# THE EFFECT OF MALOCCLUSION ON SPEECH DISORDERS:

# A LITERATURE REVIEW

**THESIS**

Submitted to Complete One of the Requirements for

Achieving a Bachelor's Degree in Dentistry

**AURA MAUDINA MAHMUD**

**J011191087**

**DEPARTMENT OF ORTHODONTIC**

**FACULTY OF DENTISTRY**

**HASANUDDIN UNIVERSITY**

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**LEMBAR PENGESAHAN**

**Judul** : **The Effect of Malocclusion on Speech Disorders**

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**Telah diperiksa dan disahkan**

**Pada tanggal, 28 Oktober 2022**

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## KATA PENGANTAR

Segala Puji bagi Allah SWT yang telah melimpahkan hidayah, rahmat dan karunia-Nya, sehingga penulis dapat menyelesaikan skripsi yang berjudul "The Effect of Malocclusion on Speech Disorders" sebagai tugas akhir dan menjadi salah satu syarat untuk mendapatkan gelar Sarjana Kedokteran Gigi (S.KG) pada program studi Pendidikan Dokter Gigi, Fakultas Kedokteran Gigi, Universitas Hasanuddin. Sholawat dan salam tidak lupa penulis curahkan kepada Rasulullah Muhammad SAW yang telah menjadi suri tauladan terbaik sepanjang masa.

Selama penulisan skripsi ini, tentu saja penulis mendapatkan hambatan dan rintangan namun penulis tidak menyerah karena telah mendapatkan banyak bimbingan dan bantuan serta dukungan dari berbagai pihak untuk menyelesaikan skripsi ini. Oleh karena itu, pada kesempatan ini penulis dengan rasa hormat dan tulus ingin mengucapkan terima kasih sebesar-besarnya kepada semua pihak yang terlibat, terutama kepada yang saya hormati:

1. **Prof. drg. Edy Machmud, Sp.Pros (K)** selaku Dekan Fakultas Kedokteran Gigi Universitas Hasanuddin.
2. **drg. Rika Damayanti Syarif, M.Kes** selaku dosen pembimbing skripsi yang telah bersedia meluangkan waktu untuk membumbinga, mengarahkan, dan memberikan nasihat serta dukungan yang sangat bermanfaat dalam menyelesaikan skripsi ini.
3. **Prof. drg. Mansjur Natsir, Ph.D** dan juga **drg. Karima Qurnia Mansjur, Ph.D**. selaku penguji skripsi yang telah memberikan banyak saran dan masukan pada seminar proposal hingga seminar akhir skripsi ini.
4. **Prof. Dr. A. Mardiana Adam, MS** selaku Penasihat Akademik yang senantiasa memberikan motivasi, nasihat dan bimbingan selama perkulihan.
5. Orang tua tercinta Ayahanda **Mahmud La Kaiya** dan Ibunda **Masliati** atas segala doa dan dukungan yang tiada hentinya sampai detik ini bahkan seterusnya, dan juga selalu memotivasi serta memberi semangat kepada penulis dalam menyelesaikan skripsi dan selama pendidikan.

6. Adik-adik tercinta **Ainun, Muti, Acul, Ayus** yang juga senantiasa berdoa, memberi dukungan, motivasi dan hiburan kepada penulis.
7. Seluruh **dosen pengajar** dan **staf akademik,** serta **staf perpustakaan** yang telah banyak membantu penulis selama pendidikan.
8. Teman-teman seperjuangan dari maba dan InsyaaAllah sampai drg bahkan setelah pendidikan, **Dara, Aya, Anggi, Lany, Zahra** yang senantiasa menemani, membantu, mendukung, tempat curcol selama perkuliahan dan penyelesaian skripsi ini.
9. Teman-teman seperjuangan di masa sekolah menengah **Salbem, Dewi, Dhini, Ainul, Anggie, Nurul** yang selalu memberi doa dan semangat kepada penulis.
10. Seluruh teman-teman **ALVEOLAR 2019** yang telah menjadi teman seperjuangan di FKG Unhas.
11. Seluruh pihak lainnya yang tidak bisa disebutkan satu-persatu.

Akhir kata dengan segenap kerendahan hati, sekali lagi penulis mengucapkan terima kasih, semoga Allah SWT memberikan balasan dan keberkahan kepada pihak yang terlibat dalam membantu penulis dalam proses dan penyelesaian skripsi ini. Penulis berharap skripsi ini dapat memberikan informasi yang bermanfaat bagi pembaca khususnya dalam bidang ortodonti kedokteran gigi.

Makassar, 28 Oktober 2022

Penulis,

## ABSTRACT

## THE EFFECT OF MALOCCLUSION ON SPEECH DISORDERS



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**Background:** Malocclusion is 3rd rank after caries and periodontal disease as dental and oral health problems in Indonesia. Adolescence is found as the highest incidence of malocclusion. The etiology of malocclusion is divided into general factors and local factors. Malocclusion is not a disease however if not treated malocclusion can affect the patient's periodontal tissue, social life mastication, swallowing, and even speech function. The balance theory explained that there is a relationship between malocclusion and tongue position because regular teeth can help balance the strength of the tongue and the labio-buccal muscle, which is an essential factor during the speech process. Laine in 1992 confirmed that speech abnormalities are more prone to occur in Class III malocclusion with anterior crossbite than in Class I with anterior open bite. Meanwhile, Subtelny in 1964 and Suzuky in 1993 concluded that articulation errors only could be detected in patients with an open bite and skeletal class II. The more significant the open bite, the more severe the articulation error. **Purpose:** To determine the effect of malocclusion on speech disorders and to find out the types of malocclusions that can affect speech disorders as well as the relationship between the severity of malocclusion and speech disorders. **Method:** Collect literature from search engines such as PubMed, Science Direct, and SciElo which discuss the effect of malocclusion on speech disorders. **Result:** There are eight kinds of literature relevant to the topic. **Conclusion:** From all literature, it can be concluded that malocclusion can affect speech disorders, especially articulation disorders, the most common type of malocclusion in speech disorder is open bite and crossbite, the changed phonemes are s, n, l, t, d, ch, z, f, v, not all cases show the effect of severity speech disorders depending the severity of malocclusion due to adaptation to the tongue.



**Keywords:** malocclusion, speech disorders, speech problems, speech distortions

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background

Indonesia still has oral and dental health problems, which are quite high. Based on the Riset Kesehatan Dasar (Riskesdas) results in 2018, Indonesia's dental and oral health problems were 57.6%, and only 10.2% received services from dental health workers. Malocclusion is one of Indonesia's dental and oral health problems, 3rd rank after dental caries and periodontal disease.[1] The prevalence of malocclusion in Indonesia is around 80% of the total population.[2] According to several researchers in the orthodontic field, the highest incidence of malocclusion was found in adolescents. The prevalence of malocclusion in adolescents in Indonesia was 90% in 1983 and 89% in 2006.[1]

Malocclusion is a condition of abnormal occlusion or dental relations that can interfere with the oral functional system. It affects the physical and emotional health of the patient and requires treatment.[2,3] The causes of malocclusion in children, are bad habits such as finger sucking, breathing through the mouth, sucking and biting the lips, advancing the jaw forward, pushing the tongue, biting nails, and bruxism. Other factors that cause malocclusion are genetics, trauma, and premature loss of deciduous teeth.[4] Malocclusion can affect the patient's periodontal tissue, social life, mastication, swallowing, and even speech function.[5]

Speech is an essential thing in everyday life. By speech, we can convey and channel the contents of our thoughts and feelings about things both concrete and abstract to other humans. Therefore, speech is one aspect of language skills that humans must master. People who listen to us can understand and digest what we say if we have good speaking skills. In general, speech is an ability that grows naturally. As humans age, their ability to speak and communicate also increases. Starting from muttering as a baby to saying a word and then a few sentences and narration as an adult.[6]

In today's era, there are many cases of language disorders or disorders, one of which is speech disorders. At the age of toddlers, it is considered normal.

However, many parents just realize their children suffer from speech disorders. Speech disorders consist of articulation, voice, fluency (stuttering), aphasia (difficulty using words, usually brain injury), and speech delays. Speech disorders are also related to oral muscle function and hearing function.[1] The causes of speech disorders consist of medical factors (brain injury, prenatal trauma), physiological conditions (impaired speech organs, nervous system, auditory system), and environmental conditions.[6]

The balance theory explains that there is a relationship between malocclusion and tongue position because regular teeth can help balance the strength of the tongue and the labio-buccal muscle, which is an essential factor during the speech process.[7]

Laine in 1992 confirmed that speech abnormalities are more prone to occur in Class III malocclusion with anterior crossbite than in Class I with anterior open bite.[8] Meanwhile, Subtelny in 1964 and Suzuky in 1993 concluded that articulation errors only could be detected in patients with an open bite and skeletal class II.[9,10] The more significant the open bite, the more severe the articulation error.

Based on the explanation above, the author is interested in understanding and investigating the effect of malocclusion on speech disorders.

## 1.2 Problem Statement

What are the effects of malocclusion on speech disorders?

## 1.3 Objective

1. To determine the effect of malocclusion on speech disorders
2. To find out what types of malocclusions can affect speech disorders
3. To find out the relationship between the severity of malocclusion and speech disorder

## 1.4 Benefits

### 1.4.1 Theoretical Benefits

This literature review is expected to be a reference for a source of scientific information for dental students and researchers to determine the effect of malocclusion on speech disorders.

### 1.4.2 Clinical Benefits

This literature review is expected to be material to increase knowledge and skills for dental students to prevent the formation of malocclusion accompanied by speech disorders through patient education and provide awareness to dentists so that they can detect speech disorders early in patients with malocclusion.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Malocclusion

### 2.1.1 Definition of Malocclusion

According to the World Health Organization (WHO), malocclusion is a disability or functional disorder that can be an obstacle to the physical and emotional health of patients who need treatment. Malocclusion is an occlusion that deviates from the normal state of the relationship between the maxilla and the mandible. There is tooth irregularity or incorrect placement of the arch of the tooth from the normal. This condition is not a disease, but if not prevented and treated, it will interfere with the system in the oral cavity which can cause abnormalities in the function of sanctification, neglect, speech and facial compatibility, and aesthetics that disturb the physical and mental sufferer. [5]

### 2.1.2 Etiology of Malocclusion

There are various classifications of the etiology of malocclusion. But Graber's classification presented a very comprehensive variety and detail, making it easy to understand. Graber divided the etiologic factors into general or local factors.

a. General Factors
    1) Hereditary
    2) Congenital
    3) Environment
        - Prenatal: trauma, maternal diet and metabolism, German measles.
        - Postnatal: birth injury, cerebral palsy, TMJ injury
    4) Predisposing metabolic climate and disease such as endocrine imbalance, metabolic disturbances, and infectious disease
    5) Dietary problems or nutritional deficiency

6) Abnormal pressure habits and functional aberrations such as abnormal sucking, thumb and finger sucking, tongue thrust and tongue sucking, lip and nail-biting, irregular swallowing habits, speech defects, mouth breathing, tonsils and adenoid, as well as psychogenetic and bruxism
7) Posture
8) Trauma and accidents

b. Local Factors
1) Anomalies of the number
2) Anomalies of tooth size
3) Anomalies of tooth shape
4) Abnormal labial frenum
5) Premature loss
6) Prolonged retention
7) Delayed eruption of permanent teeth
8) Abnormal eruptive path
9) Ankylosis
10) Dental caries
11) Improper dental restoration[11]

### 2.1.3 Classification of Malocclusion

a. Angle's Classification (1899)

This classification is considered simple and easy to learn as well as understand.

1) Class I

The mesiobuccal cusp of the maxillary first permanent molar is in the mesiobuccal groove of the mandibular first permanent molar during occlusion, as shown in figure 2.1 a.

2) Class II

The position of the mesiobuccal cusp of the maxillary first permanent molar is mesial to the mesiobuccal groove of mandibular first molars or in the interdental of the mandibular second premolar and first permanent molar during occlusion.

- Division 1: maxillary incisors are inclined labially, and increased overjet is present, as shown in figure 2.1 b.
- Division 2: maxillary central incisors are inclined lingually, and maxillary lateral incisors have tipped labially and mesially, covering the distal of central incisors, as shown in figure 2.1 c.
- Subdivision: based on unilateral presence

3) Class III

The mesiobuccal cusp of the maxillary first permanent molar is distal to the mesiobuccal groove of mandibular first molars, or it is in the distobuccal developmental groove of the mandibular first permanent molar, as shown in figure 2.1 d.

- Subdivision: based on unilateral presence[12]

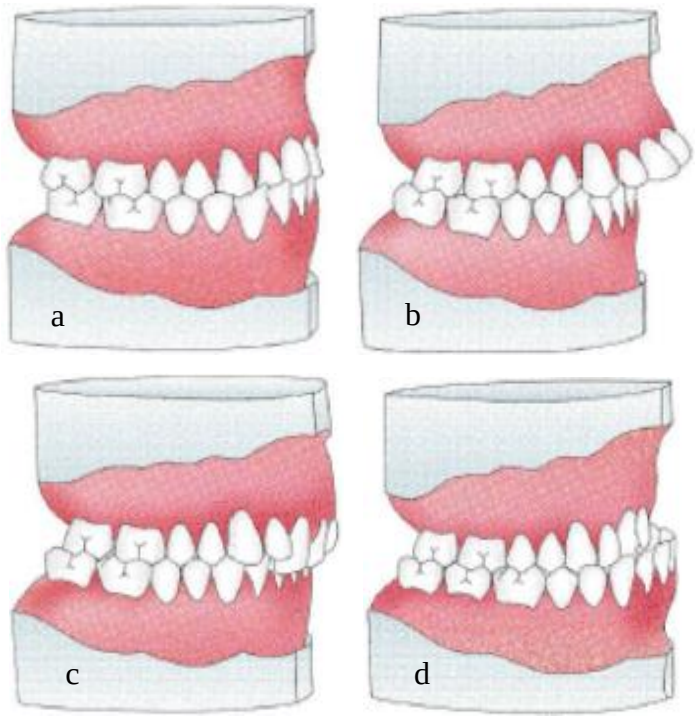


Figure 2.1 (a) Class I, (b) Class II Division 1, (c) Class II Division 2, (d) Class III
Source: Goyal S. Textbook of orthodontics. 1st ed. CBS Publisher & Distributors: New Delhi. 2017. p 311

b. Dewey's Modification of Angle's Classification Malocclusion (1915)

1) Class I

- Type 1: crowded maxillary anterior teeth (figure 2.2)
- Type 2: maxillary incisors in labio-version (figure 2.3)

- Type 3: anterior crossbite (figure 2.4)
- Type 4: posterior crossbite (figure 2.5)
- Type 5: Molars in mesio-version due to early loss of teeth mesial to them (early loss of deciduous molars or second premolar) (figure 2.6)

Figure 2.2 Dewey's Modification Class I Type 1 Malocclusion
Source: Phulari BS. Orthodontics Principles and Practice. 2nd ed. Jaypee: New Delhi. p 81

Figure 2.3 Dewey's Modification Class I Type 2 Malocclusion
Source: Phulari BS. Orthodontics Principles and Practice. 2nd ed. Jaypee: New Delhi. p 81

Figure 2.4 Dewey's Modification Class I Type 3 Malocclusion
Source: Phulari BS. Orthodontics Principles and Practice. 2nd ed. Jaypee: New Delhi. p 81

Figure 2.5 Dewey's Modification Class I Type 4 Malocclusion
Source: Phulari BS. Orthodontics Principles and Practice. 2nd ed. Jaypee: New Delhi. p 81

Figure 2.6 Dewey's Modification Class I Type 5 Malocclusion
Source: Phulari BS. Orthodontics Principles and Practice. 2nd ed. Jaypee: New Delhi. p 82

2) Class III

- Type 1: individual arches in normal alignment but when in occlusion edge to edge in anterior (figure 2.7 a)
- Type 2: mandibular incisors are crowded and lingual to the maxillary incisors (figure 2.7 b)
- Type 3: anterior crossbite (figure 2.7 c)[11,12]

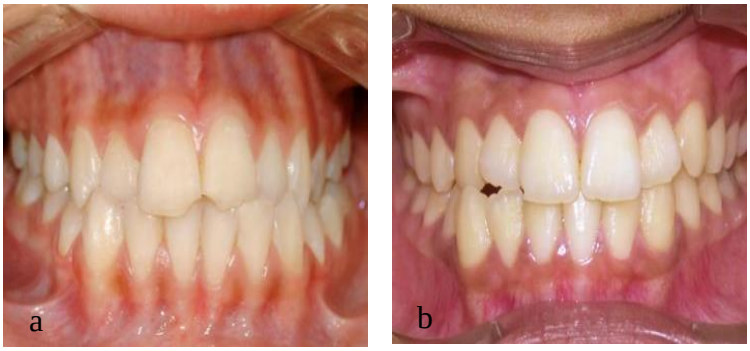


Figure 2.7 Dewey's Modification Class III (a) Type 1, (b) Type 2, (c) Type 3 Malocclusion

Source: Singh G. Orthodontics 1st ed. Jaypee: New Delhi; 2009. pp 74-6

c. Lischer's Classification

This classification is according to the individual teeth position that deviates from normal.

1) Mesioversion: mesial to the normal position
2) Distoversion: distal to the normal position
3) Linguoversion: lingual to the normal position
4) Labioversion or buccoversion: toward the lip or cheek
5) Infraversion: away from the line of occlusion
6) Supraversion: extended past the line of occlusion
7) Axiversion: tipped, the wrong axial inclination
8) Torsiversion: rotated on its long axis
9) Transversion: wrong order in the arch or transposition[13]

d. Malrelation of Dental Arches

This condition is characterized by an abnormal relationship between teeth or teeth of one dental arch and the other. Divided into three planes:

1) Sagittal Plane

They can be two types that are pre-normal and post-normal occlusion. Pre-normal occlusion is placed on the mandible more anterior when teeth are in centric occlusion (figure 2.8 a), while post-normal occlusion is placed on the mandible more posteriorly (figure 2.8 b).

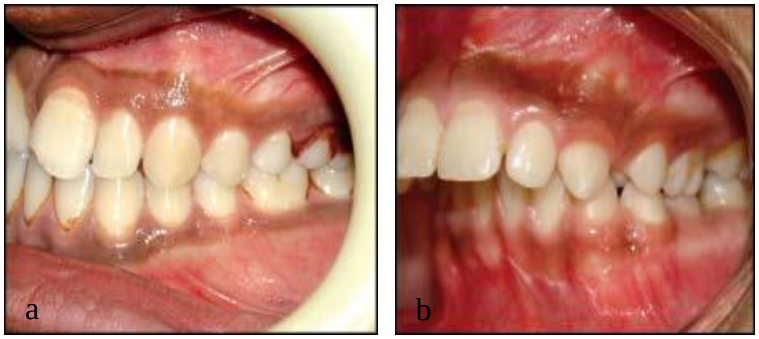


Figure 2.8 (a) Pre-normal Occlusion, (b) Post-normal Occlusion
Source: Singh G. Orthodontics 2nd ed. Jaypee: New Delhi; 2007. pp 162

2) Vertical Plane

They can be two types that are deep bite and open bite. A deep bite is a vertical overlap between maxillary and mandibular teeth that is more than normal (figure 2.9 a). In contrast, the open bite is an absence of vertical overlap between maxillary and mandibular teeth when occlusion is centric, so there is a gap (figure 2.9 c-b).


Figure 2.9 (a) Anterior Deep Bite, (b) Anterior Open Bite, (c) Posterior Open Bite

Source: Singh G. Orthodontics 2nd ed. Jaypee: New Delhi; 2007. pp 162-3

3) Transverse Plane

These include the various types of crossbites. Generally, the maxillary teeth are placed labial/buccal to the mandibular teeth. But it can be placed lingual/palatal to the mandibular teeth if there is constriction of the dental arches or some other reason this relationship is disturbed (figure 2.10).[11]

Figure 2.10 Posterior Crossbite
Source: Singh G. Orthodontics 2nd ed. Jaypee: New Delhi; 2007. pp 163

### 2.1.4 Impact of Malocclusion

a. Quality of Life

Malocclusion can interfere with the quality of life of sufferers. Research says that malocclusion is associated with psychological, social, and physical impacts on young people. This impact is due to the relationship between malocclusion and aesthetics, so sufferers feel embarrassed and lack self-confidence. Therefore, they want to do orthodontic treatment to restore good aesthetics.[5,14]

b. Teeth and Mouth Health

Malocclusion will also cause problems in periodontal tissue because malocclusion in the case of crowded teeth can cause an increase in plaque accumulation which is one of the factors driving periodontal disease and caries.[15]

c. Temporomandibular Disorder (TMD)

Class II malocclusion can be a predisposing factor in TMD.[16] In another study conducted by Magnusson et al. involving 402 patients for

more than 20 years, it has been concluded that occlusal factors are weakly associated with temporomandibular disorder. However, unilateral crossbite may be a risk factor for the disease.[17]

d. Mastication Disorders

The process of mastication is according to the harmony of the stomatognathic system, which includes the teeth, periodontal tissue, craniofacial bone, mastication muscle, temporomandibular joint, and nervous system. Teeth act as the final executor in the tearing and cutting of food, so it is hypothesized that malocclusion could decrease the performance and function of mastication.[18]

e. Speech Disorders

Malocclusion can also have an impact on speech disorders. Faymbo in 1957, in his research, showed more incredible difficulty in the pronunciation of dental consonants than those with normal occlusion.[8]

## 2.2 Speech

### 2.2.1 Definition of Speech

According to Kamus Besar Bahasa Indonesia (KBBI), speech is saying, conversing, speaking, or giving an opinion (with words, writing, etc.) or negotiating. Speech is a form of verbal communication carried out by humans in the context of expressing ideas and ideas that have been compiled in the mind.[19] According to its function, speech is a medium for humans to communicate.[20]

### 2.2.2 Mechanisms of Speech

There are four types of speech processes:

1) The process of removing sound from the lungs
2) The process of phonation or the passage of sound in the throat
3) Articulation process or sound output by articulator
4) Oro-nasal process or the release of sound through the mouth or nose

According to Suhendra Yusuf in 1998, the human voice is produced from four body organs: the lungs, the base of the throat, the oral cavity,

and the nose. The production of sound results from neuromuscular commands that release air from the lungs through the throat shaft to the base of the throat, in which there are vocal cords. Air that passes through narrow vocal cords causes the vocal cords to vibrate. It is this vibration that becomes sound or sound. Then the air comes out through the mouth or nose.[21, 22]

The channel through which air or sound passes is also called the vocal tract. The vocal tract can be formed in various ways depending on the lips, tongue, jaw, and palate mole. Clarity of articulation or each syllable is carried out by agile movements in the lips, tongue, vocal cords, velum (palate mole), and respiratory system.[22, 23]

Levelt in 1989 has described a speech mechanism divided into three stages: conceptualization, formulating and articulating.

1) Determine the concept of information that has happened before. In this stage, the formulator will translate it into one language and then produce a phonetic or articulate plan.
2) The articulator will take internal pieces of speech previously stored in the articulation buffer.
3) It then gives to motor control and issues commands to the muscles that control the larynx, articulator, and respiratory system.[24]

### 2.2.3 Kind of Speech Organs

Speech organs, such as lips, teeth, tongue, jaw, and larynx, are needed to produce sound.[25] Variations in sounds such as /a/, /i/, /u/, /e/, /o/ can be identified if these sounds have come out of the mouth. It is a speech tool that helps in this identification. In general, speech consists of exo-labial (outer lip), endo-labial (inner lip), teeth (teeth), alveolar (gums), post-alveolar (upper gums), pre-palatal (palatal). the front of the hard palate), palatal (hard palate), velum (soft palate), uvular (children's throat), pharynx (throat), epiglottis, and tongue.[22]

### 2.2.4 Speech Disorders

Speech disorders affect the way a person talks. A person with a speech disorder usually knows exactly what they want to say and what is appropriate for the situation, but they have trouble producing the sounds to communicate it effectively.[22]

### 2.2.5 Type of Speech Disorders and The Cause

In general, there are three types of speech disorders:

1) Fluency Disorders

   This disorder is also known as dysfluency. This disturbance is related to the rhythm of speech. The characteristics of a person with fluency disorders look hesitant, repeat words, and prolong certain sounds, syllables, or phrases. Stuttering and cluttering are types of fluency disturbances.[26,27] This disorder can be caused by genetic, psychogenic, and injury to the brain.[28]

2) Articulation Disorders

   This disorder also called a phoneme disorder involves the formation or articulation of words. The organs of articulation consist of the lips, tongue, teeth, and palate. In some cases, an injury or congenital disability affecting one or more of these organs can lead to an inability to pronounce words correctly.[26,27] This disorder may be due to problems with the shape of the muscles and structures of the mouth such as the cleft palate, problems with the teeth and mandible that cause incorrect sounds in the letters f, v, s, z, and th, and a short tongue that causes difficulty pronouncing the letters t, n, and l.[6,29]

   Articulation disorders can also be referred to as dystrophy, caused by brain damage to parts of the motor cortex that interfere with the nervous system. This damage causes changes to the tongue, jaw, or lips, making words unclear.[23]

   Dyslalia is also referred to as a speech articulation disorder caused by damage to the speech apparatus and not due to damage to the nerve center. Dyslalia is functionally classified into four: substitution,

omission, insertion, and distortion. Distortion dyslalias occur when a phoneme is articulated incorrectly. This is usually the result of a defective position of the articulation organs.[29,32,36]

3) Voice Disorders

This disorder is known as dysphonia. This disorder occurs when the larynx structure, which consists of vocal tone, cannot function properly due to inflammation, infection, and injury. This disturbance involves loudness and resonance—characteristics of a person with difficulty producing sound. Sometimes listeners can hear a loud, hoarse, or nasal quality voice from someone with this disorder.[26,27] Nasal sounds can occur in patients with cleft lip.[6]

## 2.3 Relation between Malocclusion and Speech Sound Production

Sound production is important for communication. The organs that play a role are the vocal cords, tongue, lips, palate, teeth, muscles, and nerves. Dental alignment as a structural boundary for the placement of the tongue and lips is inherently involved in sound production (figure 2.11-13).[6]

If there is a deviation in the structure or alignment of the teeth can interfere with the normal process of airflow and pressure and the accuracy of the placement of the lips and tongue to affect the integrity of sound production.[31] Most of the researchers in their research who discussed this concluded that the position of the tongue and teeth insisivus and orbicularis muscle tone has a large role in changes in sound production.[8]

Malocclusion and its relationship to speech sound production:[28]

1) Phonemes: m, p, b, w, as shown in figure 2.11

Dental/occlusal structure: maxillary and mandibular dental arches provide a structural foundation for appropriate labial positioning at rest and during the function

Placement: bilabial

Manner: complete occlusion of airflow and pressure

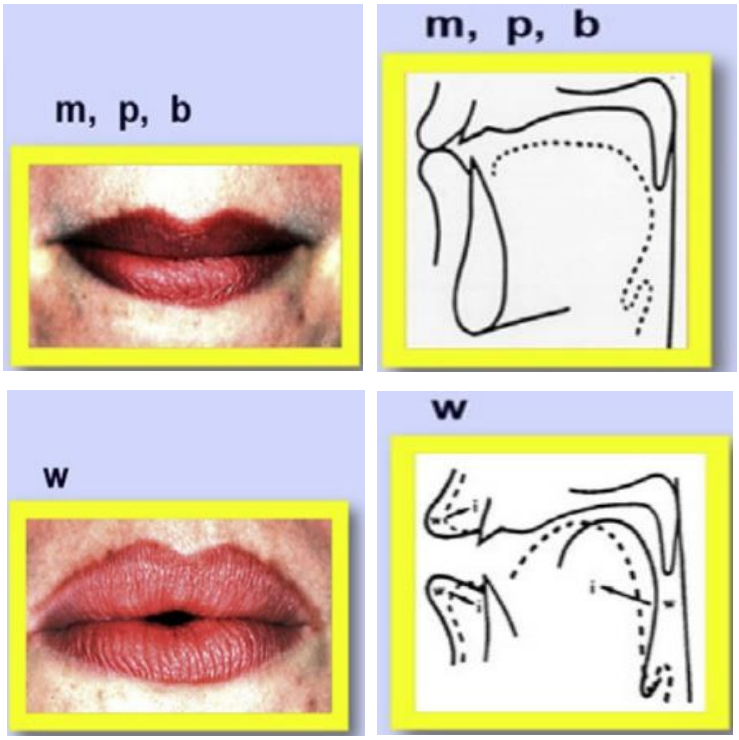


Figure 2.11 M, P, B, W Sound Production
Source: Leavy KM, Cisneros GJ, LeBlanc EM. Malocclusion and its relationship to speech sound production: Redefining the effect of malocclusal traits on sound production. AM J Orthod Dentofac Orthop. 2016; 150: 116-123: 117

2) Phonemes: th, as shown in figure 2.12

   Dental/occlusal structure: incomplete occlusal of maxillary and mandibular incisal edges provide a structure for lingual placement during sound production

   Placement: linguodental

   Manner: incomplete occlusion of airflow and pressure provides friction

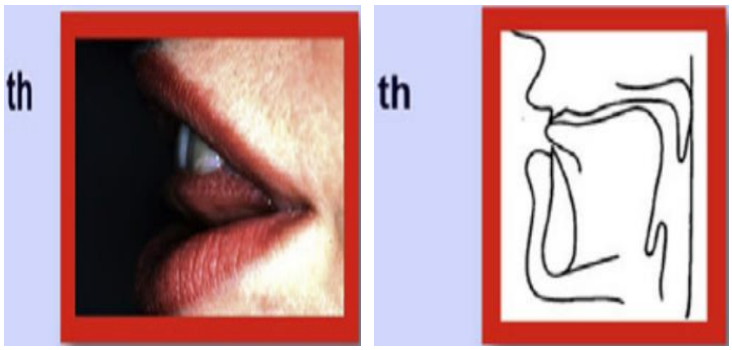


Figure 2.12 TH Sound Production
Source: Leavy KM, Cisneros GJ, LeBlanc EM. Malocclusion and its relationship to speech sound production: Redefining the effect of malocclusal traits on sound production. AM J Orthod Dentofac Orthop. 2016; 150: 116-123: 117

3) Phonemes: f, v, as shown in figure 2.13

Dental/occlusal structure: the central and lateral incisors of the maxillary arch provide structural contact with the lower lip for sound production

Placement: labiodental

Manner: incomplete occlusion of airflow and pressure provides friction

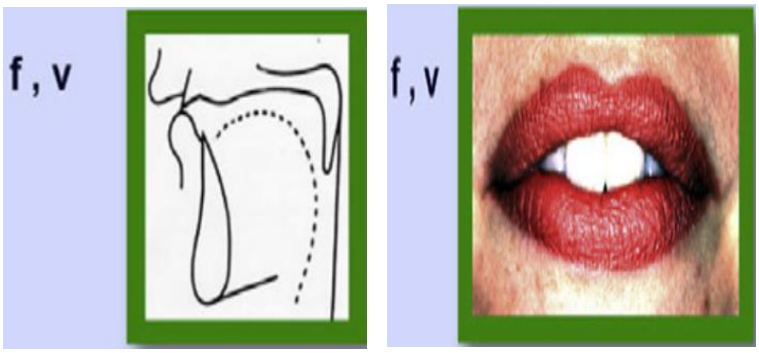


Figure 2.13 F, V Sound Production
Source: Leavy KM, Cisneros GJ, LeBlanc EM. Malocclusion and its relationship to speech sound production: Redefining the effect of malocclusal traits on sound production. AM J Orthod Dentofac Orthop. 2016; 150: 116-123: 117

4) Phonemes: ch, sh, dz, as shown in figure 2.14

Dental/occlusal structure: the lateral edges of the tongue maintain against the lingual edge of the molars and wisdom teeth, and the apex of the tongue contacts the alveolar ridge

Placement: lingual alveolar

Manner: complete and incomplete combination

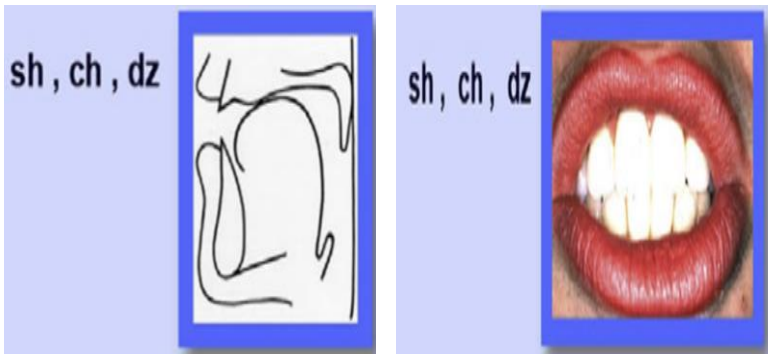


Figure 2.14 SH, CH, DZ Sound Production
Source: Leavy KM, Cisneros GJ, LeBlanc EM. Malocclusion and its relationship to speech sound production: Redefining the effect of malocclusal traits on sound production. AM J Orthod Dentofac Orthop. 2016; 150: 116-123: 117

5) Phonemes: t, d, n, s, z, as shown in figure 2.15

Dental/occlusal structure: the lingual apex makes contact with the alveolar ridge for sound production

Placement: lingual alveolar

Manner: complete occlusion for t, d, n while incomplete occlusion for s, z sound

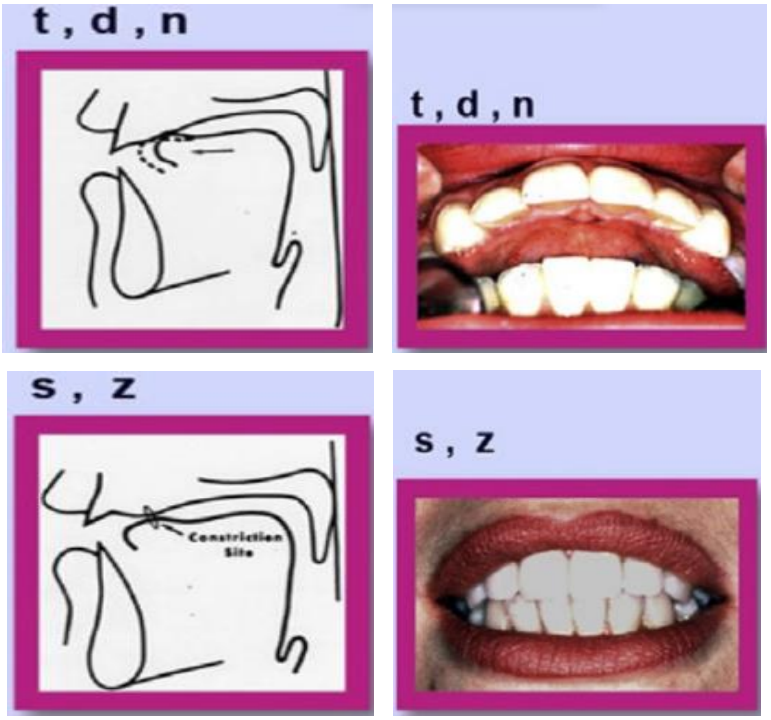


Figure 2.15 T, D, N, S, Z Sound Production
Source: Leavy KM, Cisneros GJ, LeBlanc EM. Malocclusion and its relationship to speech sound production: Redefining the effect of malocclusal traits on sound production. AM J Orthod Dentofac Orthop. 2016; 150: 116-123: 117

Research in this particular field began when Harold considered three possible interrelationship mechanisms: occlusal or bone abnormalities; The central nervous system becomes affected by genetic or metabolic components or structural abnormalities that affect articulation.[8]

Open bites and crossbites are the most common causes of speech disorders. The teeth must be in the right position to make the seal airtight so that the tongue can stick properly to the palate. If there is a gap such as an open bite, the tongue even makes a seal and causes speech problems when communicating. In addition, a crossbite can result in not having enough room for the tongue so speech will be affected.[32]

The leading cause of lisping or whistling is a deep bite. Another cause could be a gap in the teeth (diastema) that prevents proper tongue placement and allows air to escape during a speech, creating a whistling sound.[32]