeth" OR "mixed teeth" OR "pediatric" OR "child" OR "children" OR "school-aged")	635

Screening of retrieved studies followed the PICO model to ensure consistency and precision in study selection:

Population: Children in the deciduous or mixed dentition stages, without any associated syndromic conditions.

Intervention: Investigations addressing speech sound disorders.

Comparison: Research focused on malocclusions.

Outcomes: Studies analyzing how particular malocclusions affect the production of speech sounds.

Detailed inclusion and exclusion parameters are presented in **Table 2**.

Table 2. Inclusion and exclusion criteria

Included Criteria	Excluded Criteria
Research types: case–control, cross-sectional, cohort studies, individual case reports, and case report series	Studies focusing on malocclusion or speech disorder treatments
Publication type: peer-reviewed journal articles with an impact factor or referenced by articles in journals with an impact factor	Studies addressing other health conditions, such as cleft palate, temporomandibular joint issues, juvenile idiopathic arthritis, Down syndrome, etc.
Study population: individuals in primary dentition (up to 6 years) or mixed dentition phases (6–12 years)	Articles classified as reviews or letters to the editor
Focus: studies exploring the relationship between dental misalignment and speech impairments	

To achieve a broad and accurate literature base, all reference lists from the initially identified publications were manually checked for additional relevant studies. No filters were applied regarding publication year or language, and only studies conducted on human participants were considered.

All citations were imported into Rayyan® (accessed on 16 December 2024) to facilitate the management of records and the automatic removal of duplicates. Titles and abstracts were independently reviewed, and the studies that appeared relevant underwent full-text analysis. Two reviewers (MA and AV) conducted the screening independently, while a third reviewer (ES) resolved any disagreements regarding article inclusion to maintain methodological integrity.

For every eligible study, information was extracted and organized into summary tables capturing key details such as authors, publication year, study site, participant numbers, age ranges, study design, and main outcomes. Additionally, each study's malocclusion types and affected phonemes were documented. This systematic approach ensured that the resulting synthesis accurately reflected the scope and quality of the available evidence.

Results

Search details

The database search produced 1880 records in total: 505 from PubMed, 696 from Scopus, 635 from Web of Science, 44 from The Cochrane Library, and 0 from OpenGrey. After eliminating 963 duplicate entries, 46 publications were retained for abstract and title review. Subsequent full-text evaluation resulted in the inclusion of 12 studies that met all established eligibility requirements (**Figure 1**).

An overview of the characteristics of the included studies is presented in **Table 3**. Verification through the Retraction Watch Database confirmed that none of the selected articles had been withdrawn as of the time of writing.

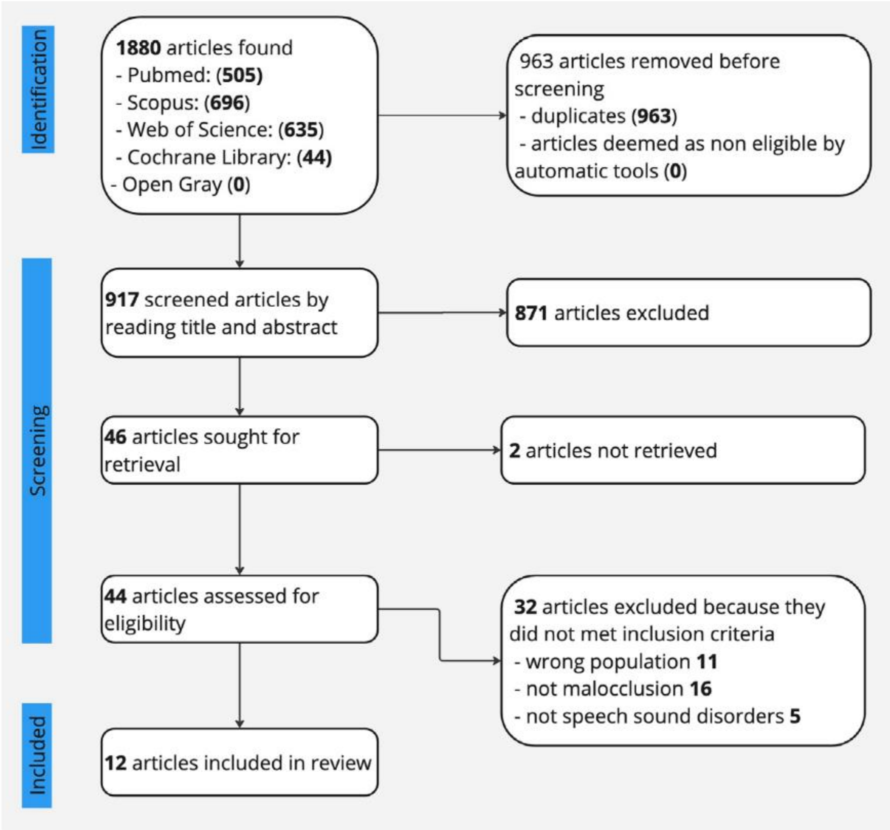

Figure 1. Flow diagram of study selection

Study characteristics

An overview of the research papers incorporated into this review is presented in **Table 3**, which outlines details such as authors, year of publication, geographic location, sample size, participant age, and main outcomes. Every investigation followed a cross-sectional framework, though only three studies employed control groups for comparative analysis [31-33].

In terms of geographical distribution, Brazil accounted for the majority of studies (five in total) [34-38]. Sweden followed with two [32, 33], while Poland [39], Italy [31], the United States [40], Spain [41], and Colombia [42] each contributed one study.

Sample sizes ranged between 69 and 880 participants. Only one study [38] enrolled fewer than 100 children, while five [31, 34, 36, 40, 41] included 200 or more participants. Participants' ages spanned from 3 to 16 years. Most researchers focused on the mixed dentition stage, although two studies [36, 38] limited their analysis to children with deciduous dentition.

Across nearly all papers, children with speech sound disorders (SSDs) showed a higher prevalence and greater severity of malocclusion compared to peers with typical speech development (TSD) [32, 39]. The findings generally support a close association between dental malalignment and SSDs, suggesting that structural discrepancies—particularly those influencing tongue movement—may serve as predisposing factors [31, 34, 39, 41, 42]. Among these, the anterior open bite (AOB) was the most frequent condition linked to tongue thrusting, lip weakness, and lisping on linguo-alveolar sounds [35, 36, 38]. Moreover, participants presenting orofacial dysfunction in conjunction with SSDs exhibited a greater likelihood of having malocclusion [33].

Table 3. Overview of publication data, research settings, participant demographics, and primary findings of the studies included. All utilized a cross-sectional design

Publication	Research Location	Number of Subjects	Age Bracket (Years)	Study Outcomes
Mogren *et al.* [32]	Sweden	105	6–16	Children with articulation difficulties exhibited a greater frequency, diversity, and intensity of tooth alignment issues compared to a reference group with standard speech patterns.

Grudziąż-Sękowska *et al.* [39]	Poland	161	7–10	A robust association was observed between tooth alignment problems and pronunciation challenges, with a higher occurrence of alignment issues in the group with speech difficulties compared to those without.
Assaf *et al.* [34]	Federal University of Santa Maria, Brazil	547	7–13	A link was established between tooth alignment issues and pronunciation difficulties, suggesting that misalignment increases the likelihood of speech issues, particularly when tongue posture is impacted.
Farronato *et al.* [31]	University of Milan Fondazione IRCCS Cà Granda—Ospedale Maggiore Policlinico, Italy	880	6–10	A significant statistical relationship was found between tooth alignment problems and speech pronunciation errors.
Amr-Rey *et al.* [41]	Dentistry and Medicine Faculty, University of Valencia, Spain	290	4–10	A strong connection was identified between tooth alignment issues and speech articulation problems, potentially related to oral habits and muscular changes leading to orofacial issues.
Maciel *et al.* [35]	Federal University of Juiz de Fora—University Hospital, Brazil	130	8–12	A relationship was noted between the causes of anterior open bite, harmful oral behaviors, and specific orofacial dysfunctions, with a connection between past harmful behaviors, tongue positioning during swallowing, and pronunciation difficulties.
Sahad *et al.* [36]	Department of Orthodontics, University of São Paulo City, Brazil	333	3–6	A clear association was found between open bite and anterior lisping or tongue thrust during linguo-alveolar sound production. Deep over-bite was linked to the absence of these speech issues, while normal over-bite or edge-to-edge alignment showed no notable connection to speech sound production.
Farret *et al.* [37]	Federal University of Santa Maria, Brazil	113	9–14	Relationships were identified between tooth alignment issues and pronunciation challenges across all Angle classifications, with particularly pronounced significance in Class III cases.
Wadsworth *et al.* [40]	California State University, USA	200	5–12	No statistically significant connection was found between tooth alignment issues and phoneme dentalization at standard thresholds. However, at a relaxed significance level ($p < 0.05$), a notable association was observed.
Mogren *et al.* [33]	Sweden	105	6–16	Among children with pronunciation difficulties, those with reduced orofacial function were more likely to exhibit tooth alignment problems.
Verrastro *et al.* [38]	University of São Paulo School of Dentistry, Brazil	69	3–5	Anterior open bite was associated with orofacial functional traits, including tongue positioning during swallowing and speech, and inadequate lip closure.
Ocampo-Parra *et al.* [42]	Universidad Cooperativa de Colombia, Colombia	132	8–16	A connection was found between tooth alignment problems and pronunciation difficulties, especially in cases of anterior open bite.

Abbreviations: SSD – Speech Sound Disorder; TSD – Typical Speech Development; AOB – Anterior Open Bite.

Further analyses revealed significant relationships between specific malocclusion types and articulatory distortions, with particularly strong patterns identified in Class II and Class III cases [37]. One paper [40] initially reported no significant link between malocclusion and phoneme distortion, though after refining statistical parameters, a relationship emerged between dental misalignment and phoneme dentalization.

Dento-skeletal characteristics

Because each study evaluated malocclusions and speech sound disorders differently, not all possible conditions were assessed across the literature. **Table 4** lists the malocclusion types examined within each paper.

The anterior open bite (AOB) appeared most frequently, being addressed in ten studies [31-36, 38, 40-42]. Deep bite followed, examined in eight investigations [31-34, 36, 39, 40, 41]. All studies assessing Class II malocclusions also considered Class III [31-34, 37, 39, 40, 41]. Cases involving overjet were analyzed in [31, 34, 36, 40, 41], while edge-to-edge bite was discussed in [31, 34, 40, 41]. Less frequently studied features included Class I malocclusion [31, 34, 37], tooth crowding [32, 39], and scissor bite [31].

Table 4. Distribution of malocclusion types evaluated by each article

Study	Anterior Open Bite	Class I Malocclusion	Class II Malocclusion	Class III Malocclusion	Crossbite	Deep Overbite	Excessive Overjet	Edge-to-Edge Occlusion	Scissors Bite	Tooth Crowding
Mogren *et al.* [32]	x		x	x	x	x				x
Grudziąż-Sękowska *et al.* [39]			x	x	x	x				x
Assaf *et al.* [34]	x	x	x	x	x	x	x	x		
Farronato *et al.* [31]	x	x	x	x	x	x	x	x	x	
Amr-Rey *et al.* [41]	x		x	x	x	x	x	x		
Maciel *et al.* [35]	x									
Sahad *et al.* [36]	x					x	x			
Farret *et al.* [37]		x	x	x						
Wadsworth *et al.* [40]	x		x	x		x	x	x		
Mogren *et al.* [33]	x		x	x	x	x				
Verrastro *et al.* [38]	x									
Ocampo-Parra *et al.* [42]	x									

Abbreviations: AOB – Anterior Open Bite. The mark "x" indicates which conditions were included in each study.

Phonemes and their association with malocclusions

While all selected works explored the relationship between malocclusions and speech sound issues, several [31, 36, 37, 39- 42] performed a more detailed analysis linking specific misalignments to phoneme-level articulation errors.

Table 5 compiles the phonemes evaluated across the literature, specifying the malocclusion types related to each and the studies documenting them. Owing to linguistic variation among study populations, not all phonemes were universally assessed. For example, study [39] uniquely incorporated Polish-specific phonemes absent from other languages. The categorization used throughout this discussion is explained in **Table 6**; the complete classification is available in reference [43].

Table 5. Overview of phonemes affected by each malocclusion type, as reported in the reviewed studies

Sound	Anterior Open Bite	Type I Malocclusion	Type II Malocclusion	Type III Malocclusion	Crossbite	Edge-to-Edge Occlusion
/r/		[37]	[37, 41]	[37, 41]	[37]	[41]
/rr/			[41]	[41]		
/s/	[37,39-42]	[37]	[37, 39, 41]	[37, 40, 41]	[37, 41]	[41]
/z/	[37,39-41]	[37]	[37, 39, 41]	[37, 40, 41]	[37, 41]	[41]

/sh/	[41]					
/zh/	[41]					
/f/	[37, 41]		[41]	[37]	[37,41]	
/v/	[37, 41]			[37]	[37]	
/ch/	[41, 42]		[41]	[41]	[41]	
/ll/						[41]
/th/	[41]					
/t/	[36, 40-42]	[37]	[39]	[37, 39, 40]	[37, 41]	[37, 41]
/d/	[36, 39-42]	[37]	[39, 40]	[37, 39, 40]	[41]	
/n/	[36,39-41]	[37]	[39]	[37, 39]	[41]	
/l/	[36, 41]	[37]	[40]	[37, 40, 41]		[41]
/ɲ/	[41, 42]					
/ʒ/	[37]	[37]	[37]	[37]	[37]	
/ɕ/			[39]	[39]		
/ʑ/			[39]	[39]		
/t͡s/	[39]		[39]	[39]		
/d͡z/	[39]		[39]	[39]		
/t͡ɕ/	[39]		[39]	[39]		
/d͡ʑ/	[39]		[39]	[39]		

Table 6. Glossary outlining the sound categories referenced in the analysis

Sound	Manner of Articulation	Place of Articulation	Acoustic Properties
/r/, /rr/	Vibratory Roll	Tongue-to-Alveolar	Rhotic vibrations
/s/, /z/	Hiss	Tongue-to-Alveolar	Tight airflow restriction at the alveolar ridge producing turbulent sound. High-frequency for sibilants (/s/, /z/, /sh/, /zh/, /ʒ/), lower for non-sibilants
/sh/, /zh/, /ʒ/	Hiss	Behind-Alveolar	
/f/, /v/	Hiss	Lip-to-Teeth	
/ɕ/, /ʑ/	Hiss	Alveolar-to-Palatal	
/th/	Hiss	Tooth-Contact	
/t/, /d/	Stop	Tongue-to-Alveolar	Full closure at the alveolar ridge with a sudden air release
/l/	Side-Flow Approximant	Tongue-to-Alveolar	Quick articulator vibration with air flowing along tongue edges
/ll/	Side-Flow Approximant	Palatal Region	Gentle airflow along tongue sides
/n/	Nasal	Tongue-to-Alveolar	Air directed through the nasal passage
/ch/	Stop-Fricative Blend	Behind-Alveolar	Combines a stop with a subsequent hissing release
/t͡s/, /d͡z/	Stop-Fricative Blend	Tongue-to-Alveolar	
/t͡ɕ/, /d͡ʑ/	Stop-Fricative Blend	Alveolar-to-Palatal	

Across all findings, the AOB consistently emerged as the most influential malocclusion, producing articulation difficulties in several sound groups:

- Sibilants (/s/, /z/, /ch/) [37, 39-42];
- Linguo-alveolars (/t/, /d/, /n/, /l/) [36, 39-42];
- Fricatives and affricates (/f/, /v/, /ʒ/) [37];
- Lateral sounds (/l/, /ll/) [36, 41].

Both Class II and Class III malocclusions produced broadly comparable articulation patterns, with clear links to rhotic distortions (/r/, /rr/) [37, 41], sibilant inaccuracies (/s/, /z/, /ch/) [37, 39, 41], fricative and affricate errors (/f/, /v/, /ʒ/) [37, 41], and lateral misarticulation (/l/) [40]. A distinctive finding was that Class II malocclusions were associated with errors on linguo-alveolar sounds (/t/, /d/, /n/, /l/) in [39, 40], while the same sounds were connected to Class III malocclusion in [37, 39-41].

Although cross-bite appeared in about half of the included studies **(Table 4)**, only two papers [37, 41] reported statistically significant associations with mispronunciation of rhotic, sibilant, fricative/affricate, and linguo-alveolar sounds.

The edge-to-edge bite had the fewest reported phonemic effects. In [41], errors were found in /r/, /s/, /z/, /t/, /l/, whereas [37] observed issues solely with /t/.

Lastly, Polish-specific affricates and fricatives (/ɕ/, /ʑ/, /t͡s/, /d͡z/, /t͡ɕ/, /d͡ʑ/), investigated only in [39], were linked to Class II, Class III, and AOB, except for /ɕ/ and /ʑ/.

Discussion

The evidence gathered through this scoping review highlights a clear and statistically significant relationship between various types of malocclusions and speech sound disorders (SSDs), influencing the articulation of a broad range of phonemes. Among all malocclusions, the anterior open bite (AOB) was the most frequently cited, showing a consistent association not only with SSDs but also with atypical tongue posture, tongue interposition, and tongue-thrust swallowing patterns.

During early childhood, particularly throughout the primary and mixed dentition phases, malocclusions are often observed, with their highest prevalence around three years of age [7, 33, 44]. Such irregularities rarely arise independently; rather, they tend to coexist with multiple environmental and behavioral influences that shape the growth and arrangement of oral structures. Contributing elements include non-nutritive sucking habits (e.g., thumb or pacifier use), mouth breathing, improper tongue rest position, tongue interposition during swallowing, and other parafunctional behaviors. When these patterns persist untreated, they can disrupt the orofacial balance, modifying tooth alignment, jaw morphology, and the interaction of muscular forces [33].

Interestingly, most of these parafunctional behaviors typically diminish naturally toward the end of the mixed dentition period as the child matures physiologically and behaviorally. Correspondingly, malocclusions tend to self-correct only when these adverse habits are simultaneously resolved. However, if such habits persist, the malocclusion may become structurally established and permanent [4, 44-46]. Moreover, sucking behaviors during the primary dentition phase can act as precursors to later occlusal anomalies [7, 44].

Some researchers [36, 47] propose that the form and function of the orofacial system are interdependent: the configuration of oral structures influences functional performance, and functional activities, in turn, can reshape occlusal patterns and craniofacial growth. Within this framework, speech sound disorders might be considered another functional dimension. In agreement with Dimberg's recommendation [7], which discourages orthodontic intervention for primary dentition malocclusions until the mixed phase, an early functional treatment approach—including speech therapy—may help mitigate the future necessity for orthodontic correction. A comparable strategy is advisable for cases involving premature loss of deciduous incisors, since this condition can predispose children to speech articulation difficulties [3].

The scientific literature remains divided on the influence of tongue posture and movement on jaw development. Some authors emphasize the chronic pressure exerted by a misplaced resting tongue as more consequential for jaw formation than transient motions during chewing, swallowing, or speech [44]. Others, however, argue that dynamic muscular forces from articulation and deglutition—though intermittent—have a greater effect on orofacial development [36]. Despite numerous studies establishing correlations between these variables [48-50], the causal pathway linking malocclusion, tongue position, and speech deficits remains unproven [31, 33, 34].

Speech production is a complex motor activity requiring precise coordination of the tongue, lips, teeth, palate, and respiratory system to modulate the airflow generated by the lungs [23, 33]. Speech sounds are classified as vowels or consonants: vowels are produced by vocal cord vibration without any obstruction, whereas consonants arise from articulatory constrictions involving the tongue, lips, teeth, and palate [51]. Consequently, any structural deviation within the orofacial complex may compromise the accuracy of consonant articulation.

Phonemes grouped within the same articulatory category often share similar vulnerability to malocclusal influences. For instance, sibilant sounds (/s/, /z/, /ch/) are produced by positioning the tongue tip near the alveolar ridge behind the upper incisors while maintaining a narrow air channel between the teeth. In the presence of an anterior open bite, this configuration cannot be properly achieved, resulting in impaired airflow control. Leavy *et al.* [52] demonstrated that even a 2 mm open bite can significantly disrupt sibilant production. The interdental placement of the tongue alters airflow direction, producing audible distortions such as lisping. These findings align with both earlier reports [20, 53] and several studies analyzed in this review [37, 39-42].

Similarly, Class II malocclusions may compromise sibilant articulation due to increased overjet and the consequent difficulty achieving lip closure [20, 54-56], a pattern likewise identified in studies reviewed here [37, 39, 41]. In contrast, Class III malocclusions tend to affect sibilant articulation through a posteriorly positioned tongue and low resting posture, as documented in previous investigations [20, 57] and confirmed by the current review [37, 40, 41]. Some individuals, however, compensate through adaptive tongue placements [22] or modified mandibular movements [21], while others show more pronounced speech distortion. Recognizing these individualized compensatory adaptations can inform targeted therapeutic planning.

Despite minor inconsistencies among studies—likely resulting from differences in phoneme selection or malocclusion types analyzed—the reported articulatory distortions affecting sibilant sounds were largely analogous to those observed for /t/, /d/, and /n/ in the included studies [36, 37,39-42]. The similarity arises because these linguo-alveolar phonemes require the tongue tip to fully contact the alveolar ridge, momentarily halting airflow. Consequently, open bites, excessive overjet, and low tongue posture can all adversely affect their articulation.

Only a subset of the studies reviewed identified the specific phonemes affected by each malocclusion category. Overall, the influence of anterior open bite (AOB) and Class II and Class III malocclusions on phonemes such as /s/, /z/, /ch/, /t/, /d/, and /n/ was consistently evident. Children exhibiting these occlusal patterns were statistically more prone to articulatory distortions. Findings from Mogren [32, 33] and Farronato [31] converge on the view that AOB and Class III malocclusions interfere with speech to a greater extent than Class II. In contrast, Sahad [36] reported comparable effects between Class II and Class III, with AOB producing less disruption than in other investigations discussed here.

Although none of the studies systematically compared phonemic variation across languages, the summary in **Table 5** indicates that the same core group of phonemes—/s/, /z/, /t/, /d/, and /n/—was most frequently compromised in English [40], Spanish [41], Portuguese [37], and Polish [39] speakers. This pattern supports the observation made by Amr-Rey [41], suggesting that these sounds are universally sensitive to certain structural deviations of the dentition.

To isolate the role of malocclusion, this review purposely excluded subjects with syndromic conditions or neurodevelopmental disorders that could independently affect speech—such as Down syndrome, cleft palate, or temporomandibular joint abnormalities. Eliminating these variables strengthens the inference that occlusal anomalies contribute to speech sound disorders (SSDs) rather than resulting from them. Nonetheless, literature remains divided, as the interplay between morphology, neuromuscular function, and environmental influences is highly complex and not yet fully delineated.

Despite its breadth, several limitations should be noted:

• The included papers varied widely in the depth of analysis devoted to the SSD–malocclusion connection;
• A strong focus on AOB resulted in under-representation of other occlusal types;
• The multilingual composition of participants introduced potential bias, since phoneme realization differs between languages;
• Being a scoping review, no formal quality appraisal was conducted, and study heterogeneity was substantial.

These methodological inconsistencies emphasize the importance of long-term prospective studies to trace how malocclusions arise and progress from childhood into adolescence, and to clarify whether they precede or follow the onset of SSDs.

Some forms of malocclusion remain under-investigated in this context. For example, lateral crossbite has been linked in several reports [20, 41, 46, 58] to altered articulation, possibly due to a low resting tongue posture, yet more rigorous research is required to define this relationship.

Across all selected publications, a shared conclusion emerges: speech sound disorders have a multifactorial origin and demand collaborative clinical management. Cenzato *et al.* [59], in their review of open bite and atypical swallowing, emphasized that combined orthodontic intervention with myofunctional and speech therapy yields the most successful outcomes.

Conclusions

Evidence from the available literature consistently demonstrates a strong association between malocclusions and speech sound disorders, a finding reaffirmed by every study assessed in this review.

Key points derived from this synthesis include:

• The anterior open bite is both common and highly influential in disturbing the production of multiple phonemes.
• Class II and Class III malocclusions exert comparable effects, approximating those produced by AOB.
• The phonemes most often distorted—/r/, /s/, /z/, /ch/, /f/, /d/, /t/, /n/, /l/, and /ʒ/—highlight the persistent, wide-ranging correlation between occlusal discrepancies and articulation difficulties.

The directionality of this relationship, however, remains uncertain. Future longitudinal investigations are necessary to determine whether malocclusions initiate SSDs or if speech anomalies contribute to occlusal imbalance. The evidence so far suggests a reciprocal interaction, where each condition may intensify the other. Consequently, an integrated therapeutic approach that unites orthodontic, myofunctional, and speech-language disciplines is recommended to achieve optimal corrective and preventive outcomes.

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