COMPARISON OF SPEECH INTELLIGIBILITY AND QURANIC RECITATION PROFICIENCY IN MALAY CLEFT PALATE PATIENTS

SITI NUR NABIHAH BTE ZAINUL ABIDIN

RESEARCH REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF CLINICAL DENTISTRY ORAL AND MAXILLOFACIAL SURGERY

FACULTY OF DENTISTRY
UNIVERSITY OF MALAYA
KUALA LUMPUR
2019

UNIVERSITI MALAYA

ORIGINAL LITERARY WORK DECLARATION

Name of Candidate: Siti Nur Nabihah Bte Zainul Abidin

Matric No: DGJ160005

Name of Degree: Master of Clinical Dentistry (Oral and Maxillofacial Surgery)

Title of Research Report: Comparison of Speech Intelligibility and Quranic Recitation Proficiency in Malay Cleft Palate Patients

Field of Study: Oral and Maxillofacial Surgery

I do solemnly and sincerely declare that:

(1) I am the sole author/writer of this Work;

(2) This Work is original;

(3) Any use of any work in which copyright exists was done by way of fair dealing and for permitted purposes and any excerpt or extract from, or reference to or reproduction of any copyright work has been disclosed expressly and sufficiently and the title of the Work and its authorship have been acknowledged in this Work;

(4) I do not have any actual knowledge nor do I ought reasonably to know that the making of this work constitutes an infringement of any copyright work;

(5) I hereby assign all and every rights in the copyright to this Work to the University of Malaya ("UM"), who henceforth shall be owner of the copyright in this Work and that any reproduction or use in any form or by any means whatsoever is prohibited without the written consent of UM having been first had and obtained;

(6) I am fully aware that if in the course of making this Work I have infringed any copyright whether intentionally or otherwise, I may be subject to legal action or any other action as may be determined by UM

Candidate's Signature Date:

Subscribed and solemnly declared before

Witness's Signature Date:

Name:

Designation:

ABSTRACT

Speech intelligibility is the most important parameter in determining the success of cleft palate repair. Previous studies have shown that adequate speech intelligibility can be achieved after primary palatoplasty. In Muslim Malay population, there is additional requirement to read Quran proficiently. The aim of this study is to assess perceptual intelligibility of speech and proficiency of Quranic recitations and to compare if there are differences between the two. Data collection was done on 30 patients clinically and by recording speech samples while these patients were reading on a Malay passage and first verse of Holy Quran. Both samples were assessed by authors using assessment form adapted from Cleft Audit Protocol for Speech – Augmented and Quranic Assessment Form adapted from the Malaysian Ministry of Education's learning module**.** Result showed that 100% of the patients have understandable speech however only 60% of these patients were able to at least recite Quran fluently with adherence to the Rules of *Tajwid.* Statistical analysis revealed significant correlation between these two parameters with P-value <0.001. The reported speech intelligibility and Quranic recitation result provide important prognostic reference information not just to the professionals in cleft team but parents and Quranic teachers as well

Keywords: Cleft palate, Speech intelligibility, Quranic recitation, Malay language

ABSTRAK

Kebolehafahaman pertuturan adalah kayu pengukur yang penting untuk mengetahui tahap kejayaan pembedahan klef lelangit. Kajian terdahulu telah membuktikan bahawa kebolehfahaman pertuturan dapat dicapai selepas pembedahan tersebut. Walaubagaimanapun, untuk pesakit klef lelangit yang berbangsa Melayu dan beragama Islam, mereka harus turut memiliki kebolehan tambaha supaya dapat mengaji Al-Quran dengan lancar. Kajian ini bertujuan menilai kebolehfahaman pertuturan, kelancaran pembacaan Quran di kalangan pesakit klef lelangit dan mengenenal pasti hubungan antara kedua perkara tersebut. Data dikumpulkan dengan membuat rakaman audio bacaan rangkap berbahasa Malaysia dan bacaan Al- Quran yang dibacakan oleh 30 pesakit. Hasil rakaman dinilai oleh penulis dengan dengan menggunakan *Cleft Audit Protocol for Speech – Augmented Assessment Form* untuk kebolehfahaman pertuturan. Manakala kelancaran bacaan Al-Quran dinilai dengan borang diadaptasi dari modul pembelajaran milik Kementerian Pendidikan. Dari kajian ini, didapati bahwa 100% pesakit mempunyai pertuturan yang baik manakala hanya 60% mempunyai kebolehan yang sama dalam bacaan Al-Quran. Analisis statistik menunjukan hubungan signifikan antara kedua parameter ini dengan nilai -P <0.001. Keputusan ini boleh menjadi rujukan yang penting kepada ahli professional di dalam pasukan kleft, ibu bapa penjaga dan guru pengajar Al-Quran.

Keywords: Kleft lelangit, kebolehfahaman pertuturan, pembacaan Al-Quran, Bahasa Malaysia

ACKNOWLEDGEMENTS

Alhamdulillah, I am truly grateful to be able to be given the opportunity to complete my research project entitled "Comparison Between Perceptual Intelligibility of Speech and Quranic Recitation in Cleft Palate Patients". This report was a big leap in my learning curve as a postgraduate student and was certainly not done singlehandedly.

First and foremost, I would like to express my gratitude to Allah (Glorified and Exalted be He) and salutation to Prophet Muhammad (Peace be Upon Him) for giving me the strength and determination in completing this challenging task. Indeed, there have been difficult moments in completion of this project that would not have been overcome without His divine intervention.

This research topics would not have been conceived if not for the brainchild of my supervisor, Dr Siti Mazlipah Binti Ismail. It was because of her wisdom, years of experience in managing cleft patients and being a good *Mukminah*, this topic has come out. I would like to take this opportunity to sincerely thanked her for giving me the idea and encouragement for me to pursuit this study. My sincere gratitude to my co-supervisor Dr Asmawati Binti Muhamad from Academy of Islamic Studies, University Malaya whom have been extremely helpful in my data collection and the write up for this report.

I wish to express my deep appreciation to all patients and their parents or guardian who have given their time and effort for this research. My acknowledgment also goes to all my lecturers and colleagues, my brilliant statistician and staff from Department of Oral and Maxillofacial Clinical Sciences, Faculty of Dentistry, University of Malaya. I also want to extend my appreciation to the Head of Department and especially the staff of Audiology Unit, Department of Otorhinolaryngology,

University Malaya Medical Centre for their patience, encouragement and cooperation during the completion of my project. Without their help I would not have been able to gather the data that I needed.

Finally, I would like to express my appreciation to my family especially my father, Dr Zainul Abidin Bin Md Hussain, my mother, A'bidah Binti Baharuddin and my siblings for their constant prayers and who have put up with me and supported me emotionally through the completion of my report. I am forever in debt to everyone and pray that Allah (Glorified and Exalted be He) continuously guide and reward everyone abundantly. *Jazakumullahukhyran kathira* and Thank you.

TABLE OF CONTENTS

ABSTRACT iii

ABSTRAK iv

ACKNOWLEDGEMENTS v

TABLE OF CONTENTS vii

LIST OF FIGURES xi

LIST OF APPENDICES xiii

CHAPTER 1: INTRODUCTION 1

1.1 Backgrounds 1

1.2 Aim of the Study 3

1.3 Objective of the Study 3

1.4 Hypothesis 3

CHAPTER 2: LITERATURE REVIEW 4

2.1 Cleft Palate 4

2.1.1 Abnormalities in Cleft Palate 4

2.1.2 Treatment of cleft palate 5

2.2 Physiology of Velopharyngeal Valve 6

2.2.1 Normal Velopharyngeal Function and Movements 7

2.2.2 Velopharyngeal Dysfunction 9

2.3 Speech Physiology 10

2.3.1 Anatomical component of speech production 10

2.3.2 Subsystem of speech 11

2.3.2.1 Respiration 12

2.3.2.2 Phonation 12

2.3.2.3 Prosody 12

2.3.2.4 Resonance and velopharyngeal function 12

2.3.2.5 Articulation 13

2.4 Abnormalities of Speech in Cleft Palate 14

2.4.1 Impact on Speech Development 14

2.4.2 Impact on Speech Production 15

2.4.3 Language specific 'Cleft' Speech Characteristic 16

2.5 Speech Assessment 17

2.5.1 Instrumental Speech Assessment 17

2.5.2 Non-instrumental Speech Assessment 18

2.5.3 Perceptual Speech Assessment 18

2.5.4 Speech Intelligibility 19

2.6 Quranic Teaching and learning 20

2.6.1 Quranic Teaching and learning in Malaysia 21

2.6.2 Assessment of Quran Education 22

2.6.3 Differences between the Malay language and Arabic 23

CHAPTER 3: MATERIAL AND METHOD 25

3.1 Patient Selection 25

3.1.1 Inclusion criteria 25

3.1.2 Exclusion criteria 25

3.2. Data Collection 26

3.3 Evaluation parameters 27
3.4 Statistical Analysis 28

CHAPTER 4: RESULTS 29
4.1 Demographic Data 29
4.2 Assessment of speech intelligibility and proficiency of Quranic recitation and its comparison 31
4.3 Cleft type association with scores of speech intelligibility and proficiency of Quranic recitation 33
4.4 Gender association with scores of speech intelligibility and proficiency of Quranic recitation 33
4.4 Scores for speech intelligibility and proficiency of Quranic recitation between different age group 34

CHAPTER 5: DISCUSSION 35
5.1 Methodology 35
5.2 Assessment of speech intelligibility and proficiency of Quranic recitation and its comparison 36
5.3 Cleft type association with scores of speech intelligibility and proficiency of Quranic recitation 37
5.4 Gender association with scores of speech intelligibility and proficiency of Quranic recitation 38

CHAPTER 6: CONCLUSION 39
6.1 Conclusion 39
6.2 Limitation 39
6.3 Recommendation 39

REFERENCES 40

LIST OF PUBLICATIONS AND PAPERS PRESENTED 43

APPENDICES 44

LIST OF FIGURES

Figure 2.1 Anatomy Of Normal Palate (A) And Cleft Palate (B)Normal Anatomy (Hoffman, 2013) 5
Figure 2.2clinical Photo Of A Cleft Palate Case. Preoperative (Top Right), Intraoperative (Top Left) And Post-Operative 4 Months (Bottom) 6
Figure 2.3 An Inferior View Of The Velopharyngeal Port (A) The Velopharyngeal Port Is Open For Nasal Breathing. (B) The Velopharygeal Port Is Closed For Speech (Kummer A., 2014) 8
Figure 2.4 Lateral View Of The Velum And Posterior Pharyngeal Wall. (A) The Velum Rests Against The Base Of The Tongue During Normal Nasal Breathing, Resulting In A Patent Airway. (B) The Velum Elevates During Speech And Closes Against The Posterior Pharyngeal Wall. This Allows The Air Pressure From The Lungs And The Sound From The Larynx To Be Redirected From A Superior Direction To An Anterior Direction To Enter The Oral Cavity For Speech (Kummer A., 2014) 8
Figure 2. 5 Velopharyngeal Insufficiency Is Caused By A Structural Cause. In This Case, The Velum Has Normal Movement, But Is Too Short To Achieve Velopharyngeal Closure (Kummera., 2016) 9
Figure 2.6 Velopharyngeal Incompetence Is Caused By A Neuromotor Disorder. In This Case, The Velum Is Normal In Structure, But Does Not Move Well Enough To Achieve Velopharyngeal Closure (Kummer A., 2016) 9
Figure 2. 7 The Three Physiologic Components Of Human Speech Production (Lieberman & Blumstein, 1988) 11
Figure 2.8 Points Of Articulation Of English Letters (Image From International Phenotic Alphabet Mouth Diagram) 24
Figure2.9 Points Of Articulation Of Arabic Letters (Ryding, 2014) 24
Figure 3.1 Sony Linear Pcm -D100 Recorder 27
Figure 4.1 Type Of Cleft Distribution 29

LIST OF TABLE

Table 2 -1 Language-Specific 'Cleft' Speech Characteristics 16

Table 2-2 Malay Letters 23

Table 2-3 Arabic Letters. 23

Table 4-1 List Of Patient's Data 30

Table 4-2 Relation Between Speech Intelligibility And Proficiency Of Quranic Recitation According To Score Categories 31

Table 4-3 The Mean Value Both In Speech Intelligibility And Proficiency Of Quranic Recitation In Relation To Type Of Cleft, Gender And Age 32

LIST OF APPENDICES

Appendix A: Ethical Approval 44

Appendix B: Patient Information Sheet 45

Appendix C: Oral Examination Sheet 50

Appendix D: Malay Passage 52

Appendix E: Quranic Text 53

Appendix F: Speech Intelligibility Assessment Form 54

Appendix G: Quranic Recitation Assessment Form 55

CHAPTER 1: INTRODUCTION

1.1 Backgrounds

A cleft lip or cleft palate denotes an abnormal split or separation affecting the lip and or palate that is present at birth. It is one of the most common congenital malformations Mossey, Little, Munger, Dixon, and Shaw (2009). A cleft lip contains a fissure in the upper lip that may extend into the nose. The fissure may be on one side, both sides, or in the middle. A cleft palate is when the roof of the mouth contains a fissure into the nose (See, Ibrahim, Lan, & Ahmad, 2018).

The incidence of cleft varies significantly by racial group and with social economic status, with an incidence of about 1 in 1000 birth in whites, 1 in 500 births in Asians and Native Americans (Stanier & Moore, 2004). Specifically in Malaysia, prevalence of cleft lip and palate in Malaysia is 1 in 941 births (Ali, Shah, Ariff Abdul Rahman, & Ilyas Shaikh Muhammad Naeem Khattak Muhammad Ameen Sahito, 2015).

Corrective surgery to repair the cleft is often done early in infancy, before the child starts speaking. Surgical treatment of cleft is very important to achieve an acceptable aesthetic result, to optimize normal bony facial growth and also to get a good speech outcome. Children with cleft palate have a unique physical challenge to the acquisition of spoken language (Morris & Ozanne, 2003). Witzel defined speech intelligbility it as how well a listener understands speech. It is one of the major factors that determines a person's communicative competence and can serve as an index of the severity of a speech disorder and an indicator of the progress of surgical, prosthetic or therapeutic intervention (S. Howard and Lohmander (2011); (Lohmander & Olsson, 2004).

The present evidence shows that adequate speech intelligibility after primary palatoplasty is present in the majority of cases, suggesting that these individuals are well understood in their social environment (Andreoli, Yamashita, Trindade-Suedam, & Fukushiro, 2016).

Speech therapy improves velopharyngeal function when velopharyngeal dysfunction is minimal. It also improves articulation errors and restore function in postoperative patients. Compensatory articulation techniques secondary to velopharyngeal dysfunction also can be corrected with speech therapy. However, in patients with a specific anatomic deficiency that precludes adequate closure of the velopharynx, speech therapy cannot replace surgery. Even after surgical repair of the palate, a number of structural abnormalities can affect speech production, including velopharyngeal incompetence, fistulae, hearing impairment and dental-occlusal abnormalities. Speech production problems in this population include misarticulation, abnormal resonance (hypernasality and/or hyponasality) and nasal emission. All these factors can lead to a deterioration in speech intelligibility, although misarticulation probably makes the greatest contribution to intelligibility loss (Whitehill & Chau, 2004).

In Malaysia, the Muslim community has the largest population. Recitation of Quran is important to all Muslims as it plays a major part of the daily prayers. Quran is the Muslim scripture that was revealed to Prophet Muhammad (Peace be upon Him) in Arabic language by God through the archangel Gabriel. According to Ibn Rajab Al-Hambalee, the sincerity that is due to the Book of Allah includes its regular recitation, learning the rules of *Tajwid*, learn about its interpretation and internalized it. *Tajwid* is defined as to set of rules governing the way in which every letter pronounced

correctly from its points of articulation while maintaining its original form (Ayob, 2010).

Recitation of Quran is also important as it is part of daily 5 prayers that need to be perform as it serves as one of the five Islamic pillars of this religion.

As stated previously that the majority of patients with repaired cleft palate have good speech intelligibility, we are keen to assess whether this group of patients has the same ability in reciting Quran proficiently.

1.2 Aim of the Study

The aim of this study is to compare perceptual intelligibility of speech and proficiency in Quranic recitations among the Malay cleft palate patients.

1.3 Objective of the Study

Through this study, we should be able to;

1. Assess perceptual intelligibility of speech in Malay cleft palate patients
2. To assess proficiency of Quranic recitation in Malay cleft palate patients
3. To identify the differences between perceptual intelligibility of speech and proficiency in Quranic recitations among Malay cleft palate patients

1.4 Hypothesis

The central null hypothesis of this study is there is no significant difference in perceptual intelligibility of speech and proficiency of Quranic recitations among Malay cleft palate patients

CHAPTER 2: LITERATURE REVIEW

2.1 Cleft Palate

Embryologically, the palate is formed by the palatal processes of the maxilla. The prolabium and the premaxilla arise from the medial nasal prominences of the frontonasal process and the lateral alveolar segments from the lateral processes of the maxilla. The primary palate, embryologically, is that part of the anterior palate, alveolus, and lip in front of the incisive foramen. This fuses from behind forward in the fifth to sixth week of intrauterine life. The secondary palate fuses from the incisive foramen in the seventh to eighth week of intrauterine life. Each of these processes may be arrested at any point, and this accounts for the varying types of clefts of the lip and palate.

Clefts of the palate may occur alone or be associated with unilateral or bilateral cleft lip. They may be complete or incomplete and if incomplete may involve soft palate alone or soft and part of the hard palate. Submucous cleft palate is a condition where the mucosa is largely intact, but the musculature is similar to that seen in a complete cleft palate (Hoffman, 2013).

2.1.1 Abnormalities in Cleft Palate

Normally the levator veli palatini muscle forms a transverse sling across the posterior half of the soft palate, and contraction causes the soft palate to move superiorly and posteriorly, contacting the posterior pharyngeal wall for velar closure, usually at the level of the adenoid pad. In addition to being discontinuous across the cleft, the levator muscle runs longitudinally along the cleft margin before it inserts aberrantly into the posterior border of the hard palate (Figure 2.1). This results in ineffective contraction and inability to close the palate against the posterior pharyngeal wall. Air escape through the nose during speech produces a characteristic hypernasal quality. In addition, aberrant levator positioning as well as an abnormal fusion with

the tendon of the tensor veli palatini muscle is thought to impair the function of the tensor muscle in assists with Eustachian tube function and is thought to be contributory to cleft otopathology (Hoffman, 2013).

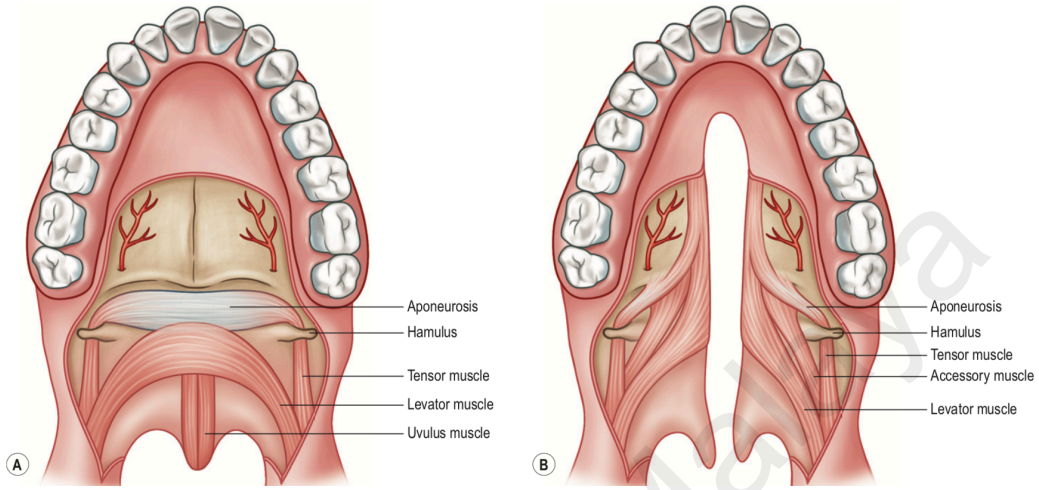

Figure 2.1 Anatomy of normal palate (A) and cleft palate (B)Normal anatomy (Hoffman, 2013)

2.1.2 Treatment of cleft palate

As cited by(John, Sell, Sweeney, Harding-Bell, & Williams, 2006) , the ultimate aim of cleft lip and palate care is for the child to be able to achieve his or her full potential and to function well in society. Speech is recognized as one of the key outcomes of cleft team care. If speech difficulties are not treated appropriately, and in a timely manner, then a child may have protracted communication problems, which can lead to learning problems, social exclusion, and adverse psychosocial adjustment and well-being.

The purpose of cleft palate repair is to establish a separation between the oral and nasal cavities in the area of the hard palate and to restore a functioning velopharyngeal closure mechanism primarily by soft palate repair. A further purpose is to establish good Eustachian tube function. There are still no standard protocols to address the issues of ideal timing for cleft palate repair to attain optimal speech and to avoid abnormal maxillofacial growth after repair. Early one-stage procedures are

usually performed between six and eighteen months of age. In a two-stage procedure, early soft palate closure is usually carried out between three and nine months, whereas age for hard palate repair can vary between twelve months and adolescence (S. Howard & Lohmander, 2011) . The standard practice at our Combined Cleft Clinic, Faculty of Dentistry, University of Malaya are one-stage palatal repair and the procedure to be done at the age of 12 months old in order to achieve good speech development.

Figure 2.2Clinical photo of a cleft palate case. Preoperative (top right), intraoperative (top left) and post-operative 4 months (bottom)

2.2 Physiology of Velopharyngeal Valve

The velopharyngeal valve consists of the velum (soft palate), the lateral pharyngeal walls, and the posterior pharyngeal wall. These structures work in concert to open and close the velopharyngeal valve during speech. Velopharyngeal space function can be divided into pneumatic and nonpneumatic functions. Nonpneumatic activities includes swallowing, gagging and vomiting. During these activities, the velum is raised very high in the pharynx and the lateral pharyngeal walls close tightly along their entire length. This type of closure is necessary because the purpose of closure is to allow substance to pass thorough the oral cavity while preventing nasal

regurgitation. Pneumatic activities are those that utilize air pressure (both positive and negative) as a result of velopharyngeal closure. Positive pressure is necessary for blowing, whistling, singing, and speech. Negative pressure is needed for sucking and kissing. With these activities, closure occurs lower in the nasopharynx and appears to be less exaggerated than with nonpneumatic activities (A. W. Kummer, 2016).

2.2.1 Normal Velopharyngeal Function and Movements

Normal velopharyngeal closure is accomplished by the coordinated action of soft palate, posterior pharyngeal walls, and lateral posterior pharyngeal wall. These structures function as a valve that serves to close off the nasal cavity from the oral cavity during speech as well as during singing, whistling, blowing, sucking, swallowing, gagging, and vomiting (Nohara et al., 2007). The valve then opens for nasal breathing and production of nasal sounds. As such, the velopharyngeal valve regulates and directs the transmission of sound energy and airflow in the oral and nasal cavities.

In looking at the entire velopharyngeal mechanism, it is important to recognize that this is a three-dimensional tube that includes the anterior– posterior dimension, the vertical dimension, and the horizontal dimension. During closure, there must be coordinated movement of all structures in all dimensions so that the velopharyngeal valve can achieve closure like a sphincter. This can be seen in Figure 2.3 , which shows an inferior view of the entire sphincter (Ann W. Kummer, 2014).

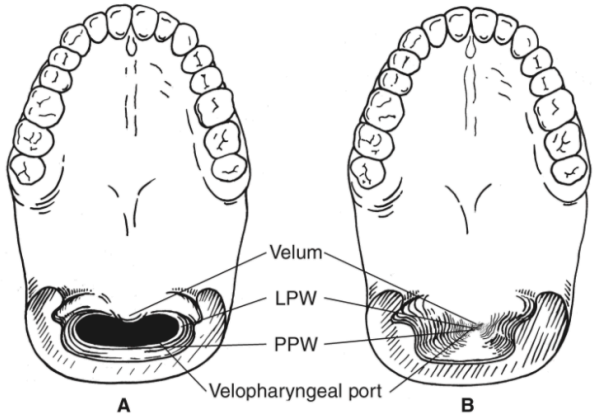

Figure 2.3 An inferior view of the velopharyngeal port (A) The velopharyngeal port is open for nasal breathing. (B) The velopharygeal port is closed for speech (Kummer A., 2014)

During nasal breathing, the velum drapes down from the hard palate and rests against the base of the tongue (Figure 2.4). This position contributes to a patent pharynx, which is important for the unobstructed movement of air between the nasal cavity and lungs during normal nasal breathing. During the production of oral speech (and other pneumatic and nonpneumatic activities as noted below), the velum moves in a superior and posterior direction to contact the posterior pharyngeal wall or, in some cases, the lateral pharyngeal walls (Ann W. Kummer, 2014).

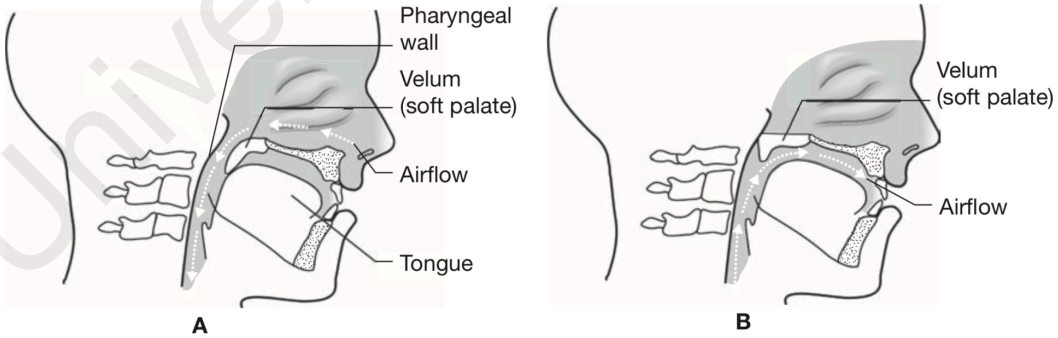

Figure 2.4 Lateral view of the velum and posterior pharyngeal wall. (A) The velum rests against the base of the tongue during normal nasal breathing, resulting in a patent airway. (B) The velum elevates during speech and closes against the posterior pharyngeal wall. This allows the air pressure from the lungs and the sound from the larynx to be redirected from a superior direction to an anterior direction to enter the oral cavity for speech (Ann W. Kummer, 2014)

2.2.2 Velopharyngeal Dysfunction

When the velopharyngeal valve does not close consistently or completely during the production of oral sounds, this is often called velopharyngeal dysfunction (VPD). These dysfunctions can further subdivide into;

1. Velopharyngeal insufficiency: is most often used to describe a structural defect that prevents complete velopharyngeal closure (Figure 2.5). Velopharyngeal insufficiency is the most common type of dysfunction because it can be caused by a history of cleft palate or submucous cleft

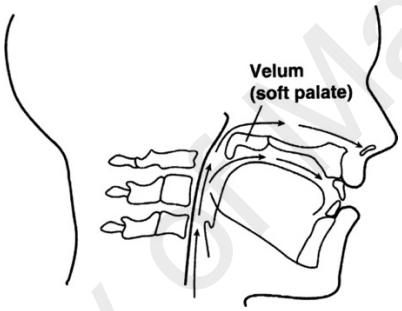

Figure 2. 5 Velopharyngeal insufficiency is caused by a structural cause. In this case, the velum has normal movement, but is too short to achieve velopharyngeal closure (KummerA., 2016)

2. Velopharyngeal incompetence: is used to refer to a neurophysiologic disorder in which poor movement of the velopharyngeal structures results in incomplete velopharyngeal closure (Figure 2.6).

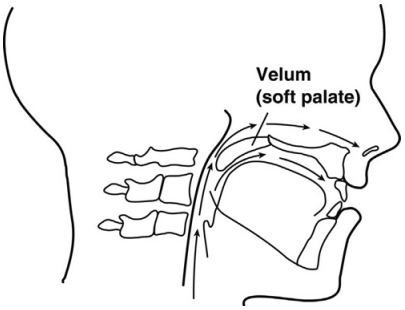

Figure 2.6 Velopharyngeal incompetence is caused by a neuromotor disorder. In this case, the velum is normal in structure, but does not move well enough to achieve velopharyngeal closure (Kummer A., 2016)

3. Velopharyngeal mislearning: refers to an articulation disorder in which speech sounds are inappropriately produced in the pharynx. As a result of this placement, the velopharyngeal valve is open, thus mimicking velopharyngeal incompetence/ insufficiency during speech

Generally, the etiologies of such problems are structural or neurological, and surgery or prosthetic management are the primary means of treatment to achieve velopharyngeal closure for speech (Ruscello, 2007).

2.3 Speech Physiology

Speech is the result of the coordination of several physiological subsystems, including respiration, phonation, resonance, and articulation. The velopharyngeal valve must function in coordination with the other subsystems of speech for speech to be produced normally and with good intelligibility. To understand the importance of these subsystems and the need for coordination, it may be helpful to review how sound is produced.

2.3.1 Anatomical component of speech production

As stated by Lieberman and Blumstein (1988) , the larynx is used as reference point of three speech production components. The vocal cords are the laryngeal anatomical structure which rapidly open and close during the process of phonation. The term glottal refers to the opening between the vocal cords of the larynx. The three major physiologic components of speech production are described with reference to the glottis (Figure 2.7).

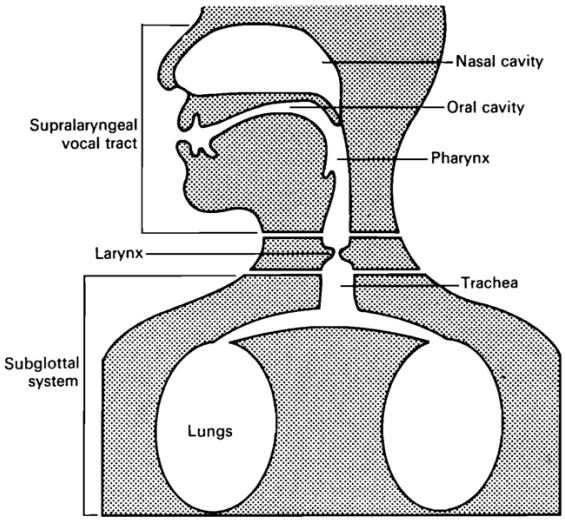

Figure 2. 7 The three physiologic components of human speech production (Lieberman & Blumstein, 1988).

The three components are subglottal component, glottal component and supralarygeal vocal tract component. The subglottal component; below the larynx which consist of the lungs and associated respiratory musculature. This component generated the air flow that powers speech production. The glottal component; its primary role is to convert flow of air out form the lungs into a series of periodic puffs of air by rapidly closing and opening the airway by moving the vocal cords together or pulling them apart. The larynx thus is a valve that can rapidly open and close, generating a "source" of energy. The supralarygeal vocal tract component; consist of airways of nose, mouth and pharynx. Act as variable acoustic filter that acts on source of acoustic energy and has resonating mechanism to damp or amplify the sound.

2.3.2 Subsystem of speech

Overall, the speech are divided into 5 subsystems which are respiration, phonation, prosody, resonance and velopharygeal function and lastly articulation (Ann W. Kummer, 2014).

2.3.2.1 Respiration

The air from the lungs provides the initiating force for phonation and the air pressure for articulation. During speech, however, inspiration occurs very quickly, and the expiratory phase is prolonged. Subglottic air pressure is then maintained under the vocal folds during the entire phrase or sentence.

2.3.2.2 Phonation

Phonation is the sound that is generated by the vocal folds as they begin to vibrate. It is called voice and used to produce all vowel sounds and about half of the consonant sounds. Some consonants are voiceless i.e. /k/ and /p/. During phonation, there is continuous adduction (or closing) of the vocal folds as they vibrate for voiced phonemes and periodic abduction (or opening) of the vocal folds as voiceless sounds are produced. Air pressure must be maintained throughout the utterance so that it can continue to provide the force for phonation.

2.3.2.3 Prosody

Prosody refers to the stress, intonation, and rhythm of speech. In connected speech, articulation is influenced by the stress of individual phonemes and the intonation of the utterance. These changes influence the rate of vibration of the vocal folds and the tension of the muscles of the larynx.

2.3.2.4 Resonance and velopharyngeal function

Once phonation has begun, air pressure from the lungs and sound energy from the vocal folds travel in a superior direction in the vocal tract. The sound energy vibrates throughout the cavities of the supraglottic tract, beginning with the pharyngeal cavity and then including the oral cavity and/or nasal cavity. The resultant shaping of the sound energy adds the resonant quality to speech. Several factors can affect the resonance and the overall acoustic product of the voice. These factors include the size

and shape of the cavities of the vocal tract. The velopharyngeal valve is very important for normal speech and resonance because it is responsible for regulating and directing the transmission of sound energy and airflow into the appropriate cavities (nasal or oral) during speech. During the production of oral speech sounds (all sounds with the exception of /m/, /n/, and /ŋ/), the velopharyngeal valve closes, thus blocking off the nasal cavity from the oral cavity. This allows the sound energy and air pressure to be directed anteriorly into the oral cavity. During the production of nasal sounds, the velopharyngeal valve opens, which allows the nasal cavity to be coupled (sharing acoustic energy) with the oral and pharyngeal cavities.

2.3.2.5 Articulation

The sound that results from phonation and resonance is further altered for individual speech sounds by the articulators. The oral articulators include the lips, the jaws (including the teeth), the tongue and the velum. The oral articulators alter the acoustic product for different speech sounds in two ways by varying the size and shape of the oral cavity through movement and articulatory placement and modifying the manner of sound and particularly the airstream, is released.

Both vowels and voiced oral consonants require oral resonance for production, and many consonants also require oral air pressure. For the production of vowels, the tongue and jaws modify the size and shape of the oral cavity, but there is little constriction of the sound energy or air pressure. On the other hand, consonants are produced by partial or complete obstruction of the oral cavity, which results in a buildup of air pressure in the oral cavity. Intraoral air pressure provides the force for the production of all pressure-sensitive consonants (plosives, fricatives, and affricates). Plosive phonemes (/p/, /b/, /t/, /d/, /k/, /g/) are produced with a buildup of intraoral pressure and then a sudden release. Fricative phonemes (/f/, /v/, /s/, /z/, /ʃ/,

/ʒ/, /h/) require a gradual release of air pressure through a small or restricted opening. Affricate phonemes (/ʧ/, /ʤ/) are a combination of plosive and fricative phonemes (/ʧ/ = /t/ + /ʃ/ and /ʤ/ = /d/ + /ʒ/). As such, affricate sounds require a buildup of intraoral air pressure and then release through a narrow opening. Consonants are differentiated not only by the manner of production (plosives, fricatives, affricates, liquids, and glides) but also by the place of production (bilabial, labiodental, lingual-alveolar, palatal, velar, and glottal) and voicing (voiced or voiceless).

2.4 Abnormalities of Speech in Cleft Palate

The effect of this congenital defect can be further divided during speech development and speech production

2.4.1 Impact on Speech Development

Based on the existing research, it appears that children with nonsyndromic clefts are at risk for mild delays in development during the first 3 years of life. These delays may be secondary to factors such as fluctuating conductive hearing loss or VPI (McWilliams et al., 1990; Mossey, Little, Munger, Dixon, & Shaw, 2009; (Ann W. Kummer, 2014). These delays, when occur, are usually mild and tend to improve with early intervention and time. Ultimately, the child usually catches up with his or her noncleft peers. In considering speech sound development, children with an unrepaired cleft palate necessarily acquire speech sounds differently than their unaffected peers. Once the palate is repaired, the rate of this development varies and is affected by the child's age at the time of the repair. Even though the prognosis for normal speech development is fairly good once the palate is repaired, the child remains at risk for persistent articulation errors, compensatory productions, and abnormal resonance due to malocclusion and VPI. Therefore, speech and resonance, in addition to language,

should be carefully monitored throughout preschool and early school years (Ann W. Kummer, 2014).

2.4.2 Impact on Speech Production

Prior to closure of the palatal cleft, speech will be greatly affected due to coupling between the oral and nasal cavities will almost inevitably result in hypernasal resonance. Patient will be having difficulty with production of consonants which requires intraoral air pressure. After palatal repair is done, if the surgery was successful in restoring the velopharyngeal mechanism, patient will continue learning his/her language. However for some patient, oral nasal coupling may persist post-surgery due to a two-stage surgery protocol.

Patient who are unable to achieve velopharyngeal closure or who exhibit improper timing of closure often demonstrate problems with speech production and such problems manifest in articulation and resonance disorders. Articulation problems are normally found with the plosive, fricative and affricate sound categories, since they require the generation of high intraoral air pressure. These pressure sounds may be produced with nasal emission, or patient may use compensatory substitutions in place of the pressure sounds. Audible nasal emission is the auditory perception or air passing through the nose during the production of a pressure sound. The patient may produce the sound at the correct point of articulation, but nasal emission accompanies the production (Morris & Ozanne, 2003). This hypernasality due to coupling of the oral and nasal cavities. Although hypernasality is the most frequent resonance problem, other resonance disorders such as hyponasality, mixed nasality, and cul-de-sac resonance may also be identified in the speech of patients with velopharyngeal dysfunction (Ruscello, 2007).

Most cleft patients are present with hypoplastic maxilla against a normal mandible causing a Class III skeletal profile with class III malocclusion. This cause tongue tip to be anterior to the alveolar ridge which cause an obligatory distortion or if the child tends to pull back the tongue it cause a compensatory error (A. W. Kummer, 2011b). Compensatory errors are sounds that are used in place of pressure sounds and generally produced at a more posterior point of articulation than the intended sound. For instance, one of the most frequent compensatory errors utilized by speakers with cleft palate is the glottal stop. It is produced by bringing the vocal folds together to create a complete constriction and then releasing the built-up air pressure created by the lungs (Morris & Ozanne, 2003).

2.4.3 Language specific 'Cleft' Speech Characteristic

There are many 'Cleft' speech characteristics that are seen regardless of the language the patient is learning (Brøndsted et al., 1994). Although less researched, there are also 'cleft' speech characteristics that appear to be language specific. These characteristics are summarized in Table 2.1.

Table 2 -1 Language-specific 'cleft' speech characteristics

Language	Authors	Findings
Cantonese	Stokes and Whitehill (1996)	Bilabial fricatives (for /s & f/)
	Whitehill and Stokes (1995)	Initial consonant deletion
	Gibbon et al., (1998)	Bilabial fricatives (for /s/)
Nepali	Shan (2001)	Consonant deletion
Arabic	Shahin (2002, 2006)	Implosive airstream
		Devoicing of oral stops

The characteristics in Arabic language are hypernasality, nasal emission, weak expiratory air, weak pressure consonants, glottal replacement, and backing, implosive airstream, oral stop devoicing, and labiodental stop (Shahin, 2006).

In Malay language, the type of speech errors that occurred the most were glottal articulations, while the least speech errors included lateralizations or lateral articulations, backing to velar, pharyngeal articulations, active nasal fricatives as well as nasal realizations of fricatives (Syahidah Zulkipli, Alam, Suriakant Patel, & Haque, 2018).

2.5 Speech Assessment

A speech pathology evaluation is indicated for all children with a history of cleft palate, particularly to rule out VPI. It is best done when the child has some connected speech which is around the age of 3 years. A speech evaluation is also indicated both before and after secondary surgery for VPI. According to (Bettens, Wuyts, & Van Lierde, 2014)speech assessment can be divided into instrumental and non -instrumental assessment.

2.5.1 Instrumental Speech Assessment

To restrict the limitations of listener evaluations, several instrumental measurements are available to supplement perceptual assessments. These instrumental assessments can be divided in two groups: direct and indirect techniques. Direct techniques directly visualize the velopharyngeal closing mechanism. Method of assessment includes nasopharyngoscopy, multiview videofluoroscopy, dynamic magnetic resonance, imaging (MRI), lateral cephalometric radiography, Computed tomography (CT) scan and ultrasound.

Indirect techniques provide information from which the velopharyngeal activity can be inferred. This method includes acoustic measurements using accelerometric techniques and nasometry and Spectral characteristics. Other method includes aerodynamic measurements in which nasal and oral airflow or pressure-flow technique is used (Bettens et al., 2014)

2.5.2 Non-instrumental Speech Assessment

Non- instrumental assessment precedes and determines the need for instrumental assessment. The most commonly used non- instrumental speech assessment is perceptual speech assessment. A speech-language pathologist can perceptually assess resonance and articulation based on a speech sample consisting of a standardized articulation test, the repetition of syllables or sentences and automatic or spontaneous speech (A. W. Kummer, 2011a).

The assessment of velopharyngeal function begins with a perceptual evaluation of the patient's speech. During this evaluation, the examiner analyses the acoustic product of velopharyngeal function in order to make inferences about the function of the velopharyngeal valve. In addition, perceptual tests can be applied to clarify this evaluation procedure, such as the Bzoch tests, used to assess hypernasality, nasal emission or hyponasality, and the Gutzmann, used to evaluate hypernasality.

2.5.3 Perceptual Speech Assessment

Perceptual assessments still remain the golden standard in the evaluation of resonance because no existing instrumental assessment technique can yet transcend the possibilities of the human ear. Perceptual assessment is adequate for determining if there is velopharyngeal dysfunction, the type (insufficiency, incompetence, or mislearning), and the approximate size of the opening. As such, recommendations for speech therapy or physical management can be made based on this assessment alone. However, if surgical management is needed, it is helpful to determine the location and shape of the opening through nasopharyngoscopy or videofluoroscopy. The ultimate goal of the assessment of velopharyngeal function is to develop recommendations for the type of treatment that will be most effective in resolving the problem with speech (A. W. Kummer, 2011a).

There are few parameters that is involved in perceptual speech assessment. This includes speech intelligibility, voice, resonance (hypernasality, hyponasality), grimace nasal emission and articulation errors (John et al., 2006). In this study, Cleft Audit Protocol for Speech—Augmented was adapted as it is accepted, validated, and reliable cleft speech audit tool.

2.5.4 Speech Intelligibility

The disorder that affecting speech production in cleft palate patient directly influence the speech intelligibility and may preclude the comprehension and understanding of the message produced by the speaker, impairing the oral communication and interfering with psychosocial integration(Andreoli et al., 2016)

Speech intelligibility is the major factor that determines a person's communicative competence. Intelligibility can serve as an index of the severity of a speech disorder and an indicator of the progress of surgical, prosthetic or therapeutic intervention. There are two major methods which are widely used to assess intelligibility: scaling procedures (such as interval scales) and word identification tasks (Whitehill & Chau, 2004). Based on literature, there several types of listeners such as surgeons, speech language pathologists, parents of children with or without cleft palate, cleft palate children that was used to judge over-all intelligibility(Van Lierde et al., 2010).

Leeper, Pannbacker, and Roginski (1980) found differences in intelligibility according to type of cleft palate: speakers with unilateral cleft lip and palate had the highest intelligibility scores, those with bilateral cleft lip and palate had the next best intelligibility, while the isolated cleft palate group had the poorest overall mean intelligibility. Isolated cleft palate patients had more problems with speech after primary surgery than unilateral cleft lip and palate patients (Timmons, Wyatt, &

Murphy, 2001). In contrast, Fletcher (1978) reported a rank order (from best to worst intelligibility) of speakers with soft palate involvement only, with soft and hard palate, with unilateral lip and palate, and then bilateral lip and palate. (Riski & DeLong, 1984) also reported that speakers with cleft palate only had better intelligibility than those with cleft lip and palate.

Speech intelligibility percentages increased significantly with age, as found in other studies with cleft palate children (Strauss, Broder, & Helms, 1988). Riski and DeLong (1984) reported a weak correlation between age and intelligibility in a study of 68 speakers with repaired cleft lip and palate and concluded that speech intelligibility scores of speakers were no longer age dependent in the age levels above age 5–6 years old.

Relatively few studies have been conducted regarding differences in intelligibility according to gender and age. Leeper et al. (1980) found that males had significantly better single-word intelligibility than females whereas adults with cleft palate had similar intelligibility to younger subjects with cleft palate found no difference in intelligibility between males and females. In 2010, Van Lierde et.al., also found the same findings in his study.

2.6 Quranic Teaching and learning

The Quran are the words of Allah and it is one of the major references for a Muslim. It was revealed to Prophet Muhammad by through the Gabriel in Arabic language. This process of Quranic teaching and learning first started during this through *talaqqi* (meeting between student and teacher face to face) and *musyafahah* (literally means receiving verbally from the movement of the lips*)* method . It is method of learning the Quran face to face where the delivery and teaching method is directly from a teacher to a student. This method was further transferred to the

companions. The companions continued this pedagogy until it is widely accepted as one of the Quran learning systems today (Nor Hafizi Yusof, 2018) .

2.6.1 Quranic Teaching and learning in Malaysia

In Malaysia, the teaching and learning the Quran is in line with the advent and development of Islam. History records show that Islam began to gain a foothold in the Malay Peninsula in 903 AD in Kedah, Kelantan in 1181 AD, 1302 AD and 1414 AD in Terengganu and Melaka. This method of teaching was implemented in school, *madrasdah* (Islamic school), mosque and home. Over the years, few contemporary techinques were developed and was implemented in Malaysia. It includes Al-Baghdadi technique, Iqra' at-Taisir technique, Hattawiyah method, Haraki method and Al-Matien method (Sharifah Norshah Bani Syed Bidin, 2018).

The Ministry of Education Malaysia has introduced educational and curriculum reforms to improve the standard and effectiveness of Islamic education at the primary and secondary public schools. These included the introduction of the New Curriculum for the Primary Schools (*Kurikulum Baru Sekolah Rendah*) or KBSR in 1983 and followed by the New Curriculum for the Secondary Schools (*Kurikulum Baru Sekolah Menengah*) or KBSM in 1989. In these reformed curriculums, there were some improvements made to the religious subject. Yet, there were issues raised against its effectiveness several years after its implementation(Harun, 1996; Mustaqim, Mohamad, & Abu Bakar, 2014).

In its response, the Ministry of Education Malaysia proposed a new initiative known as the j-QAF Programme in 2004, focuses on strengthening the students' holistic understanding of the areas and topics studied in the religious subject that consists of a wide range of basic religious skills including recitation of the Quran, the

learning of the *Jawi* (Malay-Arabic) script and Arabic language as well as the basics of worship. Specifically, it aims to produce Muslim students who can read and write the *Jawi* script skilfully; complete the reading of the whole of the Quran with proficiency; master the basics of communicative Arabic; and understand as well as practice the basic acts of worship. There are five teaching models that have been implemented since 2005, which are: the *Jawi* Writing Improvement Model, Communicative Arabic Model, Smart Prayer Model, Six-Month Completion of Quranic Recitation Model (using *Iqra'*), and Rote Reading of the Quran (*Tasmi'*) Model (Mustaqim et al., 2014).

Out of these, the last two teaching models are exclusively aimed at enhancing the skill of the students in reading the Quran and ensuring their ability to complete its recitation during their study which is from Primary 1 to Primary 6 (Sabilan, Ibrahim, Mohamed Lip, Ishak, & Nga'ishah Mohni, 2018).

2.6.2 Assessment of Quran Education

In monitoring the progress of the students in the j-QAF Programme, the Ministry of Education has outlined a set of criteria and methods of normative and formative assessments that should be followed by the teachers. These include written and oral evaluation in the form of examination, reading test, as well as practical demonstration of certain acquired skills. All these aim towards nurturing the students for continuous development and progress throughout their learning period (Mustaqim et al., 2014).

A large scale study was done by (Samsudin, 2011) based on the '*Modul Khatam Al-Quran j-QAF* which involved 3443 12 years old students. It was found that their Quranic recitation proficiency is at satisfactory level. A research was

conducted by Md Hasan, Nik Yaacob, and Yahaya (2015) to assess Quranic recitation among Standard Four student showed 46.7% of them has moderate ability in reciting Quran fluently with *Tajwid.* Another study was conducted among final- year university student with age range 19 – 25 years old showed that their Quranic recitation proficiency are moderate (Bakar, 2014) . Based on a research conducted by (Ramlan, 2003) in assessing the proficiency of Quranic recitation among Form 1 student, it is noted that female has a better proficiency in reciting Quran. To date there are no studies looking into relation of type of cleft or age-related and proficiency in Quranic recitation.

2.6.3 Differences between the Malay language and Arabic

Malaya and Arabic language come from different language family. The differences include phonology, morphology, syntax and semantics. The Malay language adapted the English alphabet starts with the letter A and finishes with the letter Z in total 26 letters (Javed, 2013) .

Table 2-2 Malay letters

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

The Arabic alphabet (Arabic: أَبْجَدِيَّة عَرَبِيَّة 'abjadiyyah 'arabiyyah) or Arabic abjad is the Arabic script as it is codified for writing the Arabic language. It is written from right to left, in a cursive style, and includes 28 letters (Table 2.3).

Table 2-3 Arabic letters.

ي	و	ه	ن	م	ل	ك	ق	ف	غ	ع	ط	ظ	ض	ص	ش	س	ز	ر	ذ	د	خ	ح	ج	ث	ت	ب	أ
y	w	h	n	m	l	k	q	f	g h	‘	ẓ	ṭ	ḍ	ṣ	s h	s	z	r	d h	d	k h	d	j	t h	t	b	‘

Phonetic differences between these two languages are due to different in articulation, aerodynamic, acoustic and auditory production (Javed, 2013). The point of articulation of each letter on both languages are as listed in Figure 2.8 and 2.9.

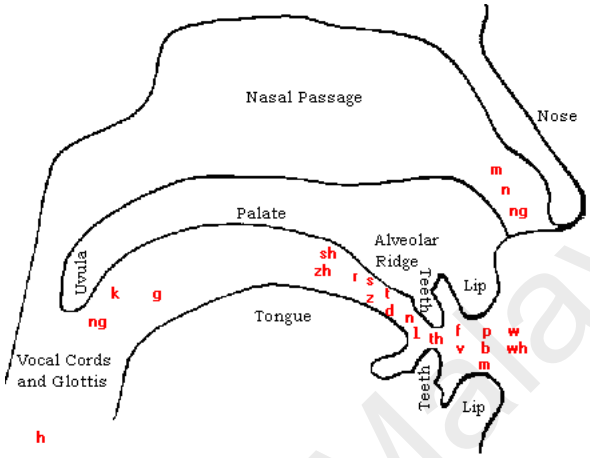

Figure 2.8 Points of articulation of English letters (Image from International Phenotic Alphabet mouth diagram)

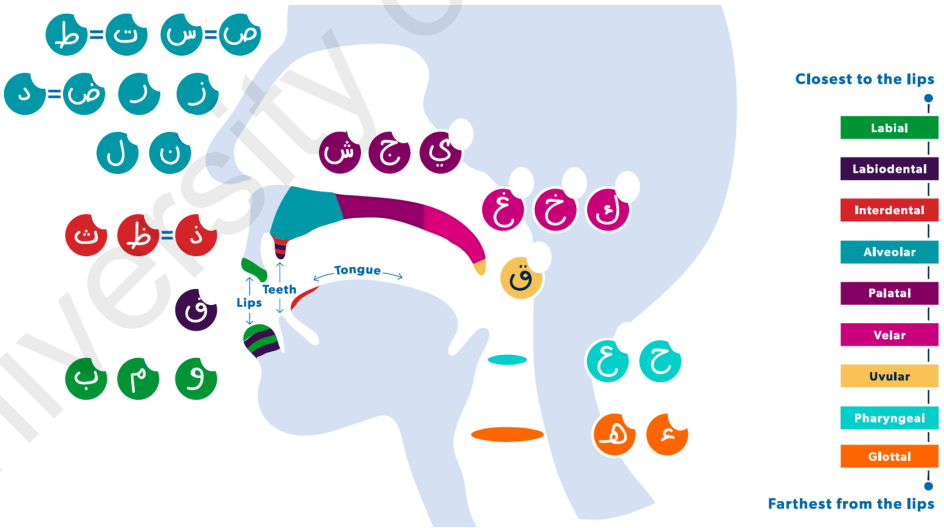

Figure2.9 Points of articulation of Arabic letters (Ryding, 2014)

CHAPTER 3: MATERIAL AND METHOD

3.1 Patient Selection

This study has obtained ethical approval from The Ethic Committee of the Faculty of Dentistry and all patients recruited for this study provided written consent (Appendix A & B). Subjects recruited for this study are from those who have registered with the Cleft Lip and Palate Association Malaysia (CLAPAM)and was seen at Combined Cleft Clinic (CCC), Faculty of Dentistry, University of Malaya. At the start of the study, a total of 50 patients were identified as potential subjects. However only a total of 32 patients agreed to join the study due to other commitments and logistics factors. Patients, parents or guardian were approached during CCC, located at Oral Surgery Clinic, Faculty of Dentistry, University of Malaya. Interviews and simple oral examinations (Appendix C) were done at chairside. Patient was then brought to a sound-proof room (audiology room) and given two passages. One is a short passage written in the Malay language (Appendix D) and another is a set of Quranic passage (Appendix E). Next, patient was asked to read both passages and both speeches were recorded. The recording was saved on a hard disk and analysed by an investigator and a consultant from Academy of Islamic Studies, University of Malaya.

3.1.1 Inclusion criteria

Patients with age group of 6-35 years old with repaired cleft palate deformities and can read simple Malay phrases and Quranic verses.

3.1.2 Exclusion criteria

Patients that were excluded from this study were patients who had palatal fistula, co-existing pathologies other than cleft lip and palate that affected their speech and pharyngeal space such as neuromuscular impairment, developmental stuttering and voice disorder. Participants were also excluded if they had any respiratory infection

on the day of data collection or if they were not able to complete the assessment protocol.

3.2. Data Collection

First, a simple interview was done specifically to obtain the history of management of the cleft and to get an insight on patient's level of education and exposure to Quranic education. Then, a simple oral examination (adapted from Great Ormond Street Speech Assessment (Sell, Harding-Bell, & Grunwell, 1994)) was done at dental chair. This is to identify any possible causes of articulator errors, which will affect the patient's speech. Patient was then brought to a sound-proof room, which is an audiology room located at Audiology Unit, Department of Otorhinolaryngology, University of Malaya Medical Centre. This step is important to avoid any interference or tainting of quality of sound of the recordings.

The protocol of documentation was adapted from the Scandcleft Protocol in 2004 (S. Howard, & Lohmander, A., , 2011) and was used as per international standard. The examiner sat in front of the patient. A recorder with built-in microphones was placed at about 40 cm from the edge of the table in front of the patient.

Patient was asked to speak spontaneously for two minutes then to read a set of stimuli specifically developed by Mohd Ibrahim in her thesis in 2009. It comprises of three Malay stimuli which was divided into an Oral passage, a Nasal passage, and a series of nine sentences (Ibrahim, Reilly, & Kilpatrick, 2012) (Appendix D). Next, patient was asked to recite the Quranic text which consist of Arabic letters from Iqra' 1 (As-Saadi, 2018) and the first chapter of Quran which is *Surah Al- Fatihah* (Appendix E). Patient's voice was digitally recorded using Sony Linear PCM -D100 recorder (Figure3).

Figure 3.1 Sony Linear PCM -D100 recorder

The recordings were saved on a hard disk and were assessed by investigator for speech intelligibility. The investigator is an Oral Maxillofacial Surgeon trainee with nine years working experience and has been dealing with patients with cleft deformities for six years. On the other hand, the Quranic recitation was assessed by co-supervisor of this research, which is a senior lecturer at Applied Science with Islamic Studies Programme, Academy of Islamic Studies, University of Malaya.

3.3 Evaluation parameters

The speech assessment form that was used to assess speech intelligibility was adapted from The Cleft Audit Protocol for Speech - Augmented tool (John et al., 2006)(Appendix F). As for the Quranic assessment, it was adapted from a teaching and learning form of J-QAF *(Ukuran Tahap Pencapaian Bacaan Al-Quran)* (Appendix G). Both assessments were repeated after one month by both authors. Based on Intra-class correlation coefficients (ICC), intra-rater reliability for both authors noted to be excellent. This translates that both authors are consistent with their result.

3.4 Statistical Analysis

Data was analysed using the IBM SPSS Statistic software version 22. Intra-class correlation coefficients (ICC) was used to find intra-rater reliability. Independent t-test were used to compare between speech intelligibility and proficiency of Quranic recitation and its relation to age and gender. One-way ANOVA test was done to compare these two parameters with types of cleft.

CHAPTER 4: RESULTS

4.1 Demographic Data

A total of 32 patients who were registered with the CLAPAM (Cleft Lip and Palate Association Malaysia) and was seen at Combined Cleft Clinic, Faculty of Dentistry University of Malaya were identified and included in the study, but 2 patients were excluded due to incomplete data. The mean (SD) age of the included sample of 30 patients was 14.4 (7.5) years with a range from 6 to 33 years old. There were 12 male and 18 female patients (Table 4.1).

The most common cleft deformity in our sample was left complete cleft lip and palate (56.67%). Six patients (20.0%) were diagnosed with right complete cleft lip and palate, four bilateral complete cleft lip and palate (13.3%) and one was diagnosed with cleft soft palate only (Figure 4.1). 86.7% patients have Class III malocclusion and 63.3% of the patients' teeth were malaligned. 75% of the patients had completed speech therapy and all the recruited sample had completed their surgery with no remaining fistula in their mouth. 76.7% of the cleft palate repair was successful during the first surgical procedure while the remaining 13.3% required second surgery for fistula repair.

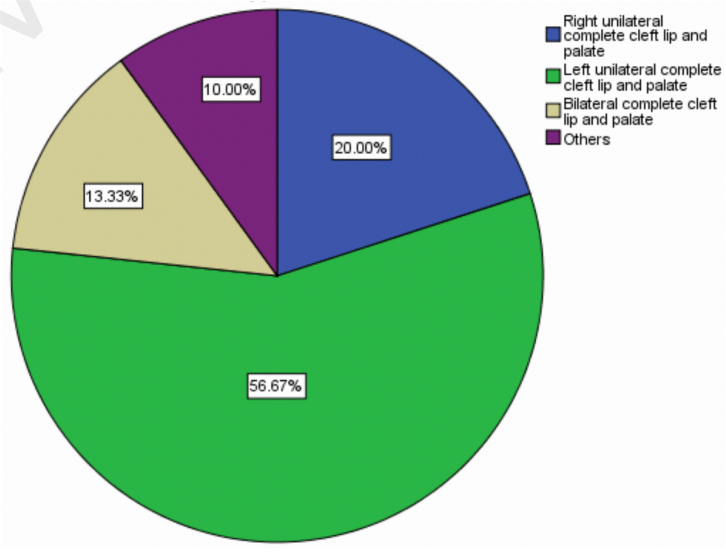

Figure 4.1 Type of cleft distribution

Table 4-1 List of Patient's Data

Subject	Gender	Age	Types of Cleft
1	M	13	Right unilateral complete cleft lip and palate
2	M	9	Left unilateral complete cleft lip and palate
3	M	10	Left unilateral complete cleft lip and palate
4	F	14	Left unilateral complete cleft lip and palate
5	F	16	Right unilateral complete cleft lip and palate
6	F	11	Left unilateral complete cleft lip and palate
7	M	10	Left unilateral complete cleft lip and palate with right incomplete cleft lip
8	F	9	Right unilateral complete cleft lip and palate
9	M	9	Bilateral complete cleft lip and palate
10	M	12	Bilateral complete cleft lip and palate
11	F	31	Bilateral complete cleft lip and palate
12	F	31	Left unilateral complete cleft lip and palate
13	F	33	Left unilateral complete cleft lip and palate
14	F	6	Right unilateral complete cleft lip and palate
15	M	9	Right unilateral complete cleft lip and palate
16	M	13	Right unilateral complete cleft lip and palate
17	F	17	Left unilateral complete cleft lip and palate
18	M	14	Left unilateral complete cleft lip and palate
19	F	12	Left unilateral complete cleft lip and palate
20	F	21	Left unilateral complete cleft lip and palate
21	F	14	Left unilateral complete cleft lip and palate
22	F	8	Left unilateral complete cleft lip and palate
23	M	7	Left unilateral complete cleft lip and palate
24	F	17	Left unilateral complete cleft lip and palate
25	M	22	Left unilateral complete cleft lip and palate
26	F	8	Left unilateral complete cleft lip and palate
27	F	24	Left unilateral complete cleft lip and palate
28	F	19	Isolated cleft palate
29	F	7	Isolated cleft soft palate
30	M	7	Complete cleft lip and palate

The mean (SD) age of patients when they started reciting Quran was 5.77 (1.17) years ranging from 2 to 9 years old of age. 53.3% of patients learned Al-Quran from Quranic teacher. 56.7% of the subjects were reciting Quran every day with 43.3% of them reciting Quran 15 minutes per day followed by 30.0% recite Quran 30 minutes per day.

4.2 Assessment of speech intelligibility and proficiency of Quranic recitation and its comparison

Result for both speech intelligibility and proficiency of Quranic recitation was listed in Table 4.2. All of patients have understandable speech however their level of speech intelligibility differs. 56.67% of patients has normal speech, 33.33% patients had difference in speech compare to other child but not enough to cause comment. The remaining 10.00% patient had different speech enough to provoke comment, but possible to understand most of the speech. None of the patients had the lowest score which deemed as impossible to understand.

Table 4-2 Relation between speech intelligibility and proficiency of Quranic recitation according to score categories

Quranic Recitation Speech Intelligibility	Patient able to recite Quran fluently, eloquently with adherence to the Rules of *Tajwid*	Patient able to recite Quran fluently with adherence to the Rules of *Tajwid*	Patient recite Quran less fluently but able to recite with adherence to the Rules of *Tajwid*	Patient able to recite Quran fluently but without adherence to the Rules of *Tajwid*	Patient was not able to recite Quran fluently and without adherence to the Rules of *Tajwid*
Normal	5 patients	7 patients	4 patients	-	1 patient
Different from other children's speech, but not enough to cause comment	2 patients	4 patients	2 patients	1 patient	1 patient
Different enough to provoke comment, but possible to understand most speech	-	-	2 patients	1 patient	-
Just intelligible to strangers	-	-	-	-	-
Impossible to understand	-	-	-	-	-

For proficiency of Quranic recitation, 60% of these patients were able to at least recite fluently with adherence to the Rules of Tajwid whilst remaining 40% recited Quran less frequently with or without adherence to the rules. It is worth to mention that two of these patients scored the lowest category which indicates that they were not be able to recite Quran fluently and without adherence to the Rules of *Tajwid.* Based on result on Table 4.2 , in general most of the patient has understandable speech and has similar ability in reciting Quran proficiently. Interestingly, there one patient that has normal speech however scored poorest in Quranic assessment as the patient was not able to recite Quran fluently and without adherence to the Rules of *Tajwid.*

Result showed mean score for the speech intelligibility was 30.75 while the mean score for Quran recitation was 23.01 (Table 4.3). It is noted that the range of proficiency of Quranic recitation score is wider than speech intelligibility scores among these patients. This indicates that patient's ability to recite Quran proficiently are varies widely. Statistical analysis revealed that there is significant correlation between these two parameters with P-value <0.001.

Table 4-3 The mean value both in speech intelligibility and proficiency of Quranic recitation in relation to type of cleft, gender and age.

	Mean (SD)	
	Quranic Recitation	Speech intelligibility
Score	23.01(7.30)	30.75 (7.31)
P-value	<0.001	
Cleft type		
Unilateral cleft	23.6 (76.9)	31.3(1.43)
Bilateral cleft	20.9 (9.8)	31.3 (9.9)
Isolated cleft	21.9 (9.0)	25.5 (7.9)
Gender		
Male	19.9(7.9)	30.6(7.8)
Female	25.2(6.1)	30.9(7.2)
P-value	0.047	0.92
Age		
Below 13 years old	21.8(8.3)	31.9(7.3)
13 years old and above	24.3(6.2)	29.6(7.4)
P Value	0.35	0.38

4.3 Cleft type association with scores of speech intelligibility and proficiency of Quranic recitation

The result on type of cleft with speech intelligibility and Quran proficiency scores are stated in Table 2. The one way ANOVA test yielded p-value more than 0.05. This showed that there was no significant difference between types of cleft in both speech intelligibility and proficiency of Quranic recitation.

4.4 Gender association with scores of speech intelligibility and proficiency of Quranic recitation

Overall the mean value both in speech intelligibility and proficiency of Quranic recitation in relation to gender are recorded in Table 2. For speech intelligibility, both genders have understandable speech. The score for male is 30.6 while in female the mean score is 30.9. An independent t-test was conducted to compare these means score and the P-value >0.05. This indicates that gender does not affecting intelligibility of speech.

For Quran recitation, most of female patients were able to recite Quran fluently with adherence to the Rules of *Tajwid* however most of male patient recite less fluently. The mean scores between male and female are 19.9 and 25.2 respectively. From independent t-test, the P-values result was > 0.05 and it was statistically significant. This shows female has ability to recite Quran more proficiently compare to male.

4.4 Scores for speech intelligibility and proficiency of Quranic recitation between different age group

All patients were divided into two groups according to their age. The first group of patients were in primary school and below (less than 13 years old) and the other group were patients in secondary school and higher (13 years old and above). Both group of patient has understandable speech for their speech assessment and were able to recite Quran fluently with adherence to the Rules of *Tajwid.*

The mean value both in speech intelligibility and proficiency of Quranic recitation according to these age group were recorded in Table 2. For speech, patient with age group below 13 has mean score of 31.9 while older age group score 29.6. For Quranic recitation, the mean score of patients below 13 years and patient above 13 years old was 21.8 and 24.3 respectively. From independent t-test, the P-value for both age group was more 0.05 hence statistically no significant. This indicates that there was no difference between age group in their ability to have intelligible speech and reciting Quran proficiently.

CHAPTER 5: DISCUSSION

This study was conducted to assess perceptual intelligibility of speech and proficiency of Quranic recitations in this population and to compare if there any differences between the two.

5.1 Methodology

This study was conducted to assess perceptual intelligibility of speech and proficiency of Quranic recitations in this population and to compare if there any differences between the two. Method of this study was adapted using existing standard protocol for any clinicians to replicate the results in future.

Both assessors showed excellent intra-rater reliability of speech intelligibility and proficiency of Quranic recitation. This shows both assessors were able to identify speech defect and consistent with their judgment. In the literature, a relatively large number of studies used only one listener for assessment oftentimes, the authors of the paper (Van Lierde et al., 2010).The same method was implemented in this study.

In this study, a non-trained listener was the assessor for the perceptual speech intelligibility. Other studies have reported various listeners ranging from trained listener which includes qualified speech-language pathologists or graduate students of speech-language pathology and non-trained listener which involves surgeons, members of the cleft palate team or even a naïve listeners which includes parents of children with or without cleft palate, and their friends(Timmons et al., 2001).

5.2 Assessment of speech intelligibility and proficiency of Quranic recitation and its comparison

All of patients has understandable speech. This good result of speech intelligibility concurs with studies by Andreoli, Timmons, Whitehill. However, local findings from Northeast region of Malaysia reported by

Normastura et. al has a contradictive result. It was found that the prevalence of speech abnormality was 61.2% and concluded that this group of patients were failed to have normal speech. This disparity could be contributed to different methodology of speech assessment. . In Normastura's study, other aspect of speech components which includes hypernasality, hyponasality, Cul-de-sac resonance and articulation speech was assessed by speech-language and pathologist . In our study, only perceptual speech intelligibility was assessed. This is because, it is very important for patient to have intelligible speech in order to be heard by layman for effective daily communication.

The findings on proficiency of Quranic recitation in this scored lower result compare to speech. The main factors contributing this result is Arabic language not a native language, not being used in daily conversation, has different point of articulation compare to Malay language. The range of proficiency of Quranic recitation was wider than speech intelligibility. This translate as patient with repaired cleft palate has different ability in reciting Quran proficiently. Interestingly, there one patient that has normal speech however scored poorest in Quranic assessment as the patient was not able to recite Quran fluently and without adherence to the Rules of *Tajwid*. The possible factors that can explained these are malalignment of anterior teeth with slightly rotated premaxillary segment which alters the point of articulation and in return greatly affecting the Arabic language speech. This issues will be address

upon commencement of orthodontic treatment and alveolar bone grafting at the scheduled timing.

To date, there is no similar study to compare this finding in the literature. In the light of this matter, comparisons were made in Arabic- speaking group of patients. Albustanji et al. reported that 74% of repaired cleft palate patient showed speech abnormalities and substantial number of them demonstrated articulation errors and hypernasality. Shahin reported that most common speech error are compensatory pharyngeal and effecting glottal articulations. On the other hand, comparison of proficiency of Quranic recitation can be made with non-cleft subject. Mustaqim et al and Hassan et al discovered that all subject has average level of proficiency in Quranic recitation and difficulty was noted especially concerning the Rules of *Tajwid.* This shows the result of proficiency of Quranic recitation are not unique to cleft palate population. However, we feel that this study had investigate further into pronunciation of individual Arabic letter, we may be able to find different outcome.

5.3 Cleft type association with scores of speech intelligibility and proficiency of Quranic recitation

It was found that no significance difference between types of cleft and scores of speech intelligibility and proficiency of Quranic recitation. This does not concur to the findings of Leeper et al which found that unilateral cleft lip and palate patient has the best score followed patient with bilateral cleft lip and palate and worst score were among the patients with isolated cleft palate. It is also contrast with Timmons et al., Fletcher and Riski and DeLong studies. This disparity can be explained due to unequal distribution of unilateral and bilateral cleft cases in our research samples.

5.4 Gender association with scores of speech intelligibility and proficiency of Quranic recitation

It was revealed that there is no statistic difference between gender in speech intelligibility. This concurred with the findings of Van Lierde et al.On the other hand, Leeper et al. reported that males had significantly better intelligibility than females. In our study, female has statistically significant score in proficiency of Quranic recitation. This finding also concurs in non-cleft subject as studied by Ramlan. It is noted that female has a better proficiency in reciting Quran.

Our result showed that there was no difference in speech intelligibility in relation to patient's age. This finding is in line with Fletcher and Riski and DeLong reported a weak correlation between age and intelligibility however differs from Strauss et al. On the other hand, patients older than 13 years old have better proficiency of Quranic recitation compare to younger group of patients. This finding concurred with studies conducted in non-cleft subject by Samsudin.

CHAPTER 6: CONCLUSION

6.1 Conclusion

The aim of this study was to assess perceptual intelligibility of speech and proficiency of Quran recitations in Malay cleft palate patients post operatively and to compare if there were any differences between the two. In conclusion, good speech intelligibility was noted among repaired cleft palate patients. However, they did not show similar abilities in reciting Quranic proficiently and the difference is statistically significant

6.2 Limitation

The sample size of this study is limited and localized only at one cleft centre and may not representative of the whole population. Element of listener bias could be present as both assessors are the author of this research.

6.3 Recommendation

Based on these findings, authors would recommend for further study to identify specific Arabic letter pronunciation that has affected by structural defect in repaired cleft palate patients. We also recommend further special teaching in Quranic recitation in this group of patients. A study with larger number of patients which involves other cleft centre in Malaysia with comparison with non-cleft subject is recommended so that the result would be more representative. Input from a speech and language therapist would also beneficial as other component of perceptual

REFERENCES

Albustanji, Y. M., Albustanji, M. M., Hegazi, M. M., & Amayreh, M. M. (2014). Prevalence and types of articulation errors in Saudi Arabic-speaking children with repaired cleft lip and palate. *Int J Pediatr Otorhinolaryngol, 78*(10), 1707-1715. doi:10.1016/j.ijporl.2014.07.025

Ali, S., Shah, S., Ariff Abdul Rahman, Z., & Ilyas Shaikh Muhammad Naeem Khattak Muhammad Ameen Sahito, M. (2015). *DEMOGRAPHIC DATA ON THE CHARACTERIZATION OF ORAL CLEFTS IN MALAYSIA* (Vol. 35).

Andreoli, M. L., Yamashita, R. P., Trindade-Suedam, I. K., & Fukushiro, A. P. (2016). Speech intelligibility after primary palatoplasty: listener perception. *Audiology-Communication Research, 21*.

As-Saadi, A. M. (2018). *Iqra' Al - Furqan : Iqra' & Makhraj Huruf*. Kuala Lumpur: NAQ Publisher.

Ayob, M. A. (2010). *Quranology Ilmu Di Sebalik Sebuah Kitab Agung* (1st Edition ed.). Kuala Lumpur: Must Read Sdn Bhd.

Bakar, M. K. B. H. A. (2014). Kebolehupayaan Pembacaan Al-Quran Dalam Kalangan Pelajar Politeknik Sultan Mizan Zainal Abidin (PSMZA) Retrieved fromhttps://www.academia.edu/8173869/KEBOLEHUPAYAAN_PEMBACAAN_ALQURAN_DALAM_KALANGAN_PELAJAR_POLITEKNIK_SULTAN_MIZAN_ZAINAL_ABIDIN_PSMZA_

Bettens, K., Wuyts, F. L., & Van Lierde, K. M. (2014). Instrumental assessment of velopharyngeal function and resonance: a review. *J Commun Disord, 52*, 170-183. doi:10.1016/j.jcomdis.2014.05.004

Fletcher, S. G. (1978). *Diagnosing speech disorders from cleft palate*. New York: Grune & Stratton.

Harun, A. B. (1996). *Pengajian al-Quran dalam program KBSM (Quranic studies in the KBSM programme)*. Faculty of Education, National University of Malaysia.

Hoffman, W. Y. (2013). Cleft Palate

. In E. D. Rodriguez, J. E. Losee , & P. Neligan (Eds.), *Plastic Surgery* (3rd Edition ed., Vol. 3, pp. 568). London: Elsevier Saunders.

Howard, S., & Lohmander, A., . (2011). *Cleft Palate Speech Assessment and Intervention* (1st Edition ed.). West Sussex John Wiley & Sons Ltd.

Howard, S., & Lohmander, A. (2011). *Cleft Palate Speech Assessment and Intervention* (1st Edition ed.). West Sussex John Wiley & Sons Ltd.

Ibrahim, H. M., Reilly, S., & Kilpatrick, N. (2012). Normative Nasalance Scores for the Malay Language. *The Cleft Palate-Craniofacial Journal, 49*(5), 61-63. doi:10.1597/11-001

Javed, F. (2013). Arabic and English Phonetics: A Comparative Study. *The Criterion An International Journal in English, 4*(4).

John, A., Sell, D., Sweeney, T., Harding-Bell, A., & Williams, A. (2006). The cleft audit protocol for speech-augmented: A validated and reliable measure for auditing cleft speech. *Cleft Palate Craniofac J, 43*(3), 272-288. doi:10.1597/04-141.1

Kummer, A. W. (2011a). Perceptual assessment of resonance and velopharyngeal function. *Semin Speech Lang, 32*(2), 159-167. doi:10.1055/s-0031-1277718

Kummer, A. W. (2011b). Types and causes of velopharyngeal dysfunction. *Semin Speech Lang, 32*(2), 150-158. doi:10.1055/s-0031-1277717

Kummer, A. W. (2016). Evaluation of Speech and Resonance for Children with Craniofacial Anomalies. *Facial Plast Surg Clin North Am, 24*(4), 445-451. doi:10.1016/j.fsc.2016.06.003

Kummer, A. W. (2014). Clefts of the Lip and Palate. In A. W. Kummer (Ed.), *Cleft Palate and Craniofacial Anomalies : Effects on Speech and Resonance* (3rd Edition ed., pp. 39). United States of America: Delmar.

Leeper, H. A., Jr., Pannbacker, M., & Roginski, J. (1980). Oral language characteristics of adult cleft-palate speakers compared on the basis of cleft type and sex. *J Commun Disord, 13*(2), 133-146.

Lieberman, P., & Blumstein, S. E. (1988). *Speech Physiology, Speech Perception, and Acoustic Phonetics*. Cambridge: Cambridge University Press.

Lohmander, A., & Olsson, M. (2004). Methodology for perceptual assessment of speech in patients with cleft palate: a critical review of the literature. *Cleft Palate Craniofac J, 41*(1), 64-70. doi:10.1597/02-136

Md Hasan, R., Nik Yaacob, N. R., & Yahaya, W. (2015). *Pencapaian Kelancaran Bacaan, Fasohah Dan Hukum Tajwid Dalam Tilawah Al-Quran Murid Sekolah Rendah: Satu Tinjauan Awal*.

Morris, H., & Ozanne, A. (2003). Phonetic, Phonological, and Language Skills of Children with a Cleft Palate. *The Cleft Palate-Craniofacial Journal, 40*(5), 460-470. doi:10.1597/1545-1569_2003_040_0460_ppalso_2.0.co_2

Mossey, P. A., Little, J., Munger, R. G., Dixon, M. J., & Shaw, W. C. (2009). Cleft lip and palate. *Lancet, 374*(9703), 1773-1785. doi:10.1016/S0140-6736(09)60695-4

Mustaqim, M., Mohamad, N., & Abu Bakar, B. (2014). *Assessing Quranic Reading Proficiency in the j-QAF Programme* (Vol. 7).

Nor Hafizi Yusof, M. A. t. R., Najmiah Omar, Mohamed Fathy Mohamed Abdelgelil, Mohd Shafiee Hamzah. (2018). Concept and Execution of Talaqqi and Musyafahah Method in Learning Al-Quran. *International Journal of Academic Research in Business and Social Sciences, 8*(11), 559-565.

Ramlan, A. (2003). *Kemahiran membaca al-Quran dan jawi pelajar-pelajar tingkatan sekolah berasrama penuh satu kajian kes.* Perpustakaan Tun Seri Lanang, Bangi.

Riski, J. E., & DeLong, E. (1984). Articulation development in children with cleft lip/palate. *Cleft Palate J, 21*(2), 57-64.

Ruscello, D. (2007). *Treatment of Velopharyngeal Closure for Speech: Discussion and Implications for Management* (Vol. 2).

Ryding, K. C. (2014). *Arabic: A Linguistic Introduction*. United Kingdom: MPG Printgroup Ltd, Cambridge University Press.

Sabilan, S., Ibrahim, B., Mohamed Lip, S., Ishak, M., & Nga'ishah Mohni, S. (2018). *Analisis Tahap Penguasaan Bacaan Al-Quran Murid Tahun 5 Sekolah Kebangsaan Sungai Karang Berdasarkan Model Khatam Al-Quran Dan Model Tasmik J-Qaf*.

Samsudin, F. (2011). *Tahap pencapaian murid-murid tahun enam dalam modul khatam al-Quran j-QAF: satu kajian di sekolah kebangsaan daerah Kuala Muda, Yan* Master Thesis. Open University Malaysia.

See, G. B., Ibrahim, H. M., Lan, T. H., & Ahmad, Z. A. (2018). *Holistic Approach in the Management of Cleft Lip & Palate* (G. B. See, H. M. Ibrahim, T. H. Lan, & Z. A. Ahmad Eds. 1st Edition ed.). Bangi: Penerbit Universiti Kebangsaan Malaysia.

Sell, D., Harding-Bell, A., & Grunwell, P. (1994). *A screening assessment of cleft palate speech (Great Ormond Street Speech Assessment)* (Vol. 29).

Shahin, K. (2006). Remarks on the speech of Arabic-speaking children with cleft palate: three case studies. *Journal of Multilingual Communication Disorders, 4*(2), 71-77. doi:10.1080/14769670600662284

Sharifah Norshah Bani Syed Bidin, M. S. H., Tasnim Abd Rahman, Kasimah Kamaruddin, Nik Azeah Nik Azman. (2018). Teaching and Learning Method of al-Quran: A Study in UniSZA's Mosque. *Jurnal Hadari: An International Journal, 10*(1).

Stanier, P., & Moore, G. E. (2004). Genetics of cleft lip and palate: syndromic genes contribute to the incidence of non-syndromic clefts. *Hum Mol Genet, 13 Spec No 1*, R73-81. doi:10.1093/hmg/ddh052

Strauss, R. P., Broder, H., & Helms, R. W. (1988). Perceptions of appearance and speech by adolescent patients with cleft lip and palate and by their parents. *Cleft Palate J, 25*(4), 335-342.

Syahidah Zulkipli, A., Alam, M., Suriakant Patel, E., & Haque, S. (2018). *A perceptual evaluation of resonance disorders in children with repaired unilateral cleft lip and palate in Hospital UniversitiSains Malaysia* (Vol. 17).

Timmons, M. J., Wyatt, R. A., & Murphy, T. (2001). Speech after repair of isolated cleft palate and cleft lip and palate. *Br J Plast Surg, 54*(5), 377-384. doi:10.1054/bjps.2000.3599

Van Lierde, K. M., Luyten, A., Van Borsel, J., Baudonck, N., Debusschere, T., Vermeersch, H., & Bonte, K. (2010). Speech intelligibility of children with unilateral cleft lip and palate (Dutch cleft) following a one-stage Wardill-Kilner palatoplasty, as judged by their parents. *Int J Oral Maxillofac Surg, 39*(7), 641-646. doi:10.1016/j.ijom.2010.02.025

Whitehill, T. L., & Chau, C. H. (2004). Single-word intelligibility in speakers with repaired cleft palate. *Clin Linguist Phon, 18*(4-5), 341-355.

LIST OF PUBLICATIONS AND PAPERS PRESENTED

Poster presentation of this research was done at 9th Asian Pacific Cleft Lip-Palate and Craniofacial Congress 2019 (APCC 2019) in Khon Kean, Thailand on 11th and 12th November 2019