
Speech Disorder in Anterior Open Bite (AOB): Systematic Review

Speech Disorder pada *Anterior Open Bite* (AOB): *Systematic Review*

Nendika Dyah Ayu Murika Sari^{1,2}, Rinaldi Budi Utomo²

Department of Pediatric Dentistry,

¹Faculty of Dentistry, Universitas Muhammadiyah Surakarta
Kota Surakarta, Jawa Tengah – 57141, Indonesia

²Faculty of Dentistry, Universitas Gadjah Mada
Bulaksumur, Yogyakarta – 55281, Indonesia

E-mail: nendika.dyahayu@ums.ac.id, nendika.dyah.ayu@mail.ugm.ac.id

Abstract

There have been numerous researches showing that articulation disorders and malocclusion are linked. The most prevalent malocclusion in speech or articulation disorders is anterior open bite (AOB). Excessive propulsion of the tongue forward when articulating phonemes causes altered articulation in patients with open bites, as the tongue is in a more forward posture. The presence of this speech disorder can have a negative impact on a person's quality of life, although there hasn't been much research done on the impacts of AOB in cases of speech disorders in children. This study was to look at the link between speech disorders and the occurrence of anterior open bites (AOB) in a comprehensive way. Search results of research on four databases, namely ScienDirect, PubMed, Springerlink, and Google Scholar, are displayed. The keywords used include speech disorder, articulation disorder, open bite, anterior open bite. Five articles were selected using case control and cross-sectional methods in their research. The sample with AOB in this study was analyzed to determine the presence of speech disorders. The five articles gave similar results, showing that patients with malocclusion, especially AOB, had a tendency to have speech disorders. Articulation disorders in the phoneme /s/z/d/l/v/ become the dominant problem experienced by patients with AOB. Anterior open bite (AOB) is a form of malocclusion that causes more articulation disorders than other malocclusions. The presence and position of the tongue are thought to have a substantial influence on articulation disorders.

Keywords: Anterior open bite; articulation disorder; speech disorder

Abstrak

Penelitian telah banyak dilakukan dan menyatakan bahwa gangguan artikulasi dan maloklusi memiliki kaitan yang erat. *Anterior open bite* (AOB) menjadi maloklusi yang paling umum dikaitkan dengan gangguan bicara/artikulasi (*speech disorder*). Artikulasi yang berubah pada pasien dengan *open bite* disebabkan oleh dorongan lidah ke depan yang berlebihan saat mengartikulasikan fonem, karena posisi lidah lebih rendah. Adanya gangguan bicara ini dapat memberikan dampak negatif pada perkembangan dan kualitas hidup seseorang, namun hingga belum banyak tinjauan literatur yang khusus membahas efek AOB pada kasus *speech disorder* pada anak. Untuk melaporkan secara integratif tentang hubungan *speech disorder* dengan kejadian *anterior open bite* (AOB). Pencarian hasil penelitian pada 4 database yaitu ScienDirect, PubMed, Springerlink dan Google Scholar. Kata kunci yang digunakan meliputi *speech disorder*, *articulation disorder*, *open bite*, *anterior open bite*. Lima artikel yang terseleksi menggunakan metode *case control* dan *cross sectional* dalam penelitiannya. Sampel dengan AOB pada penelitian tersebut dilakukan analisis untuk mengetahui adanya gangguan bicara. Kelima artikel tersebut memberikan hasil yang tidak jauh berbeda diResearchmana pada pasien kasus maloklusi terutamanya AOB memiliki kecenderungan mengalami gangguan bicara. Gangguan artikulasi pada fonem /s/z/d/l/v/ menjadi masalah dominan yang dialami pasien dengan AOB. *Anterior open bite* (AOB) dilaporkan sebagai maloklusi dengan gangguan artikulasi yang lebih besar dibandingkan jenis maloklusi lain. Gangguan artikulasi yang terjadi diduga kuat dipengaruhi keberadaan dan posisi lidah

Kata kunci: *Anterior open bite*; *articulation disorder*; *speech disorder*

INTRODUCTION

The anterior open bite (AOB) and the posterior open bite (POB) are the most prevalent malocclusions in primary and mixed dentition.¹ Depending on the population type used in each study, the global prevalence of AOB ranges from 6.2 percent to 50 percent.² According to Kasparaviciene et al., (2014) AOB is found in 17–18% of children with mixed dentition.³ Heredity, congenital skeletal problems, and other factors connected to habits such as thumb sucking, mouth breathing, and the tendency to pull the tongue forward all contribute to the etiology of this malocclusion.^{4,5}

An anterior open bite (AOB) is the absence of anterior teeth contact when the posterior teeth make contact. Malocclusions such as anterior open bite (AOB) are often associated with orofacial dysfunction.^{5–7} The presence of an intrinsic vertical gap that occurs due to the absence of anterior contact can cause difficulty in biting, chewing, and articulating during speech. Many studies have been carried out and state that articulation disorders and malocclusion are closely related because 80% of the pronunciation of certain letters when speaking is done in the anterior part of the mouth. AOB is the most common malocclusion associated with speech and articulation disorders.^{8,9} Fimbo (cited in Ocampo-Parra) evaluated 410 patients with AOB and found that 63% of them had speech disorders. Meanwhile, Bernstein (cited in Ocampo-Parra) examined 437 children with speech disorders and found that malocclusion was not always associated with phonation problems, except in the case of AOB.¹⁰ The AOB relationship was significantly associated with impaired pronunciation of the phonemes /s/, /z/, /th/, /d/, /l/, /f/, /v/. Altered articulation in patients with open bites is caused by excessive propulsion of the tongue forward when articulating the sound because the tongue position is lower than in normal patients (without open bite).¹¹ A survey that has been conducted found that 66% of educators consider a speech/communication disorder to have a negative impact on educational development and a person's quality of life.^{12,13}

Considering the literature discussed, it was found that there was a relationship between the occurrence of speech disorders and the incidence of AOB, but as far as observations have not been widely reviewed, there are not many literature reviews that specifically discuss the effect of AOB on speech disorders in children. The purpose of this study was to report integratively on the relationship between speech dis-

orders and the incidence of anterior open bite (AOB).

MATERIALS AND METHODS

This study used a systematic review method by searching for research results on four databases, namely ScienceDirect, PubMed, Spinger-link, and Google Scholar. The keywords or terms used in this search were in English and include: speech disorder, articulation disorder, open bite, anterior open bite. Articles were chosen based on the following criteria: research with a cross-sectional research design, case control, case report, not a review, letters of editor, children aged less than 18 years without special needs, and articles published between January 2012 and January 2022. Fifty two (52) articles in total were identified through these keyword searches. Then delete the articles that were repeated or duplicated, as many as 10 articles. Next, the articles were selected based on their content, legitimacy level, and can be accessed in full text. The total number of articles used in this study were 5, with the completion flowchart presented in Figure 1.

RESULTS

This review used the results of studies from various countries regarding the relationship between anterior open bite and the occurrence of speech disorders. 52 articles found through 4 databases, 5 research articles were selected for review. Most characteristics from the 5 selected articles used a case control design (60%) and the others used a cross-sectional design. The region or country where the research was conducted come from the America, Europe, and Africa. Countries from Asia and Australia rarely found studies on speech disturbances in anterior open bite.

The patient characteristics used in these studies ranged from 3 years old to 16 years of age. The sex proportion was found to be predominantly female. The results of the study were carried out by comparing the measurement of speech disturbances that occurred in the sample with an anterior open bite. The characteristics of the articles used in this review were presented in table 1.

Based on those studies, all studies found a significant relationship between speech disorders and the incidence of anterior open bite (AOB). However, the

types of speech disorders obtained were different in these studies.

DISCUSSIONS

This review aimed to explore the relationship between speech disorders and the incidence of anterior open bite (AOB). In Several articles that had been collected, it had been found that patients with AOB tend to experience speech disorders more often. Speech pathology is related to speech disorders in articulation, rhythm, sound, and language. Articulation disorders are indicated by distortion, omission, submission, or addition of inappropriate consonants and vowels in pronunciation.^{14,15} Several factors affect a person's articulation, namely the presence and position of teeth, mobility of the lips, cheeks, soft palate, tongue, and mandible, intraoral space for articulation, and sound resonance. In addition, deviations in the functions of chewing, swallowing, and breathing are also associated with speech disorders. The position of the anterior teeth is also one of the main factors that changes the articulation of sounds because almost 90% of consonant sounds are formed in this area.^{8,16,17}

The dental arches (dental and bony arches) serve as structural boundaries of the tongue and lips, which are inherently involved in the production of sound during speech. The study conducted by Leavy et al. (2016) found that individuals with anterior open bite (AOB) experienced the most disturbances in the pronuncial-types of malocclusion.¹⁸ The results of the study by Ocampo-Parra et al. (2015) were in accordance with previous researchers who showed that phoneme disturbances were strongly associated with AOB.¹⁰ However, other studies suggest that not only was AOB associated with phonation problems but also other types of malocclusion. This is in line with Sahad's finding that there was a significant relationship between AOB and the pronunciation of the phoneme /s/z/d/l/ despite the age difference between that study and the current study.¹⁹

Research conducted by Kravanja et al. (2018) found that as many as 84.4% of patients with AOB had articulation disorders, where the most frequently detected articulation disorders were sigmatism and rhotacism.⁹ This articulation disorder is often associated with tongue conditions in AOB patients. In addition to the known risk factors (prolonged bottle feeding, finger sucking), the posture of the tongue resting on the floor of the mouth plays a role in the development of AOB.¹⁴ 81.3% of AOB patients showed signs of improper tongue posture on the floor of the mouth.⁹ In line with this, Assaf (2021) found

that patients with AOB showed 2.3 times more frequency of changing tongue position.⁸ Aberrant tongue function associated with speech impairment in which the association between AOB and abnormal swallowing was reported as high as 75%.¹⁹ The position of the tongue resting on the floor of the mouth when activated can alter tooth position and jaw growth including the shape and size of the arch.²⁰

Patients with AOB have a variety of anatomical characteristics that can modify the interaction between the tongue and the lips, teeth, palate, rugae, and oropharynx where any modification of this interaction can interfere with articulation.¹⁹ Patients with open bites have lisping problems, namely speech disorders characterized by the inability to pronounce /s/ and /z/ sounds correctly, known as hissing consonants. In addition, difficulties are also experienced in producing linguo-alveolar consonants like /t/, /d/, /n/, and /l/.^{10,14,20} This disorder occurs due to the excessive thrust of the tongue forward when articulating the sound /s/, due to the lower position of the tongue.¹¹ Patients with an open bite will produce /s/ and /z/ sounds with the tip of the tongue touching the anterior maxilla.^{11,14} Lips also play an important role in the formation of pronunciation. Patients with AOB often find proclination of incisors and incompetent lips. As a result, patients will find it difficult to close their lips and achieve normal bilabial consonants. Lower lip pressure also plays a role in phonational changes. Weak lip pressure on anterior teeth causes a large vestibular inclination that can worsen AOB.^{9,19,20}

The relationship between the severity of AOB and the severity of speech/articulation disorders is still a matter of debate. According to Ocampo-Parra et al., differences in the severity of AOB do not significantly affect differences in articulation disorders.¹⁰ Other findings suggest that there are differences in the severity of AOB with those of articulation disorders.¹³ According to Farronato, the severity of the dyslalia type of articulation disorder increased in line with the increase in the degree of malocclusion.¹¹ This contradicts Botero's findings that there was no difference in the severity of dyslalia in mild, moderate, and severe AOB.²⁰ Special conditions such as Down Syndrome and AOB were found to be more common in Down Syndrome patients, but interesting findings were that there was no significant difference in speech disorders between Down Syndrome patients who had AOB and normal patients who had AOB. In Down syndrome patients who have AOB, the most common articulation error is the substitution of simple consonants when the affected phoneme is in the initial and middle positions of the word.¹⁶

To be able to diagnose speech disorders, a deeper analysis must be carried out relating to (1) morphology, tongue position and movement, (2) lip morphology and movement, (3) mouth-face skeleton and occlusion, and (4) speech motor control and sound production.^{14,16} There are several techniques and tools used to analyze the speech test, but there is no specific protocol in the analysis related to the differences in the subjects to be tested so that the results obtained allow this to happen.

In conclusion, based on the results of this article review, it can be confirmed that malocclusion is related to phonetic problems. Anterior open bite (AOB) is identified as a type of malocclusion with more articulation impairment than other types of malocclusion. Articulation disorders that occur are strongly sus-

pected to be influenced by the presence and position of the tongue, but differences in language in the research area can affect the results of the study because differences in phoneme production can occur in different types of language. Further research is also needed to determine whether AOB causes speech and articulation disorders or whether the presence of speech and articulation disorders cause AOB.

ACKNOWLEDGEMENTS

This paper would not have been possible without the support of supervisors, lecturers, friends, and staff at the Department of Pediatric Dentistry, Universitas Gadjah Mada, and friends at Universitas Muhammadiyah Surakarta.

TABLES

Table 1. Search Results for Articles and Journals

| Author | Research location | Research design | Sample quantity | Result |
|--|--------------------|-----------------|---|---|
| Deng M-Z et al (research-report) | East African | Case Control | <ul style="list-style-type: none"> • 10 (age 9-12 years old) • 5 samples of AOB • 5 control sample | The group with AOB had difficulty with sound production compared to the control group. Inadequate muscle activity in the speech intelligibility test was identified in the AOB group. The AOB group tended to have limitations in the articulation and speech impairment. |
| Lopez-Perez, Borgez-Yanez, Lopez-Morales (09200) | Mexico | Case control | <ul style="list-style-type: none"> • 114 (age 3-15 years old) • Devided in 2 groups, 57 Down Syndrome children and 57 children without disability | The results of the speech error measurement in both groups obtained significant results. However, there was no significant difference in speech errors between the Down Syndrome group with AOB and the control group with AOB. |
| Kravanja S, L et al (raon) | Slovenia | Cross sectional | <ul style="list-style-type: none"> • 446 (age 3-7 years old) • 32 children with AOB • 414 children without AOB | There were 32 samples with AOB, where as many as 84.4% had articulation disorders. |
| Ocampo-Parra et al | Envigado, Colombia | Cross sectional | 132 (age 8-16 years old) | As many as 77.8% of AOB experienced changes in phonation when speaking where the most common abnormality was dyslalia distortion (75.8%) . |
| Botero-Mariaca et al | Colombia | Case control | <ul style="list-style-type: none"> • 264 (age 8-16 years old) • 132 children with AOB • 132 with normal occlusion (control) | As many as 39.8% of children with AOB experienced distortions in pronunciation. Pronunciation distortion is a risk factor for AOB |

FIGURES

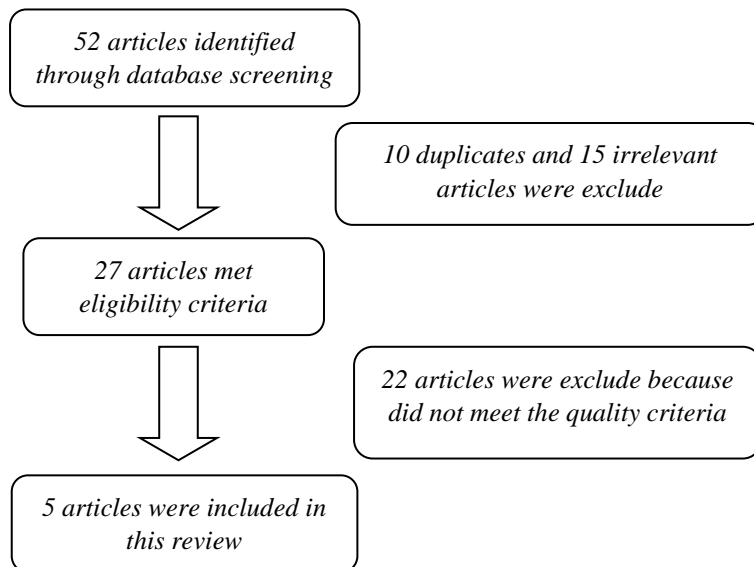


Figure 1. Articles result

REFERENCES

1. Rosa M, Quinzi V, Marzo G. Paediatric Orthodontics Part 1: Anterior open bite in the mixed dentition. *Eur J Paediatr Dent*. 2019; 20(1): 80–2.
2. Jabri M Al, Guo S, Ma J, Wang L. Anterior open bite and its management in orthodontics: A systemic re-view. *IOSR J Dent Med Sci*. 2018; 17(6): 49–54.
3. Kasparaviciene K, Sidlauskas A, Zasciurinskiene E, Vasiliauskas A, Juodzbalsys G, Sidlauskas M, et al. The prevalence of malocclusion and oral habits among 5-7-year-old children. *Med Sci Monit*. 2014; 20: 2036–42.
4. Abdul WM, Chandra P, Kulshrestha R, Singh K, Ras-togi R, Umale V. Open bite malocclusion: An over-view. *J Oral Heal Craniofac Sci*. 2018; (June): 011–20.
5. Van Dyck C, Dekeyser A, Vantricht E, Manders E, Goeleven A, Fieuws S, et al. The effect of orofacial myofunctional treatment in children with anterior open bite and tongue dysfunction: A pilot study. *Eur J Orthod*. 2016; 38(3): 227–34.
6. Dean JA, Vinson LAW. McDonald and Avery's dent-istry for the child and adolescent. 10th ed., St. Louis: Elsevier, 2016.
7. Cameron AC, Widmer RP. Handbook of pediatric dentistry. Philadelphia: Elsevier, 2013.
8. Assaf DDC, Knorst JK, Busanello-Stella AR, Ferrazzo VA, Berwig LC, Ardenghi TM, et al. Association between malocclusion, tongue position and speech distortion in mixed-dentition school chil-dren: An epidemiological study. *J Appl Oral Sci* 2021; 29: 1–11.
9. Kravanja SL, Hocevar-Boltezar I, Music MM, Jarc A, Verdenik I, Ovsenik M. Three-dimensional ultra-sound evaluation of tongue posture and its impact on articulation disorders in preschool children with ante-rior open bite. *Radiol Oncol* 2018; 52(3): 250–6.
10. Ocampo-Parra A, Escobar-Toro B, Sierra-Alzate V, Rueda ZV, Lema MC. Prevalence of dyslalias in 8 to 16 year-old students with anterior open bite in the mu-nicipality of Envigado, Colombia. *BMC Oral Health* 2015; 15(1): 1–6.
11. Farronato G, Giannini L, Riva R, Galbiati G, Maspero C. Correlations between malocclusions and dyslalias. *Eur J Paediatr Dent*. 2012; 13(1): 13–8.
12. Hitchcock ER, Harel D, Byun TM. Social, emotional, and academic impact of residual speech errors in school-age children: A survey study. *Physiol Behav*. 2017; 176(3): 139–48.
13. Lathrop-Marshall H, Keyser MMB, Jhingree S, Giduz N, Bocklage C, Couldwell S, et al. Ortho-gnathic speech pathology: impacts of Class III maloc-clusion on speech. *Eur J Orthod*. 2022; 44(3): 340-51

14. Harini R. Speech And Malocclusion-A Review. *Eur J Mol Clin Med.* 2020; 07(08): 1815–8.
15. Nowak AJ, Casamassimo PS, McTigue DJ, Fields HW. *Pediatric dentistry: Infancy through adolescence.* 5th ed., India: Elsevier, 2013: 28–34.
16. López-Pérez R, Borges-Yáñez SA, López-Morales P. Anterior open bite and speech disorders in children with Down Syndrome. *Angle Orthod* 2008; 78(2): 221–7.
17. Millett D, Day P, Campbell C, Hosey MT. *Clinical problem solving in Orthodontics and Paediatric Dentistry.* 3rd Ed., Churchill Livingstone: Elsevier, 2017: 81–7.
18. Leavy KM, Cisneros GJ, LeBlanc EM. Malocclusion and its relationship to speech sound production: Redefining the effect of malocclusal traits on sound production. *Am J Orthod Dentofac Orthop* 2016; 150(1): 116–23.
19. Meng-Zhao D, Daniel F L, Greg J H, Zhi-He Z, Zi-Jun L. Craniofacial, Tongue, and Speech Characteristics in Anterior Open Bite Patients of East African Ethnicity. *Int Arch Oral Maxillofac Surg* 2019; 3(1): 1–13.
20. Botero-Mariaca P, Sierra-Alzate V, Rueda ZV, Gonzalez D. Lingual function in children with anterior open bite: A case-control study. *Int Orthod* 2018; 16(4): 733–43