Remittances Review
April 2024,
Volume: 9, No: 2, pp.2895-2934
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)
Received : 25 February 2024, Accepted: 31 March 2024

DOI:https://doi.org/10.33282/rr.vx9i2.147

A Study of Phonological Difficulties in Children Born with Cleft Palate

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Abstract

The study aimed to discover the phonological difficulties encountered by children born with a cleft palate. the researcher utilized the 'purposive sampling' technique to select participants, comprising two groups: normal children and those born with a cleft palate. The research instruments employed include a demographic information sheet, a word elicitation list, and categorized picture descriptions based on the articulation of vowel and consonant sounds. These tools were chosen for data collection and analysis, and a speech therapist conducted examinations to evaluate the difficulties faced by children with a cleft palate in articulating speech sounds. To identify potential issues with the toolkit, a pilot study was conducted, with participants giving their consent after receiving a clear explanation of the procedure, purpose, duration, and all ethical considerations. The study utilized the CV

phonology framework proposed by Clements and Keyser (1983) to gather findings, including the substitution of consonants and vowels. This investigation into the phonological difficulties of children born with a cleft palate provides a detailed description of articulation challenges and the substitution process. The substitution process involved comparing the correct pronunciation of vowels and consonants in the Urdu language between normal children and those with a cleft palate. To gain insight into how cleft palate speech appears to them and the phonological representation difficulties faced by such children, two registered speech pathologists, experienced in cleft palate speech, were interviewed. The purpose of these interviews was also to understand the positive effects of speech therapy in improving the speech of children with a cleft palate. The study may also have clinical and educational implications.

Keywords: Cleft Palate, Phonological Difficulties, Vowels and Consonant Sounds, CV Phonology, Articulation Challenges

1. Introduction

This research aims to investigate the phonological challenges in the speech of children born with secondary cleft palate. Such children often face difficulties in producing and acquiring speech sounds accurately due to the congenital condition. According to Genisca A.E. (1997 to 2004), Cleft palate is a congenital condition characterized by a gap in the roof of the mouth, resulting from the improper joining of tissues during fetal development. It can range from a small notch to a complete separation of the palate and may affect speech, eating, breathing, teeth alignment, and facial bone development. The exact cause is not fully understood but is believed to involve genetic and environmental factors. Cleft palate impacts a child's ability to produce speech sounds, leading to communication disorders. Defects in oronasal structure, orofacial function, neuromotor patterns, and psychosocial development contribute to speech problems, with pressure consonants being particularly affected.

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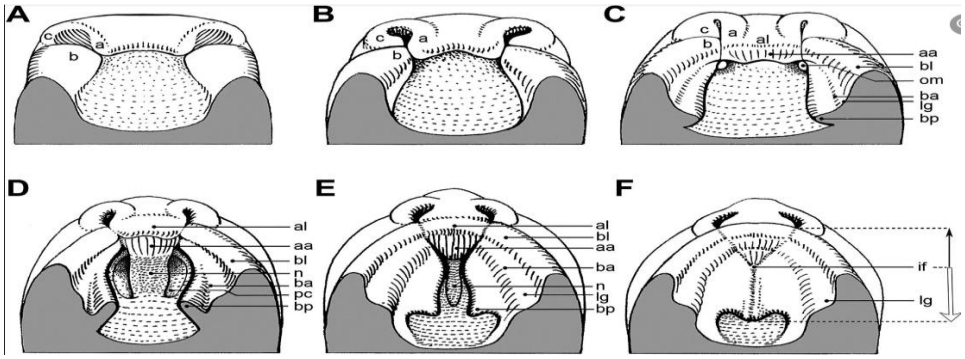


Fig.1 Classification of cleft by ACPA

1.1. Types of Cleft Palate

Children's Hospital Colorado's research presents following types of cleft palates, which refer to openings in the roof of the mouth:

1.1.1. **Alveolar:** A cleft that occurs in the upper gum line (alveolus) and it may or may not extend into the cleft palate.

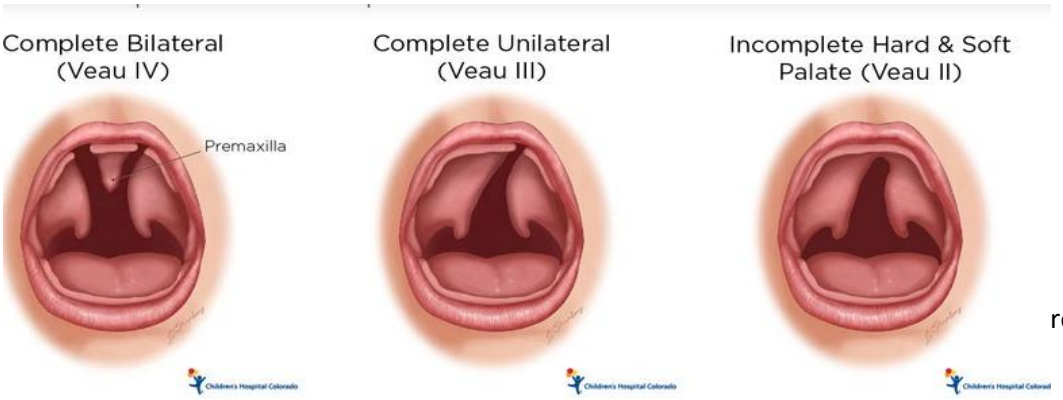
1.1.2. **Submucous:** A cleft located in the soft palate towards the posterior region of the roof of the mouth. This type of cleft is covered by a thin layer of skin or tissue, making it challenging to diagnose as it is not easily visible.

1.1.3. **Complete:** A cleft that extends from the front to the back of the palate, involving both the hard and soft palates.

1.1.4. **Incomplete:** A cleft that does not extend entirely through the hard and soft palates, partially affecting the roof of the mouth.

1.1.5. **Isolated:** A cleft palate without the presence of a cleft lip.

This classification is shown in the image below;



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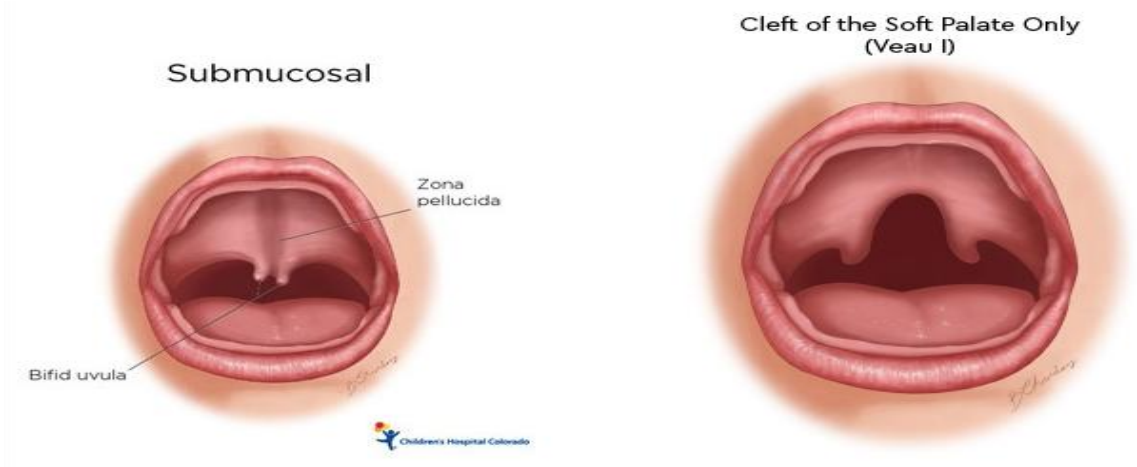

Fig.2 **Classification of Cleft-Palate by Children's Hospital Colorado**

1.2. Communication of Cleft Palate Children

Communication can be a significant challenge for children with cleft palate, as the condition affects the structure and function of the oral cavity and speech mechanisms. Cleft palate can impact a child's ability to articulate sounds and form words properly, leading to speech difficulties and potential communication limitations.

According to Peterson-Falzone & Hardin-Jones, M. A. (2017), there are two categories of cleft type errors in speech sound production; obligatory errors and Compensatory errors explained below;

1.2.1. ***Obligatory errors***

Obligatory errors are those which are caused by structural anomalies such as bad teeth, cleft which is not repaired, oronasal fistulas, etc. They generally cause patterns of articulation to shift. Speech therapy cannot address such problems unless the underlying structural abnormality is not resolved.

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1.2.2. ***Compensatory errors***

Compensatory errors in cleft speech mean the speech difficulties that cleft-palate victims may experience. These errors are displayed when individuals attempt to tackle for the structural differences and functional limitations caused by the cleft. Speech sound defects in cleft palate children may be examined considering the following terms;

1.2.3. ***Articulation:*** The cleft in the palate can affect the placement and movement of the tongue, lips, and other articulators, making it challenging to produce certain sounds accurately. This may result in distorted or unclear speech.

1.2.4. ***Nasality:*** Due to the opening in the palate, air can escape through the nasal cavity during speech, causing a nasal quality to the child's voice. This can affect the intelligibility and resonance of their speech.

1.2.5. ***Speech Intelligibility:*** The combination of articulation errors and nasality can make it difficult for others to understand the child's speech. Some sounds may be substituted, omitted, or distorted, impacting overall speech intelligibility.

1.3. Language Development

The speech difficulties associated with cleft palate can also influence a child's language development. It may affect vocabulary acquisition, sentence structure, and overall expressive and receptive language skills.

It is compulsory to note that the excess and specific compensatory errors in cleft speech might be different among individuals. The findings of this study can contribute to the understanding of compensatory errors found in cleft speech and to know how important is the surgery for children born with different types of cleft.

1.4. Urdu Phonology

This study examines the consonant and vowel system of Urdu, along with its syllable templates, within the context of a phonological theoretical framework. The aim is to investigate the phonological patterns of native Urdu language in children with cleft palate, specifically focusing

on phonological difficulties. Additionally, a comparison between the Urdu consonant and vowel system and English is included to help identify phonological challenges in children with cleft palate.

1.4.1. Consonants

Consonant sounds are produced by blocking the air flow (Roach, 2009). In Urdu, consonants are categorized into two types; voiced and voiceless.

1.4.1.1. Voiced sounds

The vocal folds are brought together to produce the voiced sound, but as the air passes through it repeatedly pulls them apart, causing a vibration impact in the process.

1.4.1.2. Voiceless sounds

When the vocal folds are wide apart and the air from the lungs travels through them unhindered, the voiceless sound is produced. Urdu language contains 16 aspirated and 28 non aspirated sounds.

1.4.2. Place of Articulation and Manner of articulation

Secondly, the focus is on concept of place of articulation and manner of articulation.

1.4.2.1. Place of articulation

The term 'articulation' refers to the position where the sound is produced during pronunciation, or the movement of the tongue and speech organs to create various sounds (Finch, 2000).

1.4.2.2. Manner of articulation

The way of Articulation is the manner in which the air stream is impacted as it streams from the lungs and emerges from the nose and mouth. The way consonant sounds are produced is determined by the manner of articulation, which involves the coordination of various speech organs. (Victoria and Robert et al., 2017).

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1.4.3. Urdu Consonants System

Urdu encompasses 41 consonant sounds, comprising stops, affricates, fricatives, nasals, and liquids/glides. Stops and nasals are articulated at various locations, categorized as labial, dental, retroflex, palatal, and velar. Palatal stops are considered affricates. As per Kahana (2021), each consonant series includes both voiced and voiceless sounds, distinguished by aspiration (aspirated and unaspirated). This contrast is unique to Indo-Aryan among Indo-European languages.

Table 1: Place and Articulation of Consonants

		Labial		Dental		Retroflex		Palatal		Velar		Uvular	Glottal
Stops	Voiced	b	bʰ	ɖ̪	ɖ̪ʰ	ɖ	ɖʰ			g	gʰ		
	Voiceless	p	pʰ	ʈ̪	ʈ̪ʰ	ʈ	ʈʰ			k	kʰ	q	ʔ
Affricates	Voiced							ʤ	ʤʰ				
	Voiceless							ʧ	ʧʰ				
Fricatives	Voiced			Z				ʒ		ɣ			
	Voiceless	F		S				ʃ		x			H
Nasals		M		N		ɳ				nʰ			
Liquids				ɭ̪	r	ɽ	ɽʰ						
Glides		ʋ						J					

1.5. Research Questions

1. What phonological difficulties may a cleft cause in the speech of a child?
2. How do surgery and the speech therapy play a role to mitigate phonological difficulties in cleft palate speech?

2. Literature Review

This study is about phonological difficulties and linguistic disabilities if the children who are born with secondary cleft palate

2.1. Cleft Lip and Palate

One in 500 to 750 children are born with cleft lip and/or palate, making it one of the most prevalent congenital birth defects (Peterson-Falzone et al., 2001). The prevalence is slightly higher in some Asian and indigenous populations and slightly lower in some African groups. According to a recent report from the Centers for Disease Control (CDC), 6,800 children in the US are affected with clefts every year (Moller, 2008; CDC, 2006). Cleft lip and palate have far-reaching effects, impacting hearing, nutrition, dental health, psychosocial development, facial growth, and speech production.

Considering the prevalence of cleft palate and the associated speech articulation and resonance concerns, it is crucial to have appropriate assessment and treatment methods for communication skills in this population (Kuehn & Moller, 2000; Kummer, 2001; Peterson-Falzone, et al., 2000). According to the 2000 U.S. Census, there was a significant increase in the number of individuals in the country who spoke languages other than English at home, totaling around 47 million (U.S. Census Bureau, 2000). The 2005 American Community Survey further revealed that the largest linguistic group consisted of Spanish speakers, comprising 12.0% of the population, which is approximately 35 million people (U.S. Census, 2005). Additionally, specific geographic regions also had concentrations of other linguistic groups.

2.2. Linguistic Diversity in Cleft Care

The United States has a large and growing bilingual population of Spanish-English speakers, and this trend is also evident in cleft and craniofacial clinics, where the number of native Spanish-speaking patients is increasing. A survey conducted in 2004, covering 171 clinics, revealed that over 25% of patients seen in 27 clinics (16% of those surveyed) were Spanish-speaking. Additionally, 75 of the clinics (44%) reported an increase in Spanish-speaking patients over the past five years (Edwards & Bonilla, 2004).

Apart from the increasing number of non-English speakers seen in cleft palate-craniofacial clinics in the U.S., there are also surgical teams that travel to developing countries to offer surgical intervention for individuals with cleft palate and related craniofacial conditions. These trips have been recorded for at least the past 50 years and are still ongoing, with teams

originating from the U.S., the United Kingdom, and other countries (Mars, Sell, &Habel, 2008; Sell, 2007a, 2007b). In most cases, the surgical professionals treat patients who speak a language different from their own, and frequently, there is no local speech-language pathologist (SLP) available.

A recent investigation revealed that only 51 nations and territories have training programs for speech-language pathology or audiology (Bleile, Ireland & Kiel, 2006).

2.3. Linguistic Disability

Communication is the primary means of conveying messages to others and expressing human thoughts and ideas. The process involves intricate movements of the head, neck, chest, and abdomen, which can be quite demanding. Any damage or imperfections in these areas can affect regular speech output. The prevalence of linguistic disorders among people is remarkably high.

A language disorder is the inability of a person to converse politely. Some disorders are brought on by genetic or developmental problems, while others are brought on by brain trauma. According to Lanier (2010) language disorders are defined as "having an incapacity to grasp, form, or use words correctly." It includes both verbal and nonverbal communication. People with language disorders trouble making sounds to communicate with other people. Even if they are highly intelligent, those who have language disorders are viewed as mentally inferior. Due to a negative perception of their personalities, many persons who live with speech or language disorders experience depression.

2.4. Velopharyngeal Inadequacy (VPI)

VPI occurs when there is an inadequate closure of the velopharyngeal valve, which separates the oral and nasal cavities during speech and swallowing. It can significantly impact a person's speech and social communication. According to Peterson-Falzone, Trost-Cardamone, & Hardin-Jones, (2017) VPI can affect a child’s speech in following way:

- Hypernasal Speech
- Hyponasal Speech
- Compensatory Articulations

2.4.1. Impact on Social Communication

VPI can have a significant impact on a person's social communication and overall quality of life. Individuals with hypernasal speech and compensatory articulations may face challenges in effective communication, as their speech may be difficult to understand by others. This can lead to social isolation, reduced self-esteem, and difficulties in academic and professional settings.

3. Materials and Methods

Research methodology provides details about the research design, sampling technique, data collection method, and the subsequent analysis. It also encompasses the entire study procedure, including the pilot study, main study, and addresses ethical considerations (Willig, 2013).

3.1. Research Design

The aim of the present study was to investigate the comparison between two groups in terms of speech phonology in children with cleft palate and normally developing children. The group of children with cleft palate was further divided into two subgroups: pre-surgery and post-surgery. The entire study is based on phonological analysis. This research is based on a qualitative approach that examines particular experiences and meanings in-depth, as perceived through the researcher's insight into a social phenomenon.

3.2. Sampling Technique

The present study employed purposive sampling. The target population for this study consisted of children with cleft palate and typically developing children who spoke Urdu. The sample was relatively homogeneous in terms of educational status, linguistic background, and cultural background. It included both male and female children with various secondary cleft palates, ranging in age from 5 to 12, and was compared with typically developing children of the same age.

3.3. Instrumentations

The tools which were used in present study for data collection are demographic questionnaire, word elicitation list, picture description and tape recordings.

3.4. Data Analysis Method

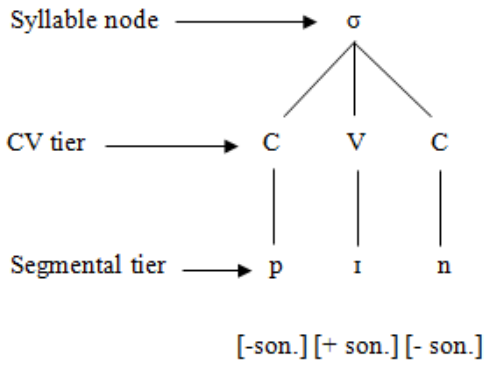
The study examined variations in phonological structure among children with cleft palate. By comparing the phonological components of Urdu language with the phonological challenges experienced by children with cleft palate, including patterns of vowels and consonants and their alterations, this study aimed to identify benchmarks for phonological structural changes.

3.5. Theoretical framework

The theoretical framework used to examine changes in phonological structure of children with cleft palate was through CV phonology, proposed by Clements and Keyser (1983).

3.5.1. CV Phonology

Clements and Keyser (1983) introduced the concept of CV phonology as a framework to illustrate syllable structure. According to this theory, syllables are considered hierarchical units, with the CV tier serving as their fundamental constituents.



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Within CV phonology, a syllable is categorized into three tiers: the syllable node, the CV tier, and the segment tier. The CV tier specifically identifies the peaks and non-peaks within a syllable.

The V tier is taken as the syllable's nucleus, as shown in this Fig. and the syllable structure. The peak of a syllable is occupied by the vowel, which is the most sonorous sound within the syllable. Clements and Keyser (1983) have presented a phonological sonority chart that categorizes segments into different positions based on their sonority. According to this chart, vowels consistently serve as the peaks in syllables due to their high sonority.

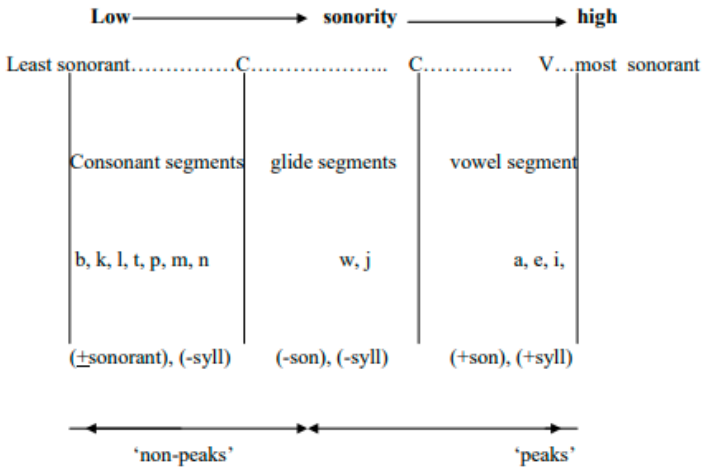

***Fig.4* Chart of Sonority Hierarchy**

With the exception of vowels, all the components in this chart function as non-peaks and hold a marginal position within the syllable. Glides, despite being more sonorant than consonants, cannot serve as peaks because they fall into the category of consonants due to their place of articulation.

During the articulation of glides, airflow is regulated, whereas vowels are produced without any interruption. The CV units, which constitute the CV tier, include vowels and consonants. However, they occupy different positions on the sonority strength chart. Vowels and consonants together comprise the segmental tier of the syllable, but they have distinct roles, as illustrated in the figure.

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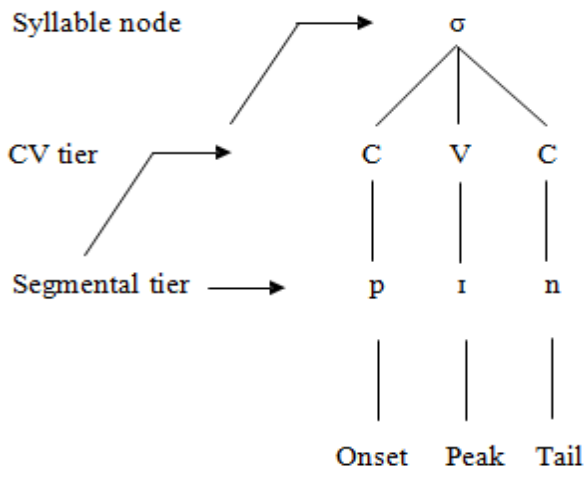

***Fig.5* Constituents of a syllable**

According to the figure, any segment influenced by the segmental tier of V functions as a syllable peak, as indicated by the [+sonorant] feature. The term "syllabicity" is employed by theorists to elucidate how C and V segments operate within CV elements.

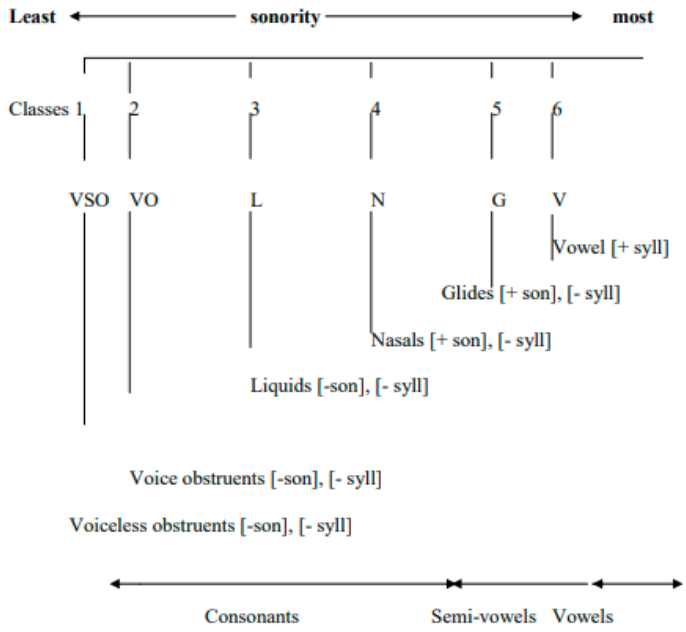

***Fig.6* Sonority Strength Hierarchy**

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A segment is considered syllabic only if it is dominated by a V-element, while a C-element of the CV tier is non-syllabic. Clements and Keyser (1983) propose that there are classes of segments that serve as peaks, and the selection of the syllable (CV) containing the sonority peak is not arbitrary but rather determined by the hierarchy of sonority strength.

The provided figure illustrates the phonetic relationship between sonority and the tendency for voicing. It demonstrates that the audibility of a sound is influenced by its sonority. According to Hooper (1976), sonority refers to the loudness of a sound, with nasals, liquids, and obstruents considered less sonorous compared to glides and vowels. In the context of a CV tier, the syllabicity of vowels is determined based on their position in the sonority hierarchy. The most sonorant element serves as the nucleus and functions as a V, while the less sonorant sound preceding the nucleus represents the onset or C-element

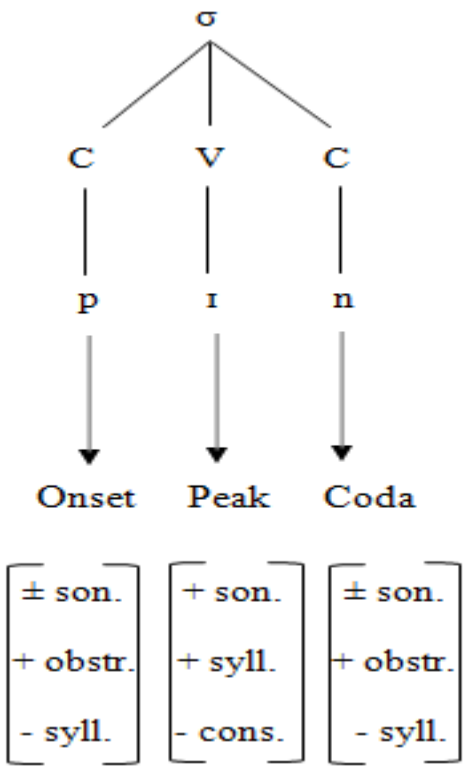

Fig.7 **Onset, Peak and Coda Algorithm**

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The Fig 3.5 shows that codas and onsets may or may not be sonorant but they are never syllabic, while nucleus are represented by the [+syll] and [+son] elements.

4. Data Analysis

This chapter focuses on the data analysis of phonological difficulties faced by cleft palate children. Firstly, the researcher examined the production of Urdu vowels and consonants in speech of cleft palate children before and after surgery. The data was collected and analyzed concerning the Urdu monophthongs including sounds such as /ɪ/, /ʊ/, /ə/, /ɛ/, /ɑ:/, /o:/, /e:/, /i:/, /æ/ and /u:/ and the consonant sounds of /p/, /b/, /ʈ/, /ʈ̪/, /ɖ/, /ɖ̪/, /k/, /g/, /h/, /s/, /z/, /f/, /v/, /ʃ/, /ʒ/, /ʧ/, /ʤ/, /l/, /r/, /ɽ/, /j/, /ɣ/, /x, /m/ and /n/. Secondly, the data analysis considered Urdu consonant substitution focusing on the word initial, medial and final positions by applying CV Phonology theory. In third phase, the data collected from Speech Language Therapists was analyzed to learn about the benefits of speech therapy in alleviating phonological difficulties of cleft palate children.

The data was collected from three types of participants; Pre- surgery, Post surgery and the normal children.

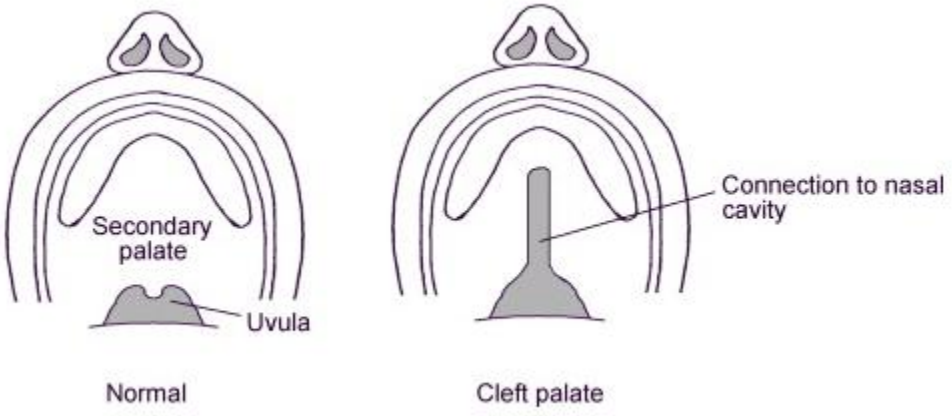

Fig.8 **Showing contrast between a normal and cleft palate**

4.1. Data taken from children before surgery

The researcher considered the children who had a secondary cleft only.

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4.1.1. Nasalization of short vowels

Nasalization of vowels refers to the phonetic process where a vowel sound is produced with a lowered velum, allowing air to pass through the nasal cavity while the vowel is articulated. This results in a nasal quality being added to the vowel sound.

Nasalization in the vowel production of children with secondary cleft is presented in the table below. First column contains the list of Urdu short vowels, the second has indication of nasalization shown by (+) sign and the third column presents if the vowel is non-nasalized shown by the sign (-).

Table 2: Short Vowels

Short vowel	Nasalized	Non-Nasalized
ɪ	+	-
ɛ	+	-
ə	+	-
ʊ	+	-

The table above indicates that the children, before surgery, demonstrate a highly defective way of producing short vowels, as they nasalize all of them. Specifically, they produce all four short Urdu vowels as ɪ̃, ɛ̃, ə̃, ʊ̃, respectively. Consequently, the column labeled "Nasalized" contains all positive signs (+) to indicate the nasalization of all short vowels. On the other hand, the column labeled "Non-nasalized" contains negative marks (-) because the cleft palate children were unable to produce any short vowel without nasalization. This happens due to their inability to close their velopharyngeal port.

4.1.2. ***Nasalization of Long Vowels***

Long vowels are vowel sounds that are pronounced for a relatively longer duration compared to short vowels. They are characterized by an extended or prolonged sound quality. Long vowels pronounced by cleft palate children are shown in the table below;

Table 3: Long Vowels

Long Vowels	Nasalized	Non-Nasalized
ɑ:	+	-
o:	+	-
e:	+	-
i:	+	-
u:	+	-
æ	+	-
ɛ	+	-

The table above reveals that prior to surgery; the children exhibited long Urdu vowels as ɑ:˜, o:˜, e:˜, i:˜, u:˜, and æ˜ respectively. This is evident in the "Nasalized" column, which bears all positive signs (+) to signify the nasalization of each long vowel. Conversely, in the column labeled "Non-nasalized," a negative mark (-) appears for each entry, indicating that the cleft palate children were incapable of producing any long vowel without nasalization.

4.2. Data Analysis of Children after Surgery

The most apparent change post-surgery will be the closure of the cleft in the palate. This data is collected from the kids with secondary cleft palate who have received the required surgery.

4.2.1. Nasalization of Short Vowels

Table 4: Nasalization of Short Vowels

Short vowel	Nasalized	Non-Nasalized
ɪ	±	±
ɛ	±	±
ə	±	±
ʊ	±	±

The table above indicates that the children, post-surgery, demonstrate a less defective way of producing short vowels, compared to the children pre-surgery. Some of them produce vowels without any type of nasal resonance, while others exhibit hyper-nasalization, but it is much less than the pre-surgery children. They produce all four short Urdu vowels as ɪ, ɛ, ə, ʊ, or with tilde for nasalized versions, ɪ̃, ɛ̃, ə̃, ʊ̃, respectively. Consequently, both the columns labeled "Nasalized" and "Non-nasalized" contain positive as well as negative signs (±) to indicate nasalization of short vowels in some cases and non-nasalization of these vowels in other cases.

4.2.2. Nasalization of Long Vowels

Table 5: Nasalization of Long Vowels

Long Vowels	Nasalized	Non-Nasalized
ɑ:	±	±
o:	±	±
e:	±	±
i:	±	±
ʊ:	±	±
æ	±	±
ɛ:	±	±

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The table above reveals that after surgery, the children exhibited a significantly lesser flawed method of producing long vowels, as some of them nasalized these vowels while others generated the long vowel sounds more clear. Specifically, some participants rendered these long Urdu vowels as aː, eː, oː, iː, uː, ɛː, æ while the other articulated them as ɑː˜, oː˜, eː˜, iː˜, uː˜, æ˜ and ɛ˜. This is evident in both the "Nasalized" and “Non-nasalized” columns, which bear positive as well as negative signs (±) to signify the nasalization of each long vowel in some case while non-nasalization of these long vowels in other cases.

4.2.3. Production of Urdu Consonants

The researcher analyzed Urdu consonant sounds based on their place of articulation. Firstly, let's discuss the **bilabials**. The children before surgery demonstrated fairly accurate production of bilabial sounds without any substitution such as /p/, /b/, /m/, and /m^{h}/. However, there was some distortion observed in the bilabial sound /ph/ and /b$^{h/}$. It's important to note that all of these bilabial sounds were hyper-nasalized, as the cleft palate children produced these sounds through their nasal cavity. None of them is hypo-nasalized or omitted.

Secondly, all the **dental and alveolar** sounds in the speech of these children are found to be distorted and hypo-nasalized. These sounds are pronounced as t̪˜, t̪^{h}˜, d̪˜, d̪^{h}˜, n˜, n^{h}˜, ʈ˜, ʈ˜, ɖ˜, ɖ^{h}˜, /s˜/, /z˜/ and /l˜/. Additionally, apart from /n/, /n$^{h/}$ and /l/, all the other alveolar sounds undergo a substitution process. The details of this substitution process will be discussed later in the section dedicated to substitutions.

Thirdly, let's consider the velar sounds, which include /k/, /k^{h}/, /g/, /g^{h}/, /q/, /ɣ/, /x/, and /ŋ/. In the speech of cleft palate children, all of these sounds are found to be distorted and hypo-nasalized. Except /s/ and /x/ other velar sounds are substituted or omitted by children prior to their surgery because of their quite open and detached velum. They certainly fail to block the air as the tongue is unable to touch the velum or palate due to its separated physiology. Due to their defective oronasal structure they totally omit these sounds or substitute them with /ɣ/ or /x/. It is noteworthy that none of the Urdu velar sounds are hypo-nasalized.

Fourthly, let's address the palatal sounds, which are /ʃ/, /ʒ/, /ʧ/, /ʤ/, /r/, /ɽ/, /ɽh/, and /j/. The researcher observed hyper-nasalization and distortion in all of these sounds. However, there is no

omission or hypo-nasalization of any palatal sound. It is worth noting that apart from /ʃ/, /ʒ/, /r/, and /j/, the other palatal sounds are compensated for by using some other sounds in their place.

Fifthly, let's discuss the labiodentals /f/ and /v/. In the speech of cleft palate children, both sounds are found to be distorted and hyper-nasalized. However, they are not omitted or hypo-nasalized. Interestingly, there is no process of substitution or compensation observed for these sounds.

Lastly, we have the glottal sound /h/, which is merely hyper-nasalized. It does not display any evidence of hypo-nasalization, omission, or substitution.

4.2.4. Substitution of Consonants

Children with cleft palate substitute certain consonant sounds due to their abnormal speech organ.

4.2.4.1. Plosives/Stops

Consonants are produced by creating a brief closure (closure stage) and compressing the air in the mouth behind closed lips (hold phase) for a short period of time, followed by a quick release of the held air (release phase) resulting in a burst of sound (post-release phase), are referred to as stops or plosives.

The data analysis presented here focuses on voiceless pairs of dental sounds, namely /t̪/ and /ʈ/, as well as voiced pairs of dental sounds, such as /d̪/ and retroflex /d/. These analyses demonstrate the occurrence of these consonants in word initial, medial, and final positions.

4.2.4.1.1. ***Substitution of / ʈ/ and /t̪/into /k/***

There are six plosives in Standard English.

Input **Output**

/ʈərɑ:k/(truck) is substituted by kərɑ:k

/t̪a:la/ (lock) is substituted by /ka:la/

/ ʈ / is a dental consonant which is pronounced while enunciating with the tongue against the upper teeth. It is voiceless sound. The sounds /ʈ / and /t̪/ are a stop pair. While the individuals

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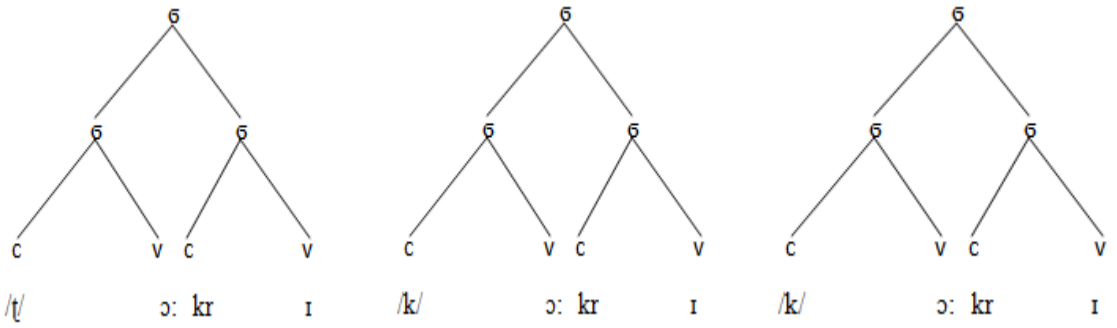
with cleft palate substitute /ʈ/, /ʈ̪/ voiceless sounds with voiceless consonant/k/ while pronouncing a word in their speech.

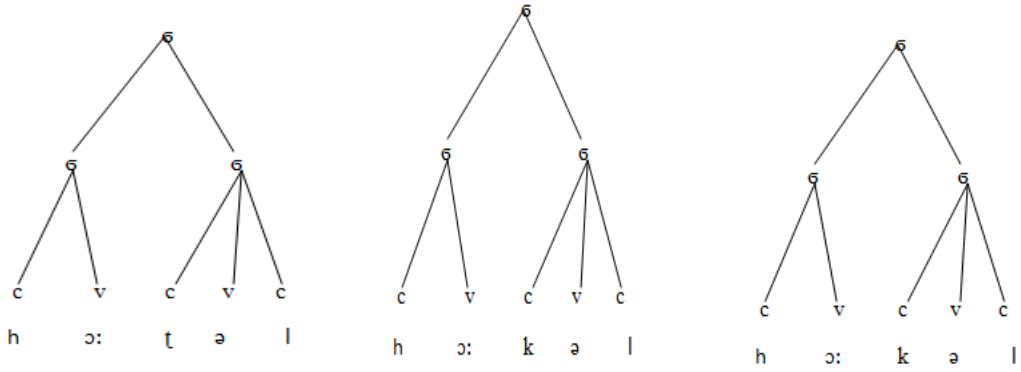
Substitution of consonant /ʈ/ into /k/ at initial position

Input **Consonant Substitution** **Output**



Substitution of consonant /ʈ/ into /k/ at middle position

Input **Consonant Substitution** **Output**



Substitution of consonant /ʈ/ into /k/ at final position

Input **Substitution of consonant** **Output**

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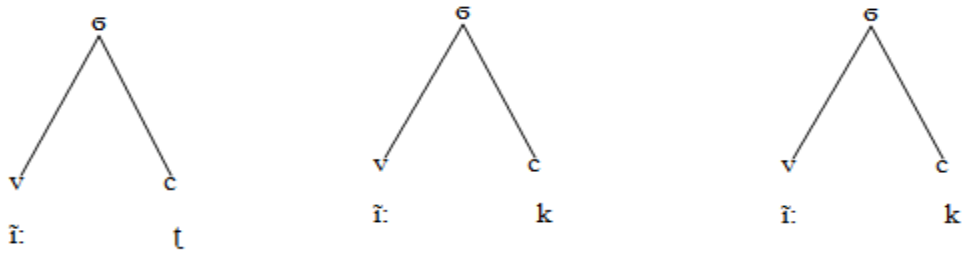

The above figure shows that the consonant sound /ʈ/ is compensated by cleft palate children as /k/ due to which input / ĩ:ʈ/ is changed into /ĩ:k/.

Table 6: Showing substitution of /ʈ/ sound by /k/ at initial, middle and final word position

Initial	**Middle**	**Final**
kɔ:kri	fɔ:kɔ:	bu:k
kɔ:pi	hɔ:kəl	pleik

4.2.4.1.2. *Substitution of /ɖ/ and /ɖ̤/ with /g/*

Retroflex are the sounds that are created with the curling of the tongue tip back towards the hard palate (Skandera and Burleigh, 2005).

Input Output

/ ɖəbba/ (Box) the Consonant is substituted by /gəbba /

/ɖ̤ərja:/ (River) the Consonant is substituted by /gərja:/

The sounds/ɖ/ and /ɖ̤/ are voiced consonant stops pair which are articulated enunciated with the tongue against the upper teeth.The native speaker children with cleft palate substitute these dental sounds with voiced velar sound /g/ which shares the same distinctive features with /ɖ/ and / ɖ̤/.

Data regarding usage of /ɖ/ and /ɖ̤/ voiced dental sounds at initial, middle and final position is presented in above chart.

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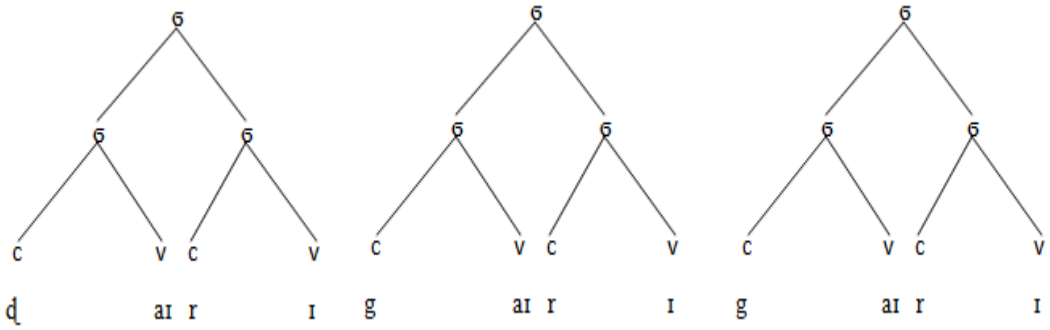
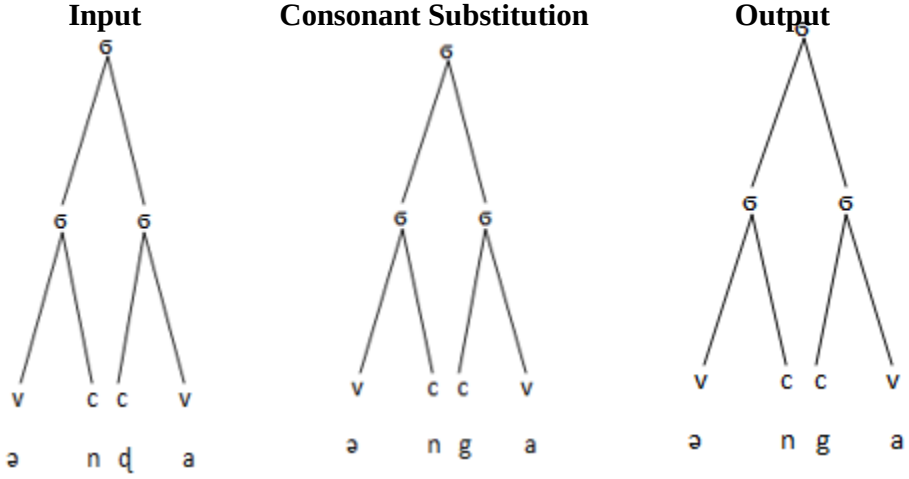
Substitution of /ɖ/ into /g/ at initial position

Input **Consonant Substitution** **Output**



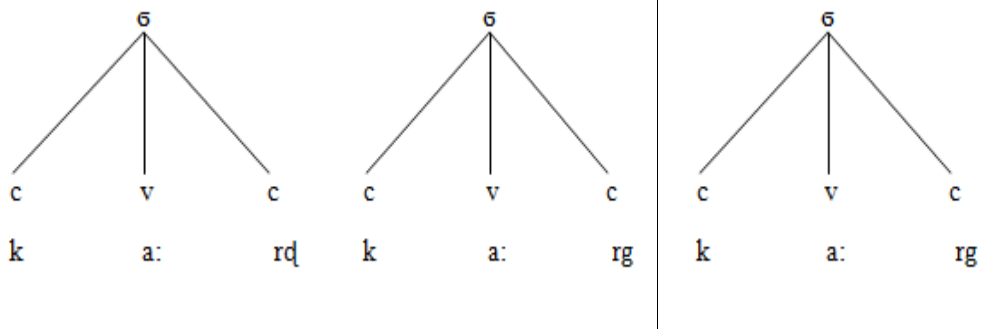
Substitution of /ɖ/ into /g/ at middle position

Input **Consonant Substitution** **Output**



Substitution of /ɖ/ into /g/ at final position

Input **Consonant Substitution** **Output**



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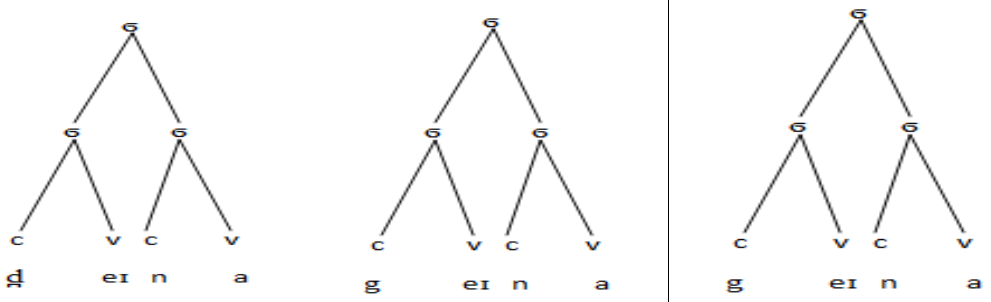
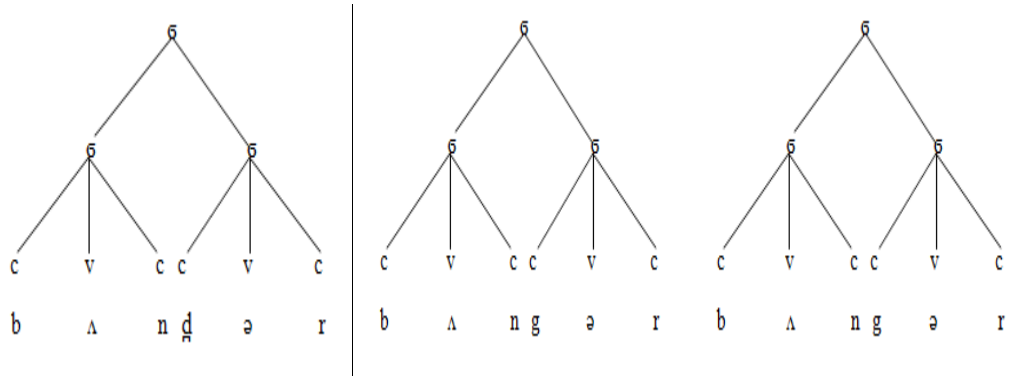
Substitution of /ɖ/ into /g/ at initial position

Input **Consonant substitution** **Output**



Substitution of /ɖ/ into /g/ at middle position

Input **Consonant substitution** **Output**



Substitution of /ɖ/ into /g/ at final position

Input **Consonant substitution** **Output**

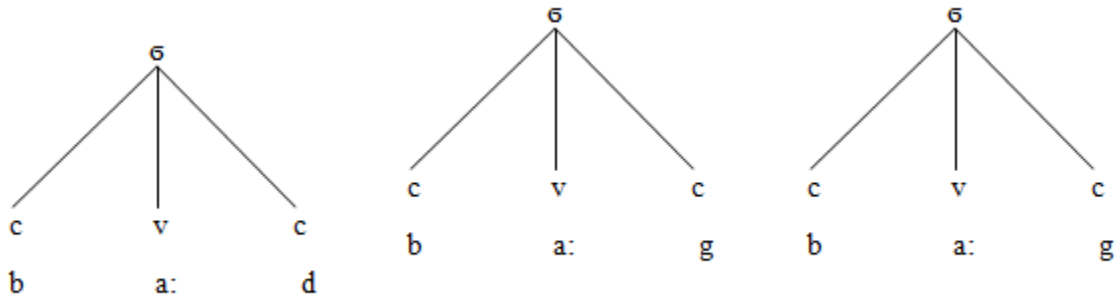


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Table 7: Showing substitution of /ɖ̪/ and /ɖ/ into /g/

Initial	Middle	Final
gəbbə/ɣəbba	kelʌngʌr	Ka:g/ kaɣ
ga:ɪrɪ:/ɣairi:	ənga:	beg/ beɣ

The above Fig.4.4 shows the replacement of Urdu consonants /ɖ̪/ and/ɖ/ into /g/.The substitution takes place at all the initial, middle and final positions in speech of children with cleft palate.

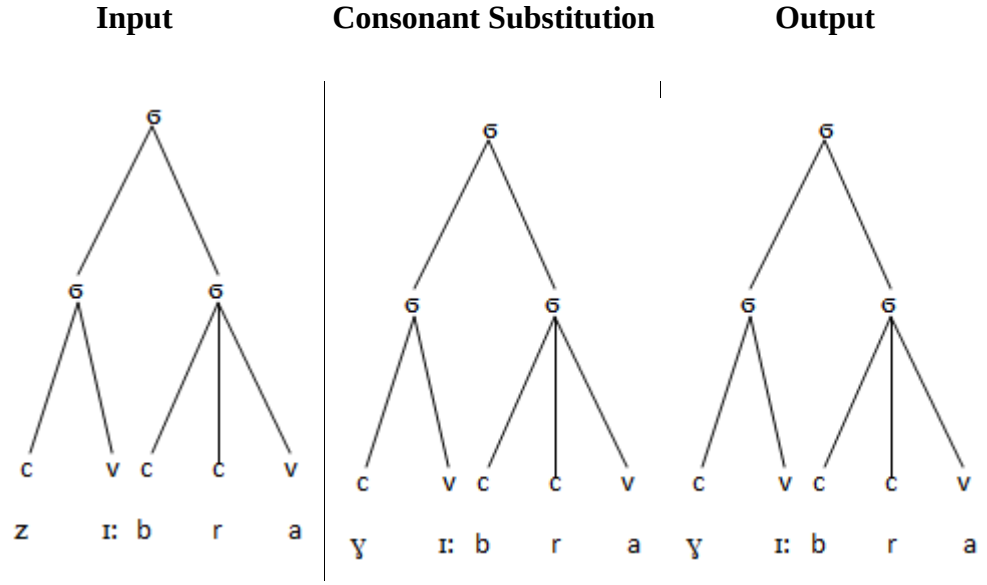
4.2.4.2. Fricatives

The voiced alveolar fricative /z/, voiceless alveolar fricative /s/, and voiceless dental fricative /θ/ are presented in the data analysis.

4.2.4.2.1. Substitution of /z/ with /ɣ/ and /s/ with /x/

The alveolar fricative/z/ is substituted with /ɣ,g/ and /s/ is replaced by /k,x/ in Urdu native speaker children with cleft palate.

Substitution of consonant /z/ into /ɣ/ at initial position



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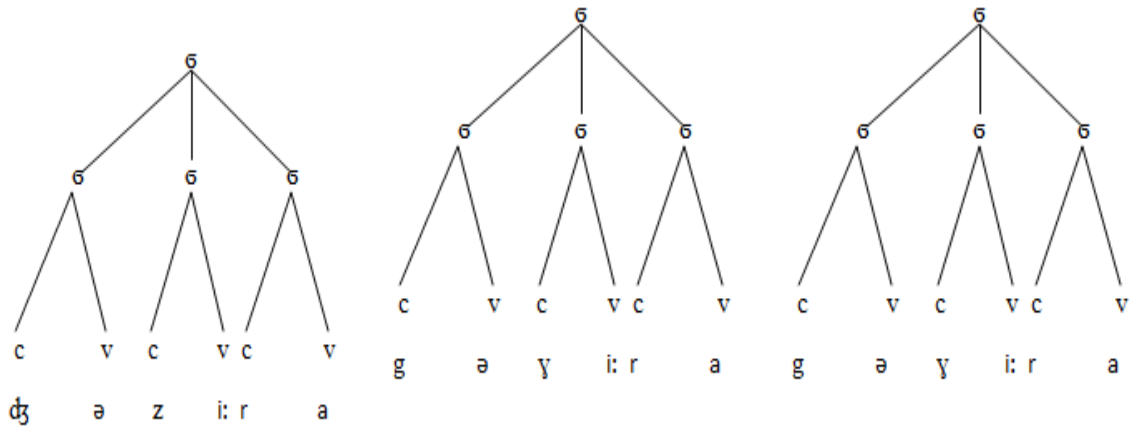
Substitution of consonant /z/ into /ɣ/ at middle position

Input **Consonant Substitution** **Output**



Substitution of consonant /z/ into /ɣ/ at final position

Input **Consonant Substitution** **Output**

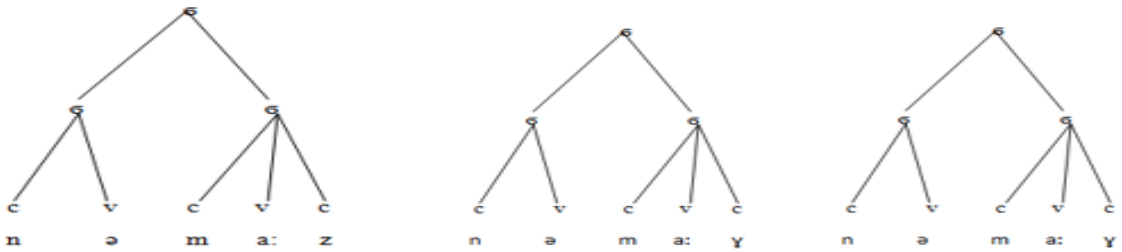


Table 8: showing substitution of /z/ into /ɣ/ at word initial, middle and final position

Initial	Middle	Final
ɣi:bra	gəɣi:ra	gəha:ɣ
ɣænəb		nəma:ɣ

Substitution of /s/ into /x/ at word initial position

Input **Consonant Substitution** **Output**

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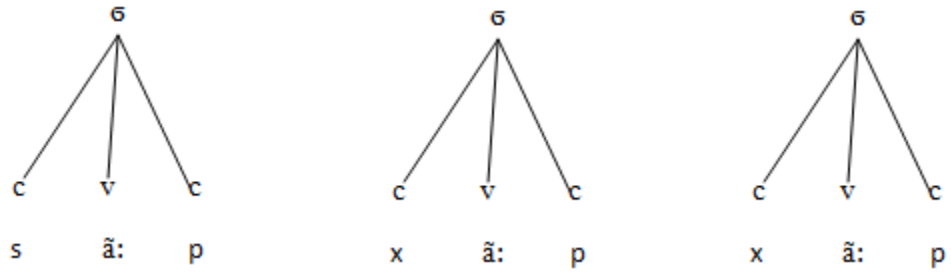
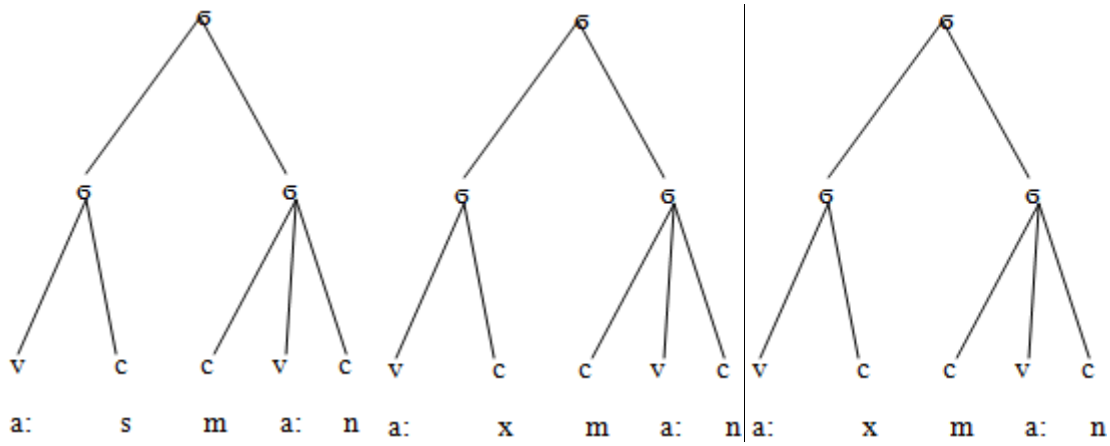


Substitution of /s/ into /x/ at word middle position

Input **Consonant Substitution** **Output**



Substitution of /s/ into /x/ at word final position

Input **Consonant Substitution** **Output**

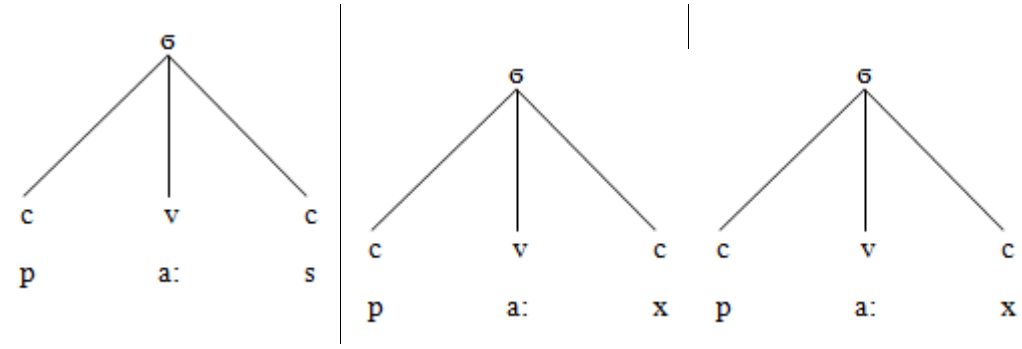


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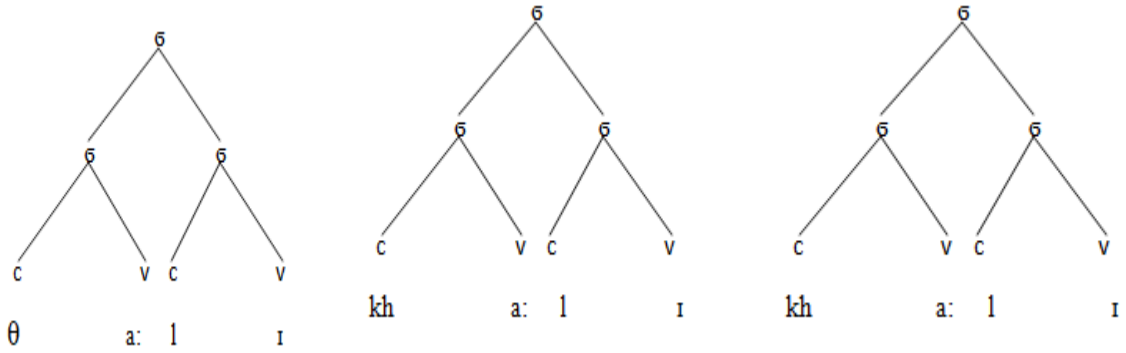
Table 9: Showing Substitution of /s/ with /x/ at word initial, middle and final position

Initial	Middle	Final
xa:np	a:xma:n	pa:x
xa:nx	a:xa:n	keɪnix

4.2.4.2.2. The substitution of /θ/ with /k^{h}/

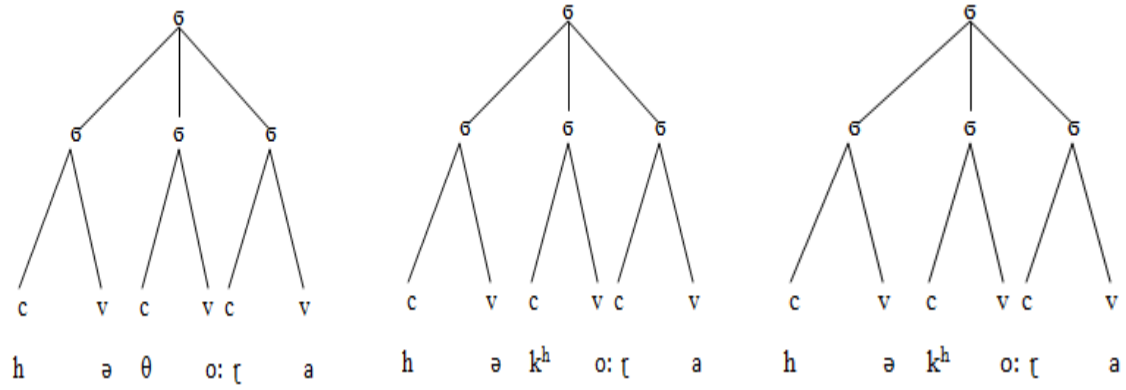
Substitution of Consonant /θ/into /k^{h}/ at Word Initial Position

Input **Consonant Substitution** **Output**



Substitution of Consonant /θ/ into /kh/ at word middle position

Input **Consonant Substitution** **Output**



Substitution of Consonant /θ/into /kh/ at word final position

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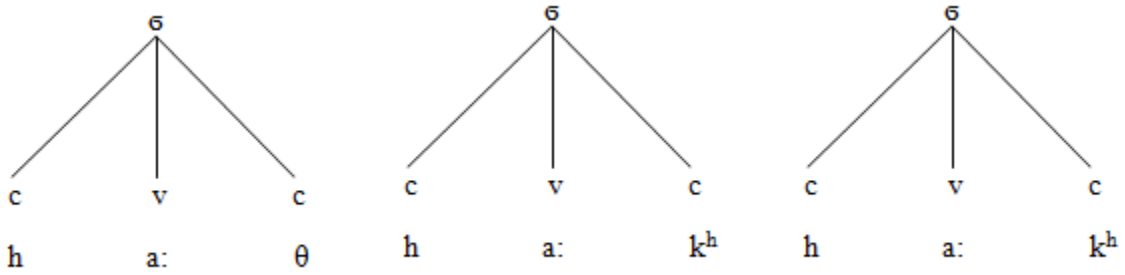
Input **Consonant Substitution** **Output**



In the below table, it is clear that in the cleft palate speech /θ/ sound is substituted by /$k^{h/.}$

Table 10: Showing cleft palate speech /θ/ sound is substituted by /$k^{h/}$

Initial	Middle	Final
K^ha:li:	hək^hɔ:ɽa	Ha:k^h
K^hæla:	ha:k^hi:	Bu: k^h

4.2.4.3. Affricates

The data collected and analyzed in the current study discusses the alteration of /ʧ/ sound into /k/ by the children born with cleft palate.

4.2.4.3.1. Substitution of /ʧ/ consonant sound into /k/:

The affricate /tʃ/ is commonly found in words like "cheese," "church," and "watch." It is produced by releasing a stop closure at the alveolar ridge followed by a fricative sound.

Substitution of /ʧ/ into /k/ at word initial position

Input **Consonant Substitution** **Output**

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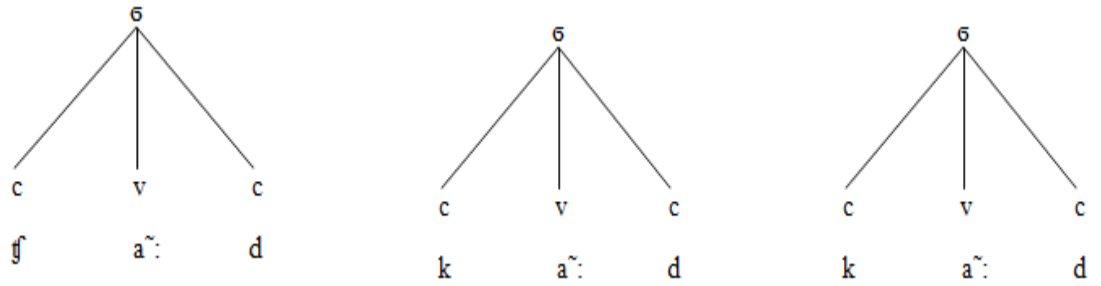
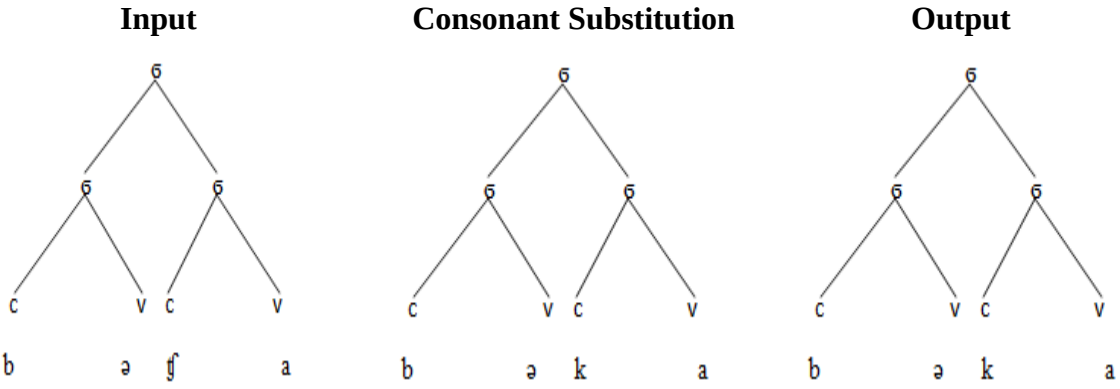


Substitution of /ʧ/ into /k/ at word middle position



Substitution of /ʧ/ into /k/ at word final position

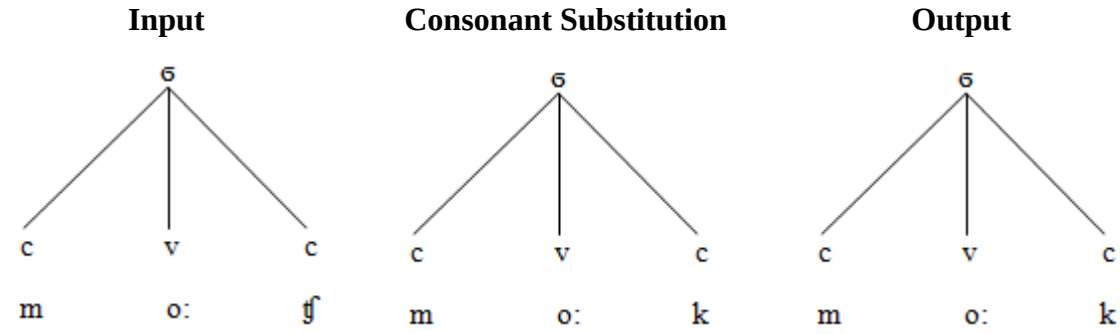


Table 11: showing substitution of /ʧ/ into /k/ at word initial, middle and final position

Initial	Middle	Final
ka:rpaɪ	kəkra	na:k
ka:r	aka:nək	xʌk

4.2.4.3.2. Substitution of /ʤ/ with /g/

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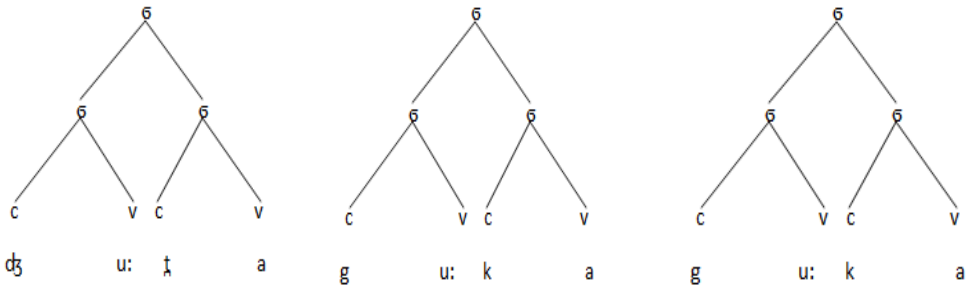
The affricate /dʒ/ is found in words like "judge," "jam," and "edge." It is produced by releasing a stop closure at the alveolar ridge followed by a fricative sound similar to the "zh" sound in "measure."

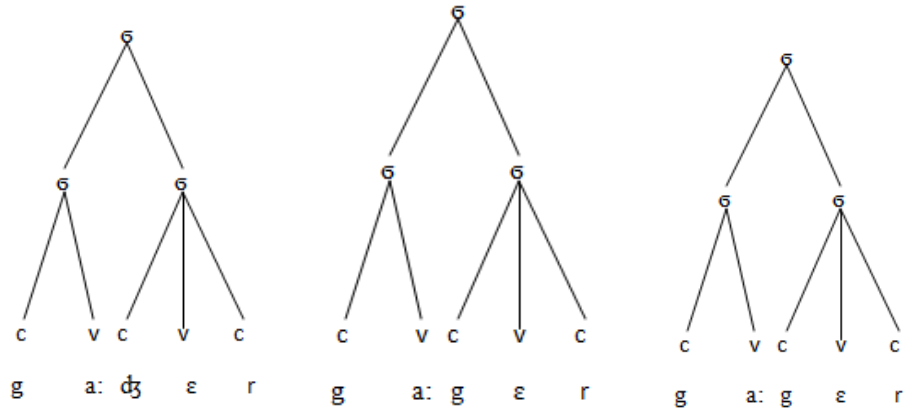
Substitution of consonant /dʒ/ into /g/ at word initial position

Input **Consonant Substitution** **Output**



Substitution of consonant /dʒ/ into /g/ at word middle position

Input **Consonant Substitution** **Output**



Substitution of consonant /dʒ/ into /g/ at word final position

Input **Consonant Substitution** **Output**

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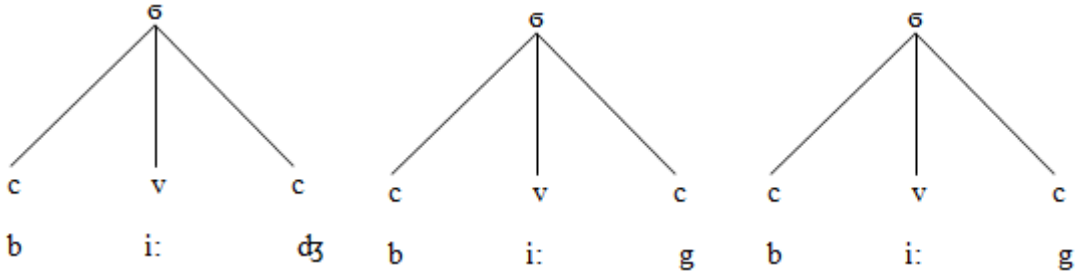

Table 12: Showing substitution of /ʤ/ into /g/ at word initial, middle and final position

Initial	Middle	Final
gəhaːɣ	k^həguːr	aːg
gaːguː	bəgaːna	həg

5. Results

After analysis of the data collected from cleft palate children and the speech pathologists, the researcher has been capable to answer the first research question what phonological difficulties a cleft palate may cause in speech of children. The whole discussion shows that the most prominent difficulty dominating the cleft speech is nasalization because these children are unable to successfully block their nasal cavity while producing speech which results from their inadequate velopharyngeal port. Distortion of sound is the other defect found in the cleft speech. The third aspect noticed in cleft palate speech is that the children are not capable to produce intelligible speech rather they compensate some sounds by substituting them with others.

To answer the second research question about the role of surgery and speech therapy mitigating phonological difficulties in cleft palate speech, the researcher compared the speech of pre-surgery and post surgery children. The comparative analysis shows that the speech of pre-surgery children is more nasalized and distorted. These children often omit velar sounds and substitute

other sounds due to their open roof of mouth. They face problem in generating /k/, /g/, /ʤ/, /ʧ/,/ɖ̪/, /ɖ/, /ʈ̪/, /ʈ/, /z/, /s/ sounds. Surgery plays a vital role in improvement of cleft speech. Factor of nasalization and distortion is much less than the children pre-surgery. They are found to be successful in production of /k/ and /g/ sounds because their palate is repaired by palatoplasty. Somehow they can produce velar sounds but they are unable to produce many other sounds which require the physical contact between the palate with velum and other parts of oral cavity too. After joining the palate with velum they fail to make contact between tongue and hard palate or alveolar ridge. The pressure is not built in a good way and the parts fall apart much before production of sounds like /ʤ/, /ʧ/,/ɖ̪/, /ɖ/, /ʈ̪/, /Ɵ/, /ʈ/, /z/, /s/. The process of substitution and compensation of sounds can be summarized as below:

The data analysis showed that the alveolar plosive Urdu consonant sounds /ʈ/ and /ʈ̪/ are replaced by /k/ sound that is a velar/glottal stop. For example, /ʈɔ:pi/ (cap) is pronounced as /kɔ:pi/ and /ʈ̪iʈ̪li/ (butterfly) is substituted by /kikli/. It is also noted that both the encountering sounds share a distinctive feature of stop/plosive. The Urdu alveolar stops /ɖ/ and /ɖ̪/ are substituted with /g/ which is velar/glottal stop e.g. /da:l/ (branch) is spoken as /ga:l/ and /ɖ̪unja:/ (world) as /gunja:/ Both the compared sounds share a distinctive feature, manner of articulation; stop. Substitution of /z/ alveolar fricative with /ɣ/ palatal fricative and /s/ alveolar fricative with velar fricative /x/ is also found in the cleft speech. For example, /zi:bra/ (zebra) is articulated as /ɣi:bra/ and /sona/ (gold) as /xɔ:na/. Here it is also to be noted that both the substituting sounds share same distinctive feature manner of articulation; fricative. The aspirated dental fricative /θ/ is substituted by aspirated velar stop /$k^{h/}$ e.g. /θæla/ (bag) is produced as /K^{h}æla/. It can be taken in noticed that both the replacing sounds share a feature of aspiration.

To talk about affricates, the cleft speech showed compensation of /ʧ/ sound which is a palatal affricate with /k/ that is a velar stop e.g. /ʧa:qu/ (knife) is articulated as /ka:qu/. There is no apparent distinctive feature shared by both the substituting sounds. The other affricate /ʤ/ is also mispronounced by cleft palate children as they compensate this sound with /g/ or /ɣ/ sound e.g the word /ʤa:mən/ is misarticulated as /ga:mən/ or /ɣa:mən/.

6. Discussion

This study provides a concise examination of phonological challenges faced by these children. It focuses on the quality of voice (distortion and nasal resonance) during the production of Urdu vowels and consonants and their substitutions. The analysis of substitution process is conducted using the CV phonology theory, introduced by Clements and Keyser in 1983. The Urdu language possesses distinctive phonological characteristics in its consonants and vowels. To analyze the patterns of Urdu language phonemes and syllables, all data was recorded using audio tapes. The researcher also interviewed Speech language Pathologists who have a good experience with cleft palate speech to check for the validity of the results of the study. After analyzing the speech data and interviewing the speech pathologists, the researcher is able to point out following facts about cleft speech.

The study addresses the question of what phonological difficulties a cleft may cause in the speech of a child through an analysis of data collected from cleft palate children, both pre-surgery and post-surgery, respectively. The analysis comprises three stages. Firstly, it briefly examines the challenges and difficulties associated with producing pure vowels in the Urdu language. These pure vowels are classified based on the height and position of the tongue during articulation. The findings reveal that pre-surgery children exhibit more difficulties in the production of speech compared to post-surgery children. Cleft speech does not involve any substitution of vowel sounds. Moreover, the children with cleft palates face significantly fewer difficulties in generating vowels compared to consonants. However, it is important to note that

vowel production may not always be fully intelligible. The phonological display of cleft speech certainly involves hyper-nasality.

Moving on to the second part, the study investigates the production of Urdu consonants, their nasalization, distortion, and substitution based on their place and manner of articulation. These consonants encompass stops/plosives, fricatives, affricates, nasals, and semivowels, each characterized by a specific place and manner of articulation. Moreover, consonants like dental, palatal, retroflex, velar and alveolar are replaced by other phonemes. It studies about substitution of consonant sounds by other consonants which may or may not share similar distinctive features, depending on their place or manner of articulation.

The cleft speech analyzed in this study shows that the most dominating factor among all the other defects and difficulties of speech production is nasalization. Children before receiving surgery are unable to produce even a single sound either vowel or consonant without nasalization. The other factor is distortion, which is very noticeable in the speech of children before surgery. Their voices are dominated by hoarseness and breathiness, and every sound is followed or accompanied by a hissing-like sound, leading to speech that lacks intelligibility. After surgery, the children's speech becomes less distorted, although it still may not be entirely intelligible. However, their speech is significantly improved compared to the group described earlier.

The element of substitution is present in both pre-surgery and post-surgery cleft speech but exception is also there as some children exhibit substitution while the others may not. Children often substitute many sounds with others in an attempt to compensate for communication difficulties. They may even omit sounds to meet their communicative needs. However, children who undergo surgery before they start speaking, face fewer difficulties. They learn how to build pressure and block their nasal cavity more effectively and quickly compared to those who have surgery later. Late recipients of surgery compensate for their speech in their own ways, leading to much variation and confusion.

It should be noted that these articulatory errors and resonance problem vary from child to child as some face only the resonance problem while some of them go through the process of substitution depending upon the conditions of their speech physiology.

Speech therapy plays an integral part in making the cleft speech intelligible. Speech therapists work their best to eliminate nasalization and train the children to block their nasal cavity while producing certain sounds. They start with production of vowels. Children are guided to block their nasal cavity and articulate vowels through their oral cavity. After vowels, consonants are practiced as a single speech sound at word initial, middle and final position. Their place of articulation is settled through single speech sound. Afterwards these sounds in clusters are rehearsed. Though surgery has its own importance in cleft speech betterment yet role of speech therapy cannot be denied.

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