

**FACILITATORY EFFECT OF CONSONANT POSITION ON ARTICULATION OF
AFFRICATES AND FRICATIVES IN CHILDREN WITH HEARING IMPAIRMENT**

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May, 2017

CERTIFICATE

This is to certify that this dissertation entitled “*Facilitatory effect of consonant position on articulation of affricates and fricatives in children with hearing impairment*” is a bonafide work submitted in part fulfillment for degree of Master of Science (Speech-Language Pathology) of the student (Registration Number: 15SLP019). This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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This is to certify that this dissertation entitled “*Facilitatoy effect of consonant position on articulation of affricates and fricatives in children with hearing impairment*” has been prepared under my supervision and guidance. It is also been certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled “*Facilitatory effect of consonant position on articulation of affricates and fricatives in children with hearing impairment*” is the result of my own study under the guidance of Dr. N. Sreedevi, Reader and Head, Department of Clinical Services, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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*Dedicated to those tiny tots
who participated in the study...*

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Chapter I

Introduction

Hearing and speaking are two eternal parts of communication. Impairment in hearing, leads to spoken language disorder which in turn leads to speech sound disorder. Speech production in children with congenital hearing impairment is directly related to the degree of hearing loss and the frequencies involved. Briefly, the common articulatory errors in individual with hearing impairment are divided into substitutions, omissions and severe distortions of the intended phoneme as well as the addition of adventitious phonemes or syllables. Among the more common error types involving consonants are confusion in voiced-voiceless distinction, substitution of one consonant for another, added nasality, misarticulation of consonant blends, misarticulation of abutting consonants, and omission of word-initial or word final consonants (Hudgins & Number,1942). The most commonly seen speech sound errors in children with hearing impairment are deletions and substitutions. Articulatory errors common to children with hearing impairment are not confined to the production of individual phonemes. They do occur because of the phonetic context in which the phonemes are embedded. The child may be able to produce a perfect /s/ in isolation but may habitually omit or distort it in flowing speech.

An individual will usually be able to produce a sound easily in the initial or final positions, in a syllable, word, phrase, or sentence (Lass 1982). Habitually, the production errors in a child with speech sound errors are inconsistent, apparently as a consequence of contextual influences. That is certain phonetic environments or

linguistic conditions are more favored than others to be associated with accurate sound production. Generally, children with speech sound disorders have delayed acquisition of speech sounds compared to typically developing children. Acquisition of sounds is specific to the phonotactic rules of a particular language. Thus, it can be observed that speech sounds are acquired in a particular manner under the influence of various contexts like position of the word, following and preceding vowels, juncture, neighboring consonants, and rules of the language.

The role of context in the facilitation of correct production of erred sound is important clinically for two reasons. First, with respect to assessment, clinicians using standard articulation tests as well as informal assessment should appreciate the influence of context. To be precise, a clinician can get extremely varied results in one test used with totally facilitative phonetic contexts and other used with totally non-facilitative contexts. The second reason is with regard to management; treatment decision could be based on contextual sensitivity of correct sound production. Specifically, intervention would advance from highly facilitating context to least facilitating or non-facilitating contexts. Ideally, the clinician could work methodically through a hierarchical categorization of facilitating conditions, explicitly word or syllable position, stress and adjacent sounds (Kent,1982)

Effect of Phoneme Position on Typical Speech Sound Development

Studies in the past decades have proved that there is a positional variation in the acquisition of each phoneme. It has been observed this to vary across languages. In English, most of the sounds are acquired first in the initial position of the word and then in the final position (Bleile, 2006; Dodd, Holm, Hua, & Crosbie, 2003; Smit, Hand, Freilinger, Bernthal, & Byrd, 1990; Stoel-Gammon, 1985; Watson &

Skucanec, 1997b). The phonetic developmental pattern of Dutch has been reported to be almost same as English with respect to vowels and singletons.

Stoel-Gammon (1985), conducted a study on 34 normally developing English speaking children. The range and types of consonantal phones produced at 15, 18, 21, and 24 months in samples of their meaningful speech were analyzed. He explored separate inventories for word-initial and final position consonants for each child at each age level. Results of this scrutiny revealed that, most of the sounds (voiced anterior stops, nasals, glides and few fricatives) were acquired at the initial position, whereas voiceless stops and alveolar consonants showed propensity towards final position. Especially phonemes /t/ and /r/ appears first in final position. He also observed extremely similar pattern in terms of the place and manner of articulation across subjects.

Various researches have been conducted on acquisition of liquid /r/. Studies by Hoffman, Schuckers and Daniloff (1980); Magloughlin (2016), report /r/ being acquired in the initial or prevocalic position. Curtis and Hardy, (1959) reported that /r/ was facilitated in intervocalic position. Conversely, few other studies reports that it is acquired in the final or post vocalic position compared to prevocalic position (McGowan, Nittrouer, & Manning, 2004; Stoel-Gammon, 1985; Smit, Hand, Freilinger, Bernthal, & Byrd, 1990; Templin, 1957).

Another sound class which is greatly explored for facilitating phoneme position are fricatives. Bennet and Ingle (1984) found that the production of /s/ was more facilitated in the context of following central vowel when compared to initial clusters. Hypothesis of Ferguson and Farwell (1975) stated fricatives tend to appear first in word -final position, later in word-initial position. Gallagher and Shriner

(1975b) concluded place of articulation of adjacent phonemes probably to play an important role compared to manner of articulation in the correct production of an error sound.

McLeod, Sutton, Trudeau, and Thordardottir (2011) studied the acquisition of consonants in Quebecois French in pre-school aged children. Results revealed that the consonants were acquired earlier in the initial position of the word followed by medial position and then final position.

In most Dravidian languages, the basic meaningful segment is a syllable where words end only with a vowel. Hence, words can have only two positions, namely, initial and medial positions. On the other hand, English has three positions in a word, namely, initial, medial, and final. So, a sound in Dravidian language can be acquired either at initial or medial positions or rarely in final position. Divya and Sreedevi in 2010 on articulatory acquisition in typically developing Malayalam speaking children in the age range of 2 to 3 years found the acquisition of dental fricative /s/ earlier in word medial position than word initial position. But for palatal fricative /ʃ/ both positions were equally facilitating.

Effect of Phoneme Position on Speech Sound Development in Children with Speech Sound Disorders

In most of the children with hearing impairment the articulatory errors are inconsistent, apparently as a result of contextual influences. That is, there is a remarkable influence of phonetic environment or linguistic conditions on correct sound production.

Scott and Milisen (1954) conducted a study on the acquisition of phonemes /f, z, s, k, l, v, r, g/ in children with articulation problems in the age range 4-to14- years. Results of this study showed that, children could produce these sound more correctly in the initial or final positions of a word than in the medial position. Also, they reported that the production of /s/ was highly facilitated in the context of clusters (/st, sn, sp, sk/) than in the context of vowel (CV).

Rockman and Elbert (1984) investigated the untrained acquisition of fricative /s/ in a child with phonological disorder. They found that the acquisition pattern of speech sound /s/ was in similar pattern as observed in typically developing children. The fricative /s/ was acquired in the final position followed by initial and then in the medial position.

From the reported studies, it can be observed that speech sounds are acquired in a particular position under the influence of various contexts like position of the word, following and preceding vowels, juncture, neighboring consonants, and rules of the language. On the whole, the foremost importance of testing the context is to identify position that may facilitate the sound production in speech therapy. Such information is useful and will help SLPs for planning more effective articulation therapy.

Intelligibility in hearing impaired

Even after the primary intervention, one of the prominent factors affecting quality of life of hearing impaired individual is the reduced speech intelligibility (Lass 1982). Although some hearing- impaired children develop good speech intelligibility, many do not. It has generally been found that overall frequency of segmental or phonemic errors increases in the speech of hearing impaired following which intelligibility decreases (Brannon, 1964; Gold, 1978; Hudgins & numbers, 1942;

Markides, 1970; Smith, 1975). Hudgins and Numbers (1942) found a negative correlation between intelligibility and total number of vowel errors as well as total number of consonant errors. According to Levitt, Smith and Stromberg (1980), segmental errors which have been observed to have a significant negative correlation with intelligibility are omission of phonemes in the word initial and medial position, consonant substitutions involving a change in the manner of articulation, substitutions of non-English phonemes such as the glottal stop, and unidentifiable or gross distortions of the intended phoneme (Lass 1982).

Need for the study

When children with hearing impairment are integrated into an educational setup, generally their vocabulary is in par with that of typically developing children. However, intelligibility in these children remains significantly reduced even at this point of time. The major sound classes which are affected in hearing impaired children according to the clinical observations are fricatives, affricates, retroflex and velars. Even though few studies related to the contextual facilitation of these phonemes are present in English, studies in Indian languages are very limited.

Articulation therapy in the Indian context generally does not use any facilitating contexts. Hence this study will help us in finding the influence of phoneme positions in correct production of erred sound in hearing impaired population. This information will help the Speech Language Pathologists in planning more structured therapy procedure for correcting the misarticulation in hearing impaired population in a shorter span of time and thereby improving the overall speech intelligibility and their quality of life.

Aim

Is to study the facilitatory effect of consonant position in the articulation of affricates and fricatives in native Malayalam speaking children with hearing impairment.

Objective

To investigate the facilitatory effect of consonant positions in the articulation of affricates and fricatives in native Malayalam speaking children with hearing impairment.

Hypothesis

There is no significant facilitatory effect of consonant positions in the correct articulation of affricates and fricatives in native Malayalam speaking children with hearing impairment.

Clinical implications

The outcome of this study will be helpful in treating children with hearing impairment. It will help to achieve a structured therapy intervention program for the correct production of affricates and fricatives. It will also emphasize the importance of selecting appropriate phoneme positions for the intervention of correct production of speech sounds, thereby improving the speech intelligibility.

Generally positional effects are ignored during the articulatory interventions. The results of this study would serve as guidelines for SLPs in selecting phoneme positions for articulation intervention at word level. Knowledge about the correct facilitatory phoneme position will make the therapy program less tedious and will help quick improvement.

Chapter II

Review of Literature

Deciding the target with which the speech intervention can be initiated is a critical factor in the management of children with articulation disorders. The primary goal will be to select target that will aid the child for maximum amount of improvement with minimum amount of treatment (Elbert, Dinnsen, Powel, 1984). One of the factors which can be considered is the positional context in which the child could easily produce the target correctly. Zehel, Shelton, Arndt, Wright and Elbert (1972) stated that contexts need to be individualized in order to encourage generalization. Hence context becomes an important factor while investigating articulation remedies.

As noted before, in early stages of sound-production training, the clinician should use a list of factors influencing the contexts, which help the client produce sounds correctly. In later stages, however, when the client should practice his sound in a variety of complex contexts typical of those found in spontaneous speech, the clinician should use the list to select contexts which will challenge the client's ability to produce his problem sound correctly (Fleming, 1971).

Importance of key environments and phoneme position in articulation intervention

Bleile (2006) described the key environments for the sounds acquired at a later stage in typically developing children. The target sounds and their key environments are depicted in table 2.1

Table.2.1

Late acquiring sounds and their key environments (Bleile, 2006)

Treatment Targets	Key Environments	Example
/θ/	End of a syllable or word	Teeth
	Before high front vowel	Thin
/ð/	Between vowels	Weather
	Before high front vowel	These
/s/	End of a syllable or a word	Bus
	Before high front vowel	See
	After [t] and before [i]	Pizza
	After [t] occurring in the same syllable	Beats
/z/	End of a syllable or a word	Fizz
	Before high front vowel	Zip
	After [d] and before [i]	Dzi
	After [d] occurring in the same syllable	Beads
/l/	Light /l/: Before high front vowel	Leaf
	Dark /l/: after a high back vowel at the end of a syllable	Call
Vocalic /r/.	Word consisting single stressed syllable.	Girl.
Consonantal /r/	Before high front vowel	Rid
	Between vowels	
	Syllable initial consonant velar cluster	Creek
/ʃ/	End of syllable or word	Fish
	Before high front vowel	She
/tʃ/	End of syllable or word	Batch
	After high front vowel	Witch

From this data it is apparent that each sound favor a particular position for undemanding production of the same. The positional influence for correct production of articulation can vary due to a number of reasons. The following studies will give more evidences regarding acquisition of phonemes in different positions.

Branigan (1976) asserted that all consonants appear first in initial position and this position is the "testing ground" for the acquisition of new sounds. He explained

this advantage as consonants in initial position would receive the first neural commands and therefore be least influenced by preceding positions of the articulators (p. 129). But in contrast, studies of co-articulation specify a broad interaction between initial consonants and the sounds that follow them, so much, so that MacNeilage and De Clerk (1969) remarked on the cohesiveness of CV (consonant-vowel) combinations. One might even propose that the opposite of Branigan's statement is true, that consonants in final position are modestly influenced by the articulatory requirements of surrounding sounds. That is, because the final sound does not have to be accommodated to upcoming articulatory requirements. It is subject only to retentive effects from earlier sounds. Fleming (1971) reported that an individual will be able to produce the error sounds easily in initial or final position whether the context is a syllable, a word, a phrase, or a sentence. This is in consonance with both Branigan's (1976) and Kent's (1982) results.

Curtis and Hardy (1959) studied liquid /r/ on 30 children with functional misarticulation in the age range 5.6-to 8.6- months. They performed a word elicitation task using picture cards. Results showed correct production of phoneme /r/ being facilitated in consonant blends (especially front-stop consonant blends) rather than in singletons. They also found that inter syllabic /r/ was produced more correctly compared to /r/ in the initial or final position.

More recently, Ghandour and Kaddah (2011) studied factors affecting stimulability of erred sounds in common types of dyslalia. They assessed the stimulability check of the erred phonemes in isolation and syllables on 75 Arabic speaking children. All the children were equally divided into three groups: Group 1 – stigmatism, Group 2-front-to-back displacement, and Group 3-rhotatism. Results showed that stigmatism group was highly stimuable followed by front-to-back

displacement group and then rhotacism group. They attributed this to the fact that airstream of fricatives are partly blocked and hence, can be produced in isolation which makes children to identify them as separate units. On the other hand, stops are produced with the complete obstruction of airflow and hence, difficult to identify them as separate entities. The results were also attributed to acoustic studies which state that the following phoneme has an effect on the acoustic representation of stops to a large extent (Treiman, Broderick, Tincoff, & Rodriguez, 1998), meanwhile, the acoustic representation is constant across the context in case of fricatives (Lieberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). Voiceless phonemes were more stimulable compared to voiced counterparts. In terms of phoneme position, results revealed highest stimulability in the initial position followed by medial position and then final position. This they attributed to the study by Gregory (2008) that hypothesized that stimulable children had higher correct positions in the initial position.

Deepa and Savithri (2010) revised the Kannada articulation test and reported sound acquisition pattern in children in the age range 2-to 6- years. They found that in girls, velars, dentals, bilabials, nasals, and glides were acquired both in the initial and final positions by 2.6 years. On the other hand, in boys, the voiced velars, dentals, and bilabials were acquired in the medial position, whereas, their voiceless cognates were acquired only in the initial position by this age. Nasals and glide /j/ were acquired in both positions by 2.6 years in boys. Affricates were reported to be acquired in both initial and medial positions by 4 years. Retroflex sounds were acquired by 5 years in both genders. Fricative palatal /ʃ/ was reported to be acquired earlier to dental /s/. Palatal /ʃ/ was found to be acquired first in the initial position, whereas, dental /s/ in the medial position. The authors also reported clusters being

acquired earlier in girls compared to boys. In addition, medial clusters are acquired first.

An extensive study by Shishira and Sreedevi (2013) and Sushma and Sreedevi (2013) investigated the phonetic repertoire, syllable structure, and cluster acquisition in typically developing children in the age range 12-to18- months and 18-to 24-months respectively. Both studies divided the age band of 6 months to 2 sub-groups of 3 months interval. The combined findings found that low-central vowels occurred (medial position followed by initial and then final position) more frequently, followed by high-back vowels and then high-front vowels. Vowels [i] and [o] occurred in the medial and final positions respectively more compared to the initial position. Bilabials and velars were found to occur more in the initial position of the word, whereas, palatals, dentals, and glottal sounds were more in the medial position. Retroflex sounds were found to occur both in the initial and medial positions almost similarly. Similar studies have been carried out in children with speech sound disorders also.

Acquisition of fricatives and affricates in positional context

A longitudinal study by Farwell (1977), analyzed the strategies used by children for attaining the correct production of fricative sound class. Production of fricatives in postvocalic or final position was one of the strategies used by the subjects. Hence this sheds light on the manner children use specific word position as a self strategy for correct production of a sound.

Investigations by Ingram (1975, 1978) revealed that there was a different and delayed development of fricatives and affricates in word-initial position rather than in word –final position. Edward and Mary Louise (1978) studied seven English-speaking children ranging in age from 1.5 to 2.3 years. They elicited pronunciation of words

with a fricative content over a seven-month period. They analyzed correct fricative productions and substitution errors in recorded speech sample of children. The findings of the study indicate that overall percentage of correct production of fricatives is slightly higher in final position than in other positions. In addition, the results varied across subjects, the individual subjects did not favor a specific position for all fricatives. The results also suggested that the order of acquisition of each fricative varied across children.

Studies on the effects of position in words indicate that purpose of facilitative influences involves more than requirement of the immediately adjacent phonetic elements. Mazza, Schuckers, and Daniloff (1979) ignore word boundary effects that might explain why the percentage of correct /s/ production varied greatly across the experimental sentences. Of the 23 contexts showing the highest percentages of correct /s/ production, 15 were contexts of /s/ in the word final position. Also, 25 contexts had the lowest percentages of correct /s/ production, only 7 had /s/ in word-final positions. The remainder of these 25 contexts had a word-initial /s/. With further selection of the 10 *most facilitating* contexts, all but one was of the construction having /s/ in word-final position. Of the 15 *least facilitating* contexts, only one was a construction having/s/ in the word-final position. Clearly, the word-position effect should be recognized. The advantage of word-final for /s/ production accords with data on normal speech development showing that fricatives may be produced in word-final position before they are produced in word-initial position (Edwards,,Oller, Wieman, Doyle, & Ross, 1975).

Stoel-Gammon (1985) analyzed the inventory of fricatives and affricates in children. The results revealed that voiceless fricatives were acquired first rather than voiced, in both initial and final positions. Also there was no preference of particular

position in the acquisition of fricatives across subjects. The findings of this study are contradictory to the hypothesis put forth by Ferguson (1975) and Farwell (1977) i.e. fricatives tend to appear first in word-final position and later in word-initial position.

Divya and Sreedevi (2010) studied the articulatory acquisition in typically developing Malayalam speaking children in the age range of 2 to 3 years. The result revealed that by 2.3 to 2.6 year, 100% of the children acquire affricates in word medial position. As part of the Revalidation of Malayalam articulation test, Neenu and Sreedevi (2011), tested the acquisition of different consonants in initial and medial positions in the age range of 3 to 4 years. They report that fricatives /s/ and /ʃ/ were acquired by 90% of the children in the initial position earlier than in medial position by children of 4 years of age.

Results from the deep test of articulation in Malayalam by Maya (1990) indicated that consonant environment of fricatives and trills showed greater difficulty in production in Malayalam speaking children. Rohini (1988) reported that /s/ and /ʃ/ were the most difficult for acquisition in Kannada speaking children. The findings of the study by Sangeetha (1995) revealed that trill /r/ and /s/ were the most difficult for acquisition in Tamil speaking children.

Articulatory acquisition has been studied in communication disordered population also. Sheridan (1948) studied the speech characteristics of hearing impaired children and reported that the commonest fault in speech of hearing impaired children was either a defective /s/ or its omission, particularly at the end and the middle of the words. Miller-Shaw (1936) conducted a study on 10 hearing impaired children. He stated that none of the participants could produce /s/ and /z/ correctly in all 3 positions (initial, medial and final). Powell and McReynolds (1969)

intervend four children with misarticulation of /s/. It is interesting to note from the study that, once a child can produce the sound correctly in a certain position, generalization of its correct articulation to other positions may occur quickly and spontaneously. This is another reason for considering the effect of the position of a sound, particularly during initial stages of speech production training.

Rockman and Elbert (1984) investigated the acquisition of untrained fricative /s/ in a child with phonological disorder over a period of several months. The child's production of /s/ was monitored in imitated words and spontaneous connected speech. The results revealed that the acquisition pattern of speech sound /s/ was similar to typically developing children. The fricative /s/ was acquired in the word final position followed by initial and then in the medial position. In Kannada, Shalini and Sreedevi (2016) explored the efficacy of non-words in articulation therapy for trill /r/ and found that its production was facilitated better in the medial position compared to the initial position in non-words particularly.

Hence the literature review of the present study shows there are attempts to look into the positional effects on phoneme acquisition in both typically developing and speech disordered children with varied findings. However such understanding is indispensable for a Speech Language Pathologist to be an effective scientific clinician.

Chapter III

Method

The aim of the study was to determine the facilitatory effect of phoneme position on the production of affricates and fricatives in native Malayalam speaking children with hearing impairment

3.1 Participants

Six children in the age range of 3-to12years with severe to profound sensorineural hearing loss were recruited as participants from the All India Institute of Speech and Hearing, Mysuru.

Table 3.1.

Demographic details of the participants

Participants	Age	Severity
P1	4.5years/Female	Bilateral severe hearing loss
P2	4years/Male	Bilateral profound hearing loss
P3	4.5years/male	Bilateral severe hearing loss
P4	12years/male	Bilateral profound hearing loss
P5	6.5years/Male	Bilateral profound hearing loss
P6	5.3years/Male	Bilateral severe to profound hearing loss

Inclusion criteria

Participants met the following criteria for the study.

- Children attending speech and language therapy and were diagnosed as Spoken Language Disorder secondary to hearing loss.
- Degree of hearing loss should be severe to profound in both ears based on recent audiological evaluation.

- Should have substitution, distortion or omission errors in the production of affricates (/c/) /ʃ/, and fricatives (/s/, /f/) which was confirmed using Malayalam Diagnostic Articulation Test – Revised (Neenu, Vipina, Vrinda & Sreedevi, 2011) and parental inputs.
- Fitted with hearing aid before the age of 3 years and using it regularly since then.
- Aided audiogram should be within the speech spectrum.
- Mean length of utterance of three to four words.
- Speech intelligibility less than 80%.
- No complaint of any associated disorders.
- Native speakers of Malayalam.

3.2 Design

In the current study a single-subject time series design was employed. Initially, a pre-therapy assessment was carried out which was followed by the intervention sessions. Mid-therapy evaluation was carried out once the child acquired the target phoneme in any one position (initial/medial). Finally, a post-therapy assessment was performed after the participant attained consistent correct production in that position.

3.3 Stimuli

- The stimuli for the articulation therapy program were sets of highly structured bisyllabic (CVCV) non-words in which the target phonemes were placed in either initial or medial positions, in the context of vowel /a/. The target phonemes considered were affricates (/c/ and ʃ and fricatives (/s/and /f/) which are highly erred in children with hearing impairment.

- In order to control the phonetic contextual variability, the stimuli considered were consonant harmonized and consonant non-harmonized sets of non-words. Consonant harmonized set had same consonants in both initial and medial positions e.g. /caca/. On the other hand, consonant non-harmonized set had different consonants in both the positions of a non-word, e.g. /capa/. The consonant harmonized set prepared for affricates (/c/ and /ʃ/) and fricatives (/s/ and /ʃ/) constituting a total of four stimuli i.e. one non word for each phoneme, is shown in table 3.2.

Table 3.2.

Table shows the harmonized set of stimuli for the phonemes /c/, /ʃ/, /s/ and /ʃ/

<u>Harmonized Set</u>
/caca/
/JaJa/
/sasa/
/ʃaʃa/
Total = 4

- The non harmonized set had the target phoneme in both initial and medial positions. Hence there were two subsets in the non-harmonized set, the first subset had the target phoneme in the initial position and the second subset had the target phoneme in the medial position. The other phonemes in the non-word were /p/, /b/, /t/ or /d/ which are developmentally early and hence correctly produced by children.

- Hence, a total of eight non-words for each target phoneme were considered as the stimuli. For example, /c/ will have /capa/, /caba/, /caṭa/, /caḍa/ as stimuli in the first subset and /paca/, /baca/, /ṭaca/, /ḍaca/ in the second subset. table 3.3 shows the illustration of the non harmonized set of stimuli. The entire stimulus list is provided in table 3.4

Table 3.3

Shows an illustration of non –harmonized stimuli for articulation therapy program

<u>Non Harmonized Stimuli Set</u>	
Eg: for the target consonant unvoiced dental fricative /s/	
Target consonant in initial position	Target consonant in medial position
/sapa/	/pasa/
/saba/	/basa/
/saṭa/	/ṭasa/
/saḍa/	/ḍasa/
Number of non-harmonized stimuli= 8 (for single target consonant /s/)	
Number of harmonized stimuli= 1(for single target consonant /s/)	
Total number of stimuli for single consonant=8 + 1= 9	
Over all total no. of stimuli for 4 target stimuli = 9 x 4 = 36 non-words	

Table 3.4

Shows the complete stimuli set for the phonemes /c/, /ʃ/, /s/ and /ʃ/

Target phoneme	Harmonized	Non harmonized set-I (target phoneme in initial position)	Non harmonized set –II (target phoneme in medial position)
/c/	/caca/	/capa/	/paca/
		/caba/	/baca/
		/cata/	/taca/
		/cada/	/daca/
/ʃ/	/ʃa ʃa /	/ʃapa /	/paʃa/
		/ʃaba /	/baʃa/
		/ʃata /	/taʃa /
		/ʃada /	/daʃa /
/s/	/sasa/	/sapa/	/pasa/
		/saba/	/basa/
		/saʃa/	/tasa/
		/saɖa/	/dasa/
/ʃ/	/ʃaʃa/	/ʃapa/	/paʃa/
		/ʃaba/	/baʃa/
		/ʃata/	/taʃa/
		/ʃada/	/daʃa/

3.4 Procedure

Initially a written consent was from the participant's parents and all the ethical procedures was followed. Details on recent (within six months) audiological and speech and language evaluation were obtained from respective case files. The aided audiogram of each participant was within the speech spectrum. Information regarding the regularity of hearing aid usage and its benefit was known from the parent's observation in conjunction with the recent evaluation. To assess the participant's

language age Verbal Receptive and Expressive subtests of Scales of Early Communication Skills for Hearing Impaired children (SECS; Moog & Geers, 1975) was used.

The study was carried out in the following sequence

- Baseline assessment
- Intervention sessions
- Mid-therapy assessment
- Post therapy assessment

This sequence was followed for each target phoneme one after the other. The details of the same are explained in the following subsections.

3.4.1 *Baseline assessment*

A pre-therapy assessment was carried out to evaluate the articulation abilities of the participants. Each participant was instructed to repeat the set of non-words after the researcher and the scores for correct production of the target phoneme were noted down. Scores were out of 5 (i.e., 1 harmonized + 4 non-harmonized). Participant's scores were noted down separately for initial and medial position. For e.g., in the initial position, if a participant produces /c/ correctly in the harmonized set and 2 non-words in the non-harmonized set, the score for initial position will be 3 (1 harmonized + 2 non-harmonized). Similarly in the medial position, if the participant produces /c/ correctly in the harmonized set and 1 non word in the non harmonized set, the score for medial position will be 2 (1 harmonized + 1 non-harmonized).

3.4.2 *Intervention*

The intervention which included several sessions was carried out by the researcher herself. The target phoneme was taught in the following steps:

1. Only one target phoneme was considered for intervention at a time.
2. The intervention was carried out using bisyllabic non-words.
3. The stimulus was presented verbally to the participants and they were instructed to repeat the same one at a time. For participants who were unable to perform using verbal modality, orthographic form of the stimulus was used.
4. The target phoneme was taught using phonetic placement via a combination of modalities (auditory, visual, tactile, and a combination of any).
5. Reinforcement (verbal, social or tangible reinforcement) was given for every correct production of the target phoneme.
6. A rating sheet was used to mark correct/ incorrect productions. Correct production was indicated by a tick mark (✓) and an incorrect production with a cross mark (✗). A sample of the rating sheet is provided in table 3.5. As indicated, for each position, one harmonized and 4 non-harmonized stimuli were used. The therapy was initiated with the harmonized non-word set followed by the non-harmonized set. (See appendix)

Table 3.5

Shows sample of the rating sheet used in intervention

Target phone me	Harmonizd	Response (✓)/(✗)	Non harmonized set-I (target phoneme in initial position)	Respo nse (✓)/(✗)	Non- harmonized set-II (target phoneme in final position)	Response (✓)/(✗)
/c/	/caca/		/capa/ /caba/ /cata/ /cada/		/paca/ /baca/ /taca/ /daca/	

7. A position was considered as most facilitating when the participant was able to correctly produce the target phoneme 4 out of 5 times, first in that position when compared to the other position.
8. The participants were provided with two to three articulation therapy sessions of 40 minutes each per week. The total number of sessions varied across participants depending on individual's learning pace.

3.4.3 *Mid therapy assessment*

Once the child reached a score of 4 out of 5 in any position for a particular target phoneme, a mid-therapy evaluation was carried out. In this the same set of nonwords were randomly presented. After the mid-therapy assessment, the intervention sessions were continued until the participant achieved consistent correct production of the target phoneme in the most facilitating position.

3.4.4 *Post-intervention assessment*

Once the participant acquired consistent production of the target phoneme in any one position, the intervention was terminated for that target phoneme. The post

intervention assessment was carried out in the same way for that target phoneme as discussed in the pre-therapy assessment. Following this, next target phoneme was taken up for intervention.

3.4.5 *Intelligibility rating.*

Participants were asked to repeat 8 (one word for each position for 4 target phonemes) words containing the target phonemes, from the Malayalam Articulation Test-Revised (Neenu, Vipina, Vrinda & Sreedevi, 2011). Percentage of intelligibility was calculated by three Malayalam speakers individually, who were unfamiliar with the wordlist of MAT-R. They were asked to note down the number of words which they can identify, by listening to the audio recorded MAT-R sample of the participant. Speech Intelligibility of the participants was calculated using the following formula:

$$\text{Intelligibility \%} = \frac{\text{Total number of words identified}}{\text{Total number of words presented}} \times 100$$

An average percentage score of the three judges was the speech intelligibility score of each participant. This procedure was carried out before and after the intervention sessions and a comparison was made to see the difference.

3.5 Statistical Analysis

The results of each participant were depicted in graphical form. SPSS software was used for statistical analysis. Descriptive statistics was applied to obtain the median scores of participants in pre-therapy, mid-therapy and post-therapy for each phoneme. Wilcoxon Signed Rank Test was used to find the facilitating position of each phoneme in initial and medial position. Friedman and Wilcoxon Signed Rank Test were used to verify the therapy outcome across intervention sessions.

Chapter IV

Results and Discussion

The study aimed to determine the facilitatory effect of phoneme position on the production of affricates and fricatives in native Malayalam speaking children with hearing impairment. A total of six participants in age range of 3 to 12 years were recruited for the study. Since the error phonemes were different in each participant, the number of participants considered for intervention varied for each phoneme. Details on target phonemes considered for each participant is provided in table 4.1.

The results will be discussed under the following headings

- Facilitatory phoneme position for affricates
 - Facilitatory phoneme position for /c/
 - Facilitatory phoneme position for /ʃ/
- Facilitatory phoneme position for fricatives
 - Facilitatory phoneme position for /s/
 - Facilitatory phoneme position for /ʒ/
- Statistical analysis of the study
- Intelligibility rating

Table 4.1

Phonemes considered for intervention for the six participants

Participants	Phonemes for intervention
P1	/c/, /ʃ/, /s/, /ʒ/
P2	/ʃ /, /s/, /ʒ/
P3	/s/, /ʒ/
P4	/s/, /ʒ/
P5	/s/, /ʒ/
P6	/s/, /ʒ/

Initially a pre-therapy assessment was carried out in session 1. The intervention session started from session 2 onwards. When the child achieved the criteria of 4 correct productions out of 5 stimuli presentations in any position, mid therapy assessment was carried out in the consecutive next session. The intervention sessions were continued and when the participant achieved consistent correct production, articulation therapy was terminated with post-therapy assessment.

4.1. Facilitatory phoneme position for affricates

4.1.1 Facilitatory phoneme position of /c/

Two participants (P1 & P5) were recruited for intervention of unvoiced affricate /c/. During the pre-therapy session both participants substituted dental /t/ for /c/. Details of participants and session number of mid-therapy and post-therapy assessment for phoneme /c/ are shown in table 4.2

Table 4.2

Details of participants considered for intervention of /c/

Participants	Age & Gender	Severity	Session numbers	
			Mid-therapy assessment	Post-therapy assessment
P1	4.5years/Female	Bilateral severe hearing loss	9 th session	15 th session
P2	6.5years/Male	Bilateral profound hearing loss	11 th session	15 th session

During mid therapy assessment, both participants achieved correct production of /c/ for 4/5 times in the medial position. P1 could acquire /c/ in the medial position by the 9th session, whereas P2 by the 11th session. P1 and P2 produced /c/ correctly 3/5 times in initial position. Both participants could produce /c/ consistently in the medial position by the 15th session. P1 and P5 produced the target word correctly in the medial position both in the harmonized (/ca- ca/) as well as in the non-harmonized stimuli. Visual inspection of figure 1 and figure 2 revealed medial position to be the most facilitating context for unvoiced affricate /c/.

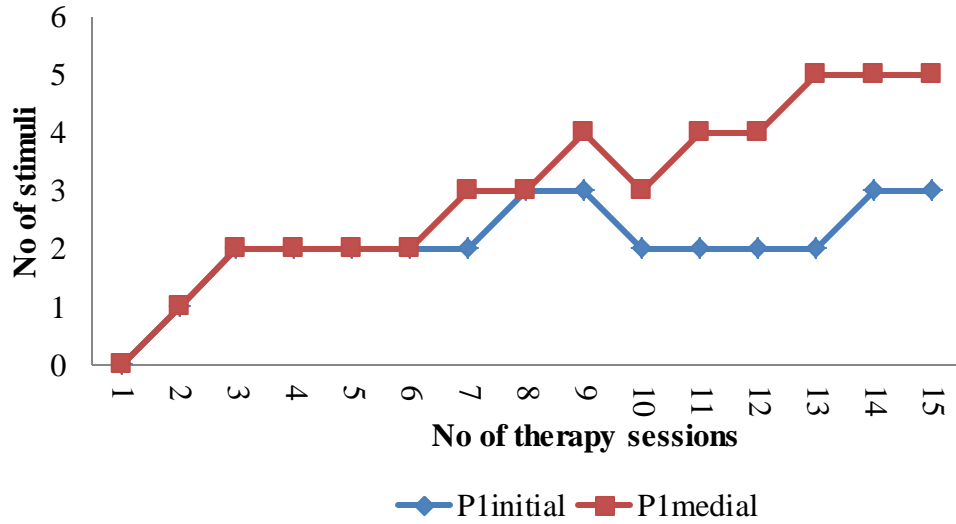


Figure 4.1: Acquisition of /c/ for P1.

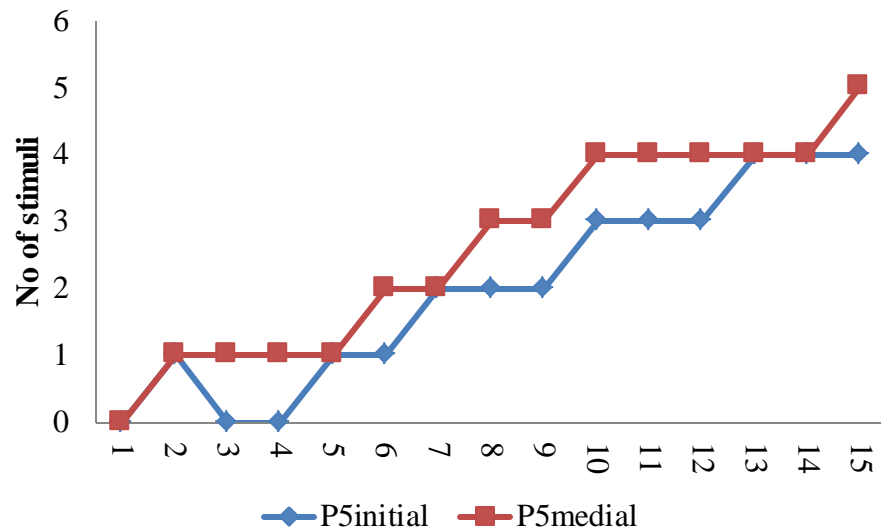


Figure 4.2: Acquisition of /c/ for P5.

There was a linear progress in the production of voiceless affricate /c/ over the sessions. The accuracy of production was better in medial position rather than in initial position. These findings are in support of the studies by Ingram (1975,1978), on typically developing English speaking children revealing delayed development of fricatives and affricates in word-initial position than in word-final position. In

Malayalam also, studies have reported earlier acquisition of /c/ in the medial position compared to initial position (Divya & Sreedevi, 2010; Neenu & Sreedevi, 2011).

4.1.2. Facilitatory phoneme position of /ʒ/

Participants P1, P2 and P5 misarticulated voiced affricate /ʒ/. Intervention started following the correct production of /c/ for P1 and P5. Since /c/ was already acquired by P2, intervention was initiated for the correction of /ʒ/. Details of participants and session number of mid-therapy and post-therapy assessment for phoneme /ʒ/ is depicted in table 4.3.

Table 4.3

Details of the participants considered for intervention of /ʒ/

Participants	Age& Gender	Severity	Session numbers	
			Mid-therapy assessment	Post-therapy assessment
P1	4.5year/Female	Bilateral severe hearing loss	6 th session	10 th session
P2	4year/Male	Bilateral profound hearing loss	7 th session	10 th session
P5	6.5year/Male	Bilateral profound hearing loss	8 th session	11 th session

Performance of P1 and P2 on mid therapy assessment revealed, medial position to be the facilitating context with 4/5 correct production of /c/ compared to initial position by 6th and 7th therapy session respectively. Consistency of production was also maintained in the medial position. In contrast, initial position facilitated the production of /c/ in P5 with a score of 4/5 by 8th therapy session compared to medial position. P5 also maintained consistent correct production only in initial position than in medial position.

Visual inspection of figure 3, figure 4 and figure 5 revealed that medial position was the most facilitating context for P1 and P2 for voiced affricate /ʒ/, in contrast initial position was the facilitating for P5 in both harmonized and non-harmonized set of stimuli.

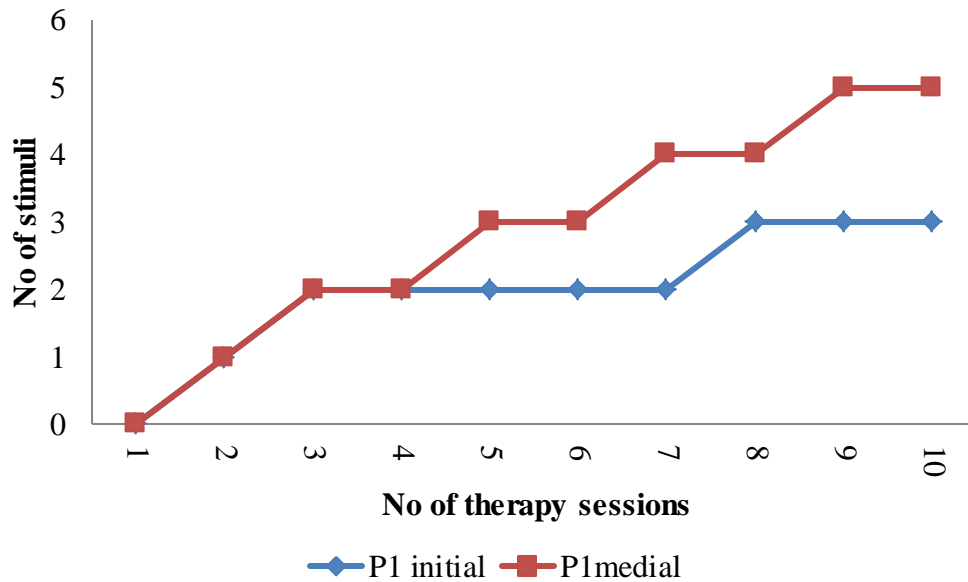


Figure 4.3: Acquisition of /ʒ/ for P1

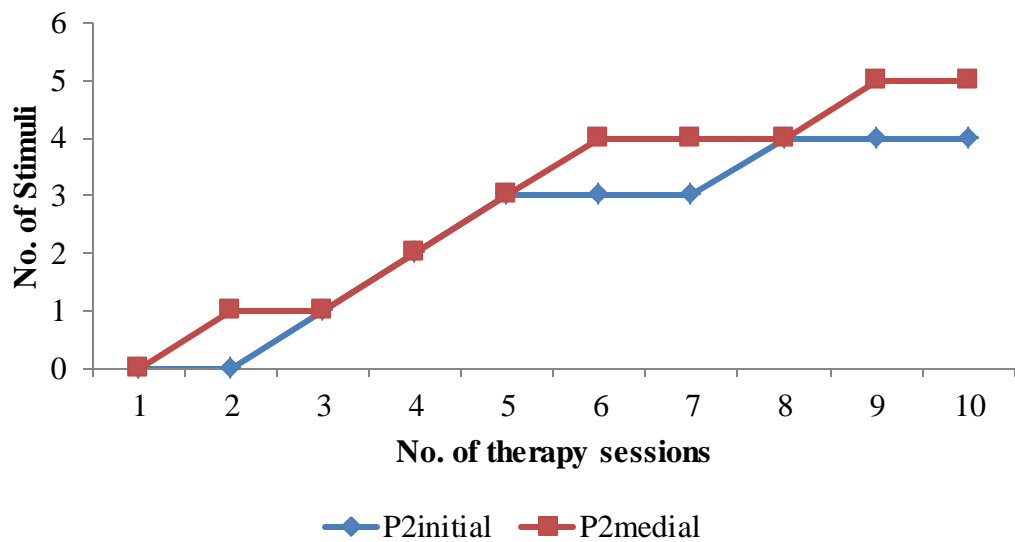


Figure 4.4: Acquisition of /ʒ/ for P2

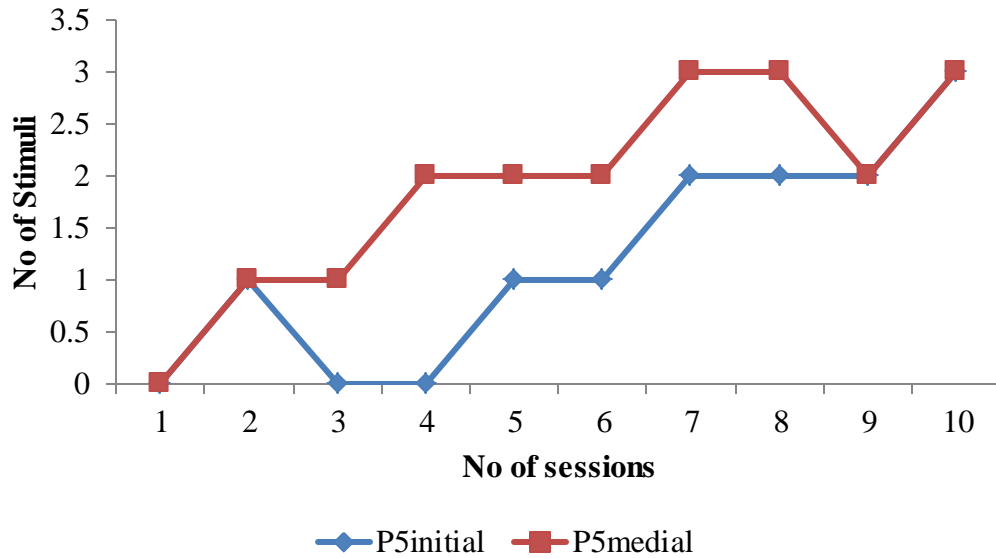


Figure 4.5: Acquisition of /j/ for P5

Graphically, pre- and post-therapy comparison of performances for all the three participants showed linearly rising pattern indicating significant improvement in the production of /j/ during therapy using nonwords. Participants acquired /j/ in less number of sessions compared to /c/. As voiced affricate /j/ was introduced soon after the acquisition of voiceless affricate /c/, easy learning was observed for /j/. This is in support of Distinctive Feature Theory, which states that when the error and target phoneme share common features, therapeutic implications follow logically (Jacobson, 1942). Here both /c/ and /j/ shared common features i.e., place and manner of articulation. The only unlearned feature was voicing. The children could easily learn voiced affricate /j/ by associating it with the features of voiceless /c/.

Similar to the production of /c/, the accuracy of production of /j/ was better in medial position rather than initial position. This finding is similar to the earlier reports of acquisition of in /j/ Malayalam speaking typical children (Divya & Sreedevi, 2010;

Neenu and Sreedevi, 2011). Both studies reported earlier acquisition of voiced affricate /ʃ/ in the medial position than in the initial position.

4.2 Facilitatory phoneme position for fricatives

4.2.1 Facilitatory phoneme position of /s/

Six participants were recruited for correction of voiceless fricative /s/. Intervention for /s/ started following the intervention of affricates for P1, P2 and P5. As affricates were present in the phonetic repertoire of P3, P4 and P6, intervention was directly initiated with /s/. All the participants were substituting voiceless affricate /c/ for /s/. Details of the participants are given in table 4.4.

Table 4.4

Details of the participants considered for the intervention of /s/

Participants	Age & Gender	Severity	Session numbers	
			Mid-therapy assessment	Post-therapy assessment
P1	4.5year/Female	Bilateral severe hearing loss	9 th session	15 th sessions
P2	4years/Male	Bilateral profound hearing loss	6 th session	12 th sessions
P3	4.5year/male	Bilateral severe hearing loss	12 th session	15 th sessions
P4	12year/male	Bilateral profound hearing loss	5 th session	7 th sessions
P5	6.5year/Male	Bilateral profound hearing loss	8 th session	12 th sessions
P6	5.3year/Male	Bilateral severe to profound hearing loss	11 th session	14 th sessions

During mid therapy assessment, four participants P3, P4, P5 and P6, scored 4/5 correct production in the initial position and maintained consistent correct production till post-therapy session in the initial position only. All participants scored less (2 or 3) in medial position. On the other hand, P1 and P2 acquired and maintained consistent correct production of /s/ only in the word medial position. Both participants scored lesser in initial position. Graphical illustration of figure 6 to figure 11 shows the facilitating position in all six participants recruited for the intervention of phoneme /s/ using harmonized and non-harmonized set of stimuli.

Table 4.5
Facilitating phoneme position for /s/ across participants

Participants	Facilitating phoneme position	
	Non-harmonized set	Harmonized set
P1	Medial position	Medial position
P2	Medial position	Medial position
P3	Initial position	Initial position
P4	Initial position	Initial position
P5	Initial position	Initial position
P6	Initial position	Initial position

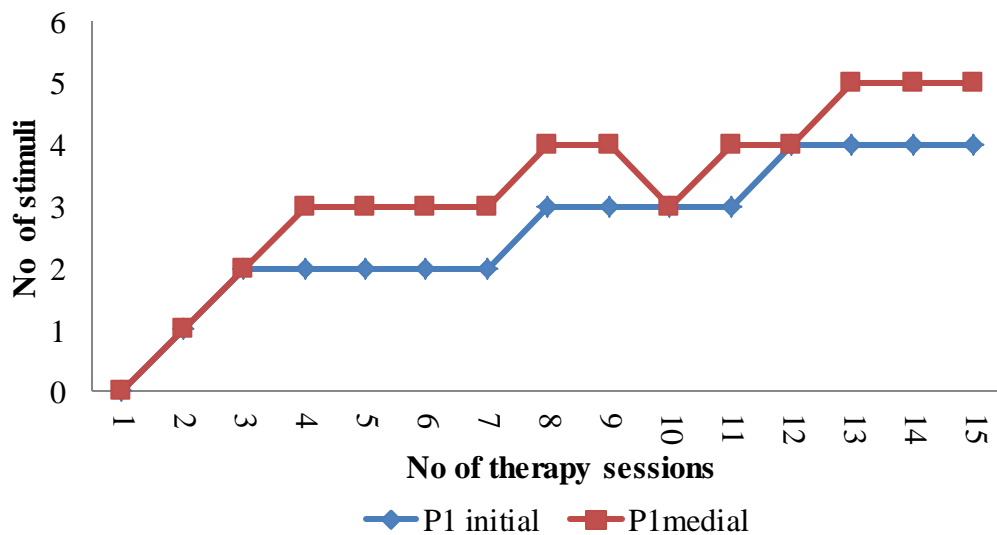


Figure 4.6: Acquisition of /s/ for P1

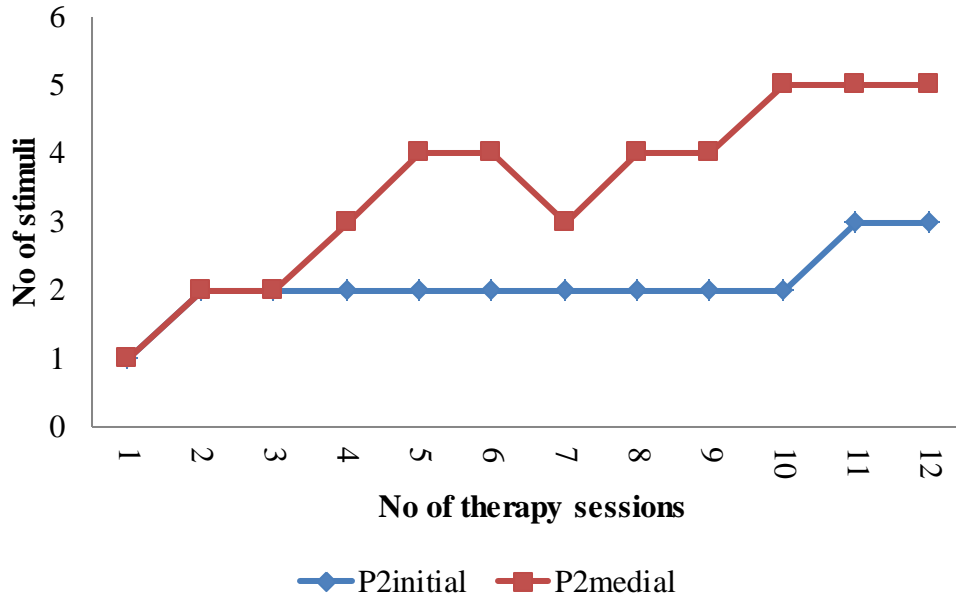


Figure 4.7: Acquisition of /s/ for P2

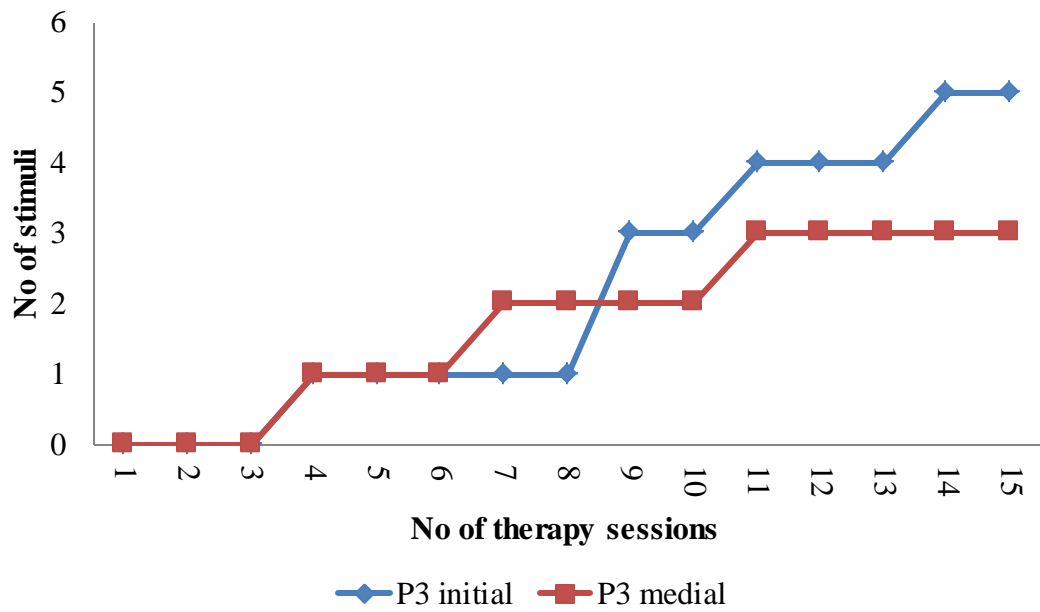


Figure 8: Acquisition of /s/ for P3

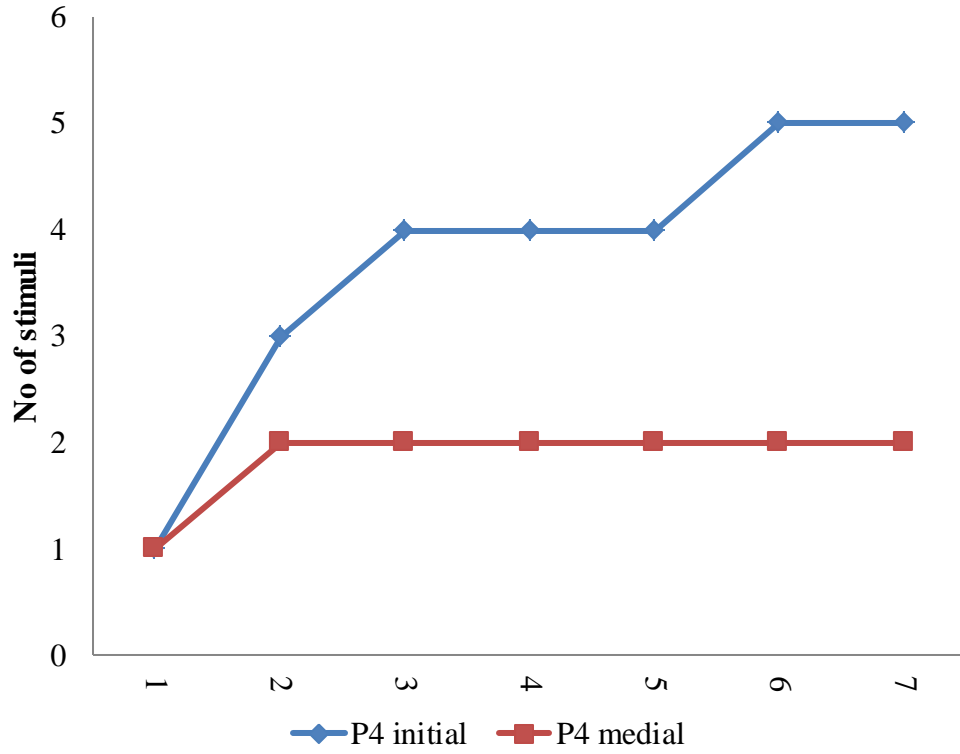


Figure 9: Acquisition of /s/ for P4

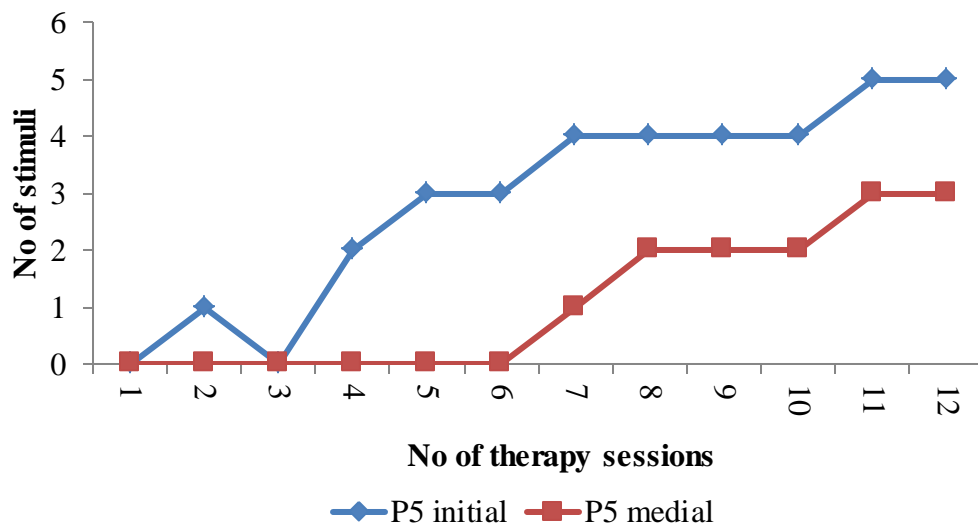


Figure 10: Acquisition of /s/ for P5

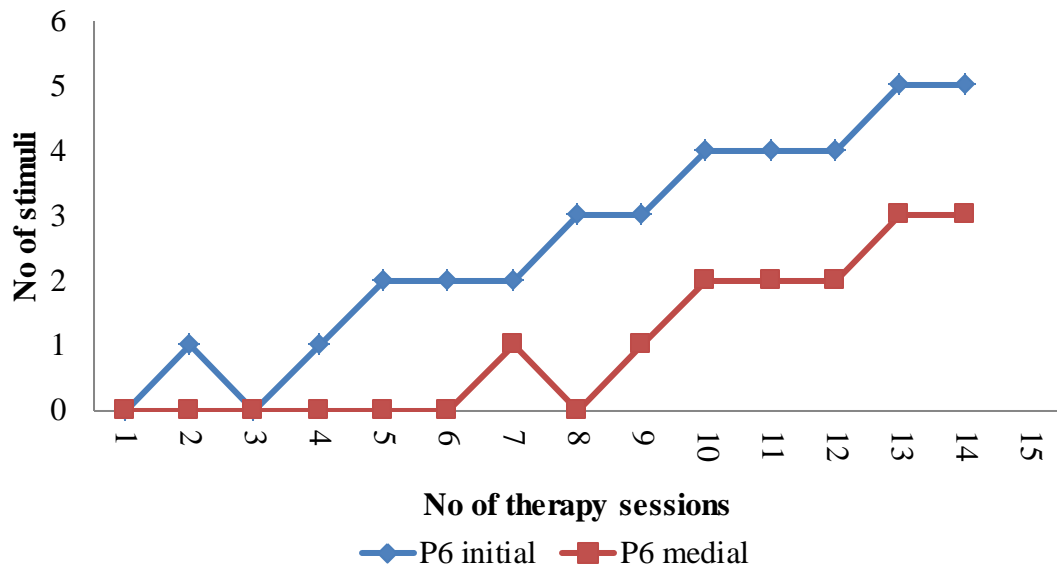


Figure 11: Acquisition of /s/ for P6

On comparison of pre- and post- therapy session performance graphs, an increasing trend was observed. This again highlights significant improvement in articulation of target phonemes during the intervention program using nonwords.

In sum, all participants substituted /c/ for /s/ and had distortion errors. Most of the participants acquired /s/ in the initial position. Literature on fricative acquisition has varied views with respect to findings of the present study. Gallagher and Shriner (1975b) reported that /s/ is accurately produced in the initial position compared to final position of a word in typically developing children with inconsistent production of /s/. Rockman and Elbert (1984) also reported fricative /s/ to be acquired in the word initial position followed by the medial position in a child with phonological disorder. In English, acquisition of /s/ is found to be facilitated in the final position (Rockman & Elbert, 1975b; Ferguson, 1975; Farwell, 1977; Kent, 1982). However word final position was not considered in the present study as phonotactics of Malayalam does not permit the occurrence of fricatives in the word final position except in loan words.

In the Indian context, Neenu and Sreedevi (2011) reported that greater percentage of children acquired fricative /s/ and /ʃ/ in the initial position followed by medial position by 4 years of age in Malayalam which is in accordance to the findings of the present study.

4.2.2. Facilitatory phoneme position of /ʃ/

Same six participants who were recruited for intervention program for /s/ were considered here. Intervention for /ʃ/ started following the intervention for /s/ for all participants. Details of participants and session number of mid-therapy and post-therapy assessment for phoneme /ʃ/ are shown in table 4.6.

Table 4.6

Details of participants considered for the intervention of /ʃ/

Participants	Age& Gender	Severity	Session numbers	
			Mid-therapy assessment	Post-therapy assessment
P1	4.5years/Female	Bilateral severe hearing loss	7	15 th session
P2	4years/Male	Bilateral profound hearing loss	6	12 th session
P3	4.5years/male	Bilateral severe hearing loss	8	15 th session
P4	12years/male	Bilateral profound hearing loss	5	7 th session
P5	6.5years/Male	Bilateral profound hearing loss	8	12 th session
P6	5.3years/Male	Bilateral severe to profound hearing loss	6	14 th session

In the mid therapy assessment P3, P4, P5 and P6, obtained 4/5 correct production in the initial position. All of them scored only 2 or 3 in word medial position. These participants could maintain consistent correct production till the post

therapy session, only in the initial position. But in contrast, P1 and P2 met the criteria (4/5) in medial position and scored only 2/4 in initial position. They could also maintain consistent correct production in the medial position. Results of treatment intervention for /ʃ/ for all six participants are depicted from figure12 to figure17

Table 4.7

Facilitating phoneme position for /ʃ/ across participants

Participants	Facilitating phoneme position	
	Non-harmonized set	Harmonized set
P1	Medial position	Medial position
P2	Medial position	Medial position
P3	Initial position	Initial position
P4	Initial position	Initial position
P5	Initial position	Initial position
P6	Initial position	Initial position

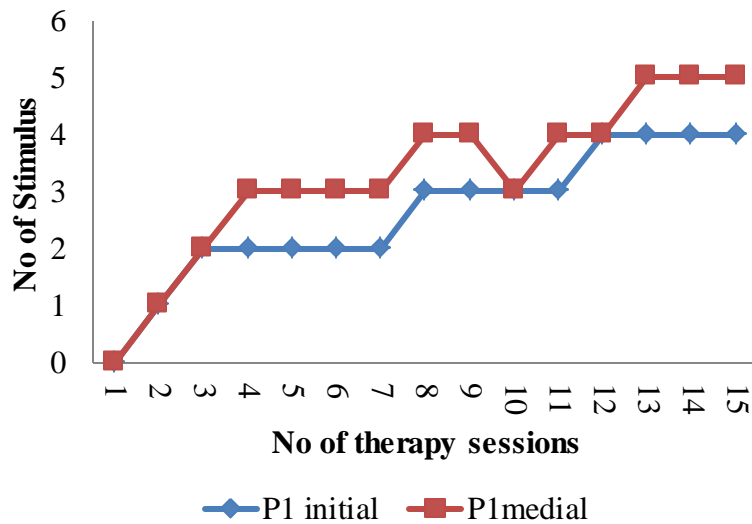


Figure 12: Acquisition of /ʃ/ of P1

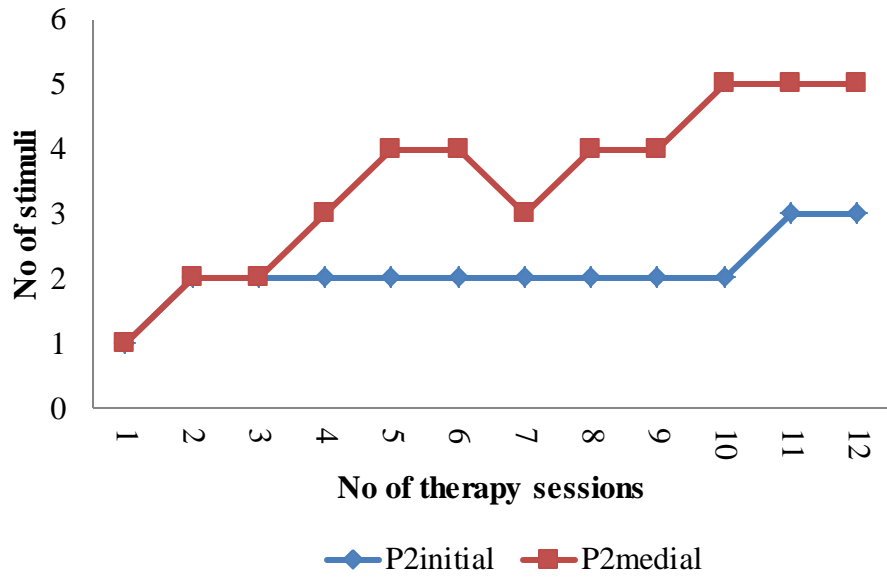


Figure13: Acquisition of /f/ of P2

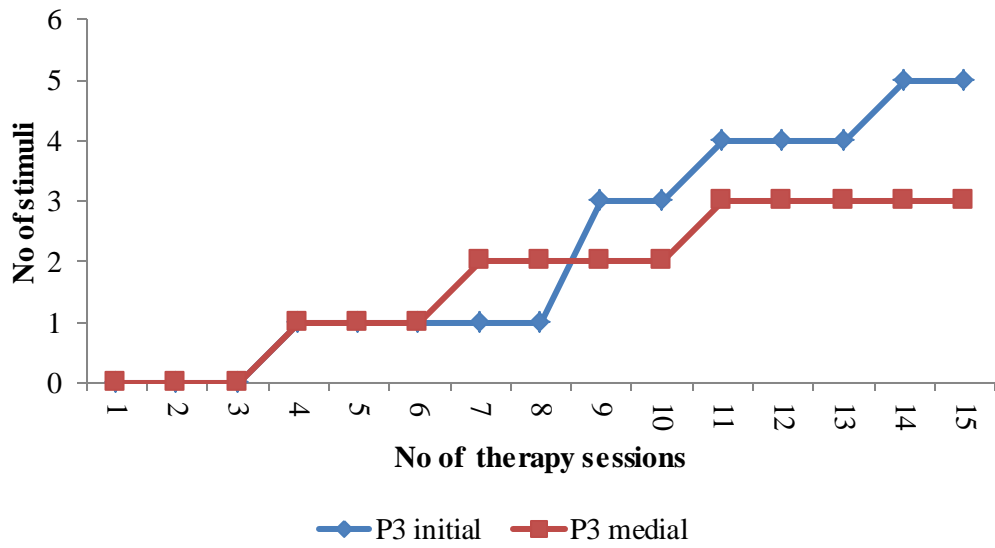


Figure 14: Acquisition of /f/ in P3

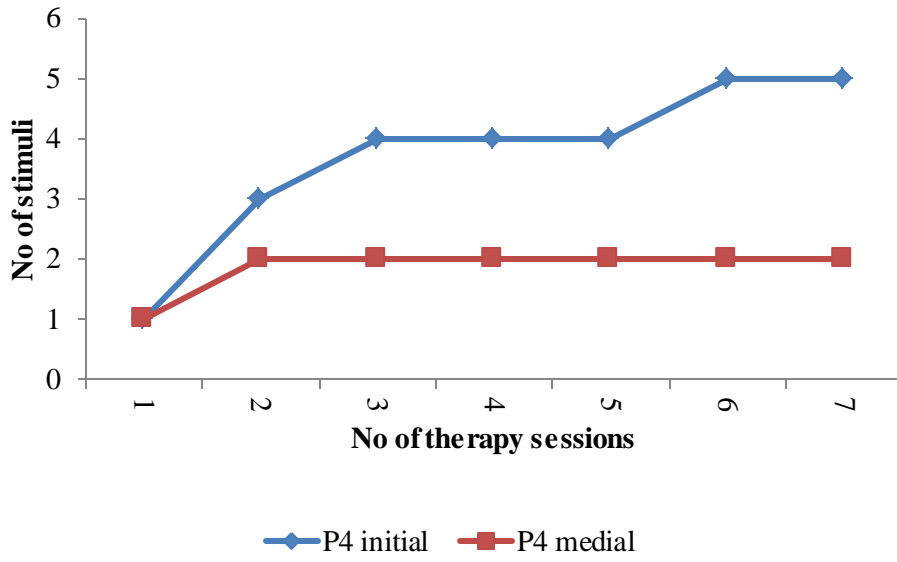


Figure 15: Acquisition of /ʃ/ in P4

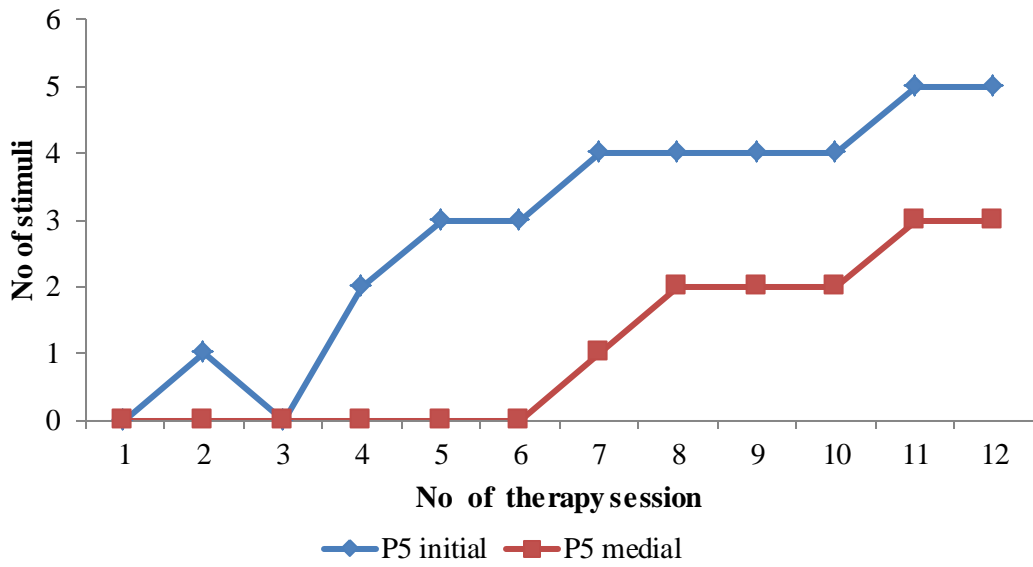


Figure 16: Acquisition of /ʃ/ in P5

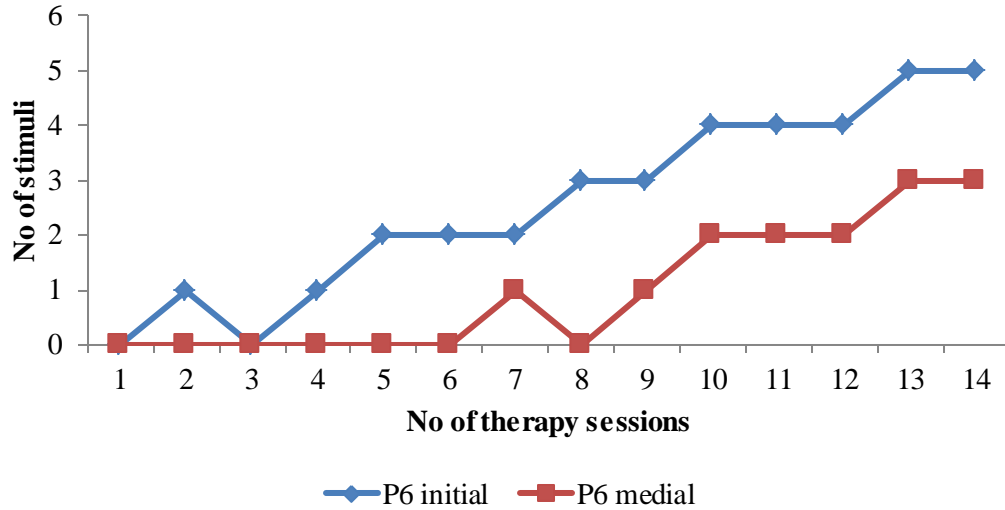


Figure 17: Acquisition of /j/ in P6

Comparing the performance graphs of pre- and post-therapy sessions, an increasing pattern was observed for both the positions. Faster acquisition of /j/ was observed as it was introduced immediately after the acquisition of /s/. Children could easily learn /j/ by associating it with the learning pattern of /s/. All participants inconsistently substituted affricate /c/ and fricative /s/ for /j/. Results of the present study revealed that initial position is the most facilitating in the acquisition of fricatives in Malayalam speaking children with hearing impairment. In support of this finding, Neenu and Sreedevi (2011) reported faster acquisition of /j/ in the initial position when compared to medial position in Malayalam speaking children.

4.3 Statistical analysis using SPSS (Version 21)

4.3.1 Descriptive Analysis

Descriptive statistics was used to obtain the median scores of correct production of phonemes targeted for intervention. In the pre-therapy session all the

participants did not have production of /c/, hence scored zero in initial and medial positions. Table 4.8 shows the median scores.

Table 4.8
Median scores in the initial and medial positions of different phonemes

Target phonemes	Pre-therapy		Mid-therapy		Post-therapy	
	Initial	medial	Initial	medial	initial	Medial
/c/	0	0	3	4	3	4.5
/ʃ/	0	0	3	4	4	5
/s/	0	0	4	2.5	5	2.5
/ʒ/	0.5	0	4	2.5	5	3

4.3.2 Statistical comparison across facilitating positions

Wilcoxon Signed Rank Test was used for statistical comparison of facilitating positions. The analysis was carried out only for fricatives and not for affricates owing to the less number of participants. The findings for fricatives revealed that there was no significant difference across initial and medial positions for all six participants, as $P > 0.05$ for all the phonemes. However in the graphical representation of scores a linear change towards correct articulation was evident as discussed earlier.

4.3.2 Statistical comparison across assessments

Friedman test was used for obtaining significant difference across pre v/s mid, mid v/s post and pre v/s post therapy sessions. The results revealed that for affricates there were no statistical significance as $P > 0.05$ across the 3 assessments. However for fricatives, there were significant differences across 3 assessment as $P < 0.05$. The results of Friedman test is depicted in table 4.9.

Table 4.9

Results of Friedman test for /s/ and /ʃ/ across assessments

	/s/		/ʃ/	
	χ^2	P value	χ^2	P value
Initial position	12.000	0.002	12.000	0.002
Medial position	9.333	0.009	11.565	0.003

Since there is a statistical difference across sessions, Wilcoxon Signed Rank Test was utilized for pair wise comparison of assessments. The results of the same are depicted in table 4.10. Analysis of table 4.10 revealed that there were significant difference across the pairs; pre v/s mid, mid v/s post and pre v/s post therapy sessions in both phoneme positions for /s/ and /ʃ/, except for /ʃ/ in the mid v/s post therapy session comparison in the medial position

Table 4.10

Pair wise comparison of assessments for /s/ and /ʃ/ using Wilcoxon signed rank test

		Pre v/s Mid Therapy assessment		Mid v/s Post Therapy assessment		Pre v/s post Therapy assessment	
		/s/	/ʃ/	/s/	/ʃ/	/s/	/ʃ/
		Initial Position	z	2.232	2.214	2.449	2.333
	P value	.026	.027	.014	.020	.026	.026
Medial position	z	2.232	2.214	0.973	2.236	2.214	2.226
	P value	.026	.027	.330	.025	.027	.026

4.3 Intelligibility rating

Intelligibility scores were calculated before initiation of therapy and on termination of therapy. Eight real words (2 each for /c/, /ʒ/, /s/ and /ʃ/) were selected from Malayalam Articulation Test- Revised to calculate intelligibility scores. Audio recorded samples of these words were rated by three judges who were unfamiliar with the test words. Average percentage of the three judges was served as intelligibility scores for each of the participant. Visual inspection of Figure 4.18 portray that, there was a difference across pre-therapy and post-therapy intelligibility scores in all the participants.

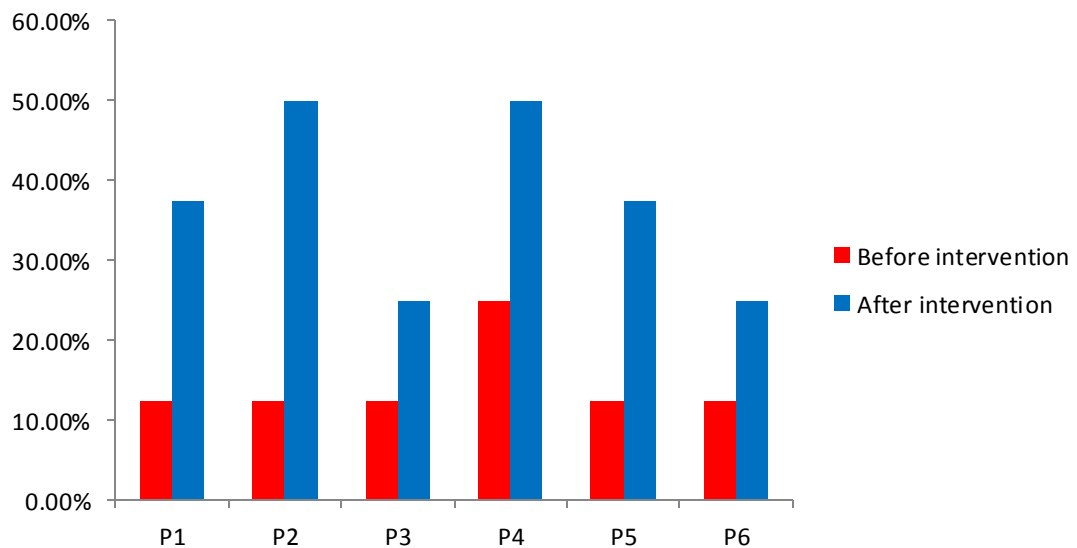


Figure 18. Intelligibility scores in percentage for pre-therapy and post-therapy assessments

To summarize, affricates were most facilitated in the medial position whereas fricatives were most facilitated in the initial position in both harmonized and non-harmonized sets of stimuli in Malayalam speaking children with hearing impairment.

Summary and Conclusions

Intelligible speech is very essential for successful communication. There are some literature reports of key environments and positions for effective production of erred sounds in English. In the context also there are few studies on the use of facilitative contexts (Krishna & Manjula, 1991; Shalini & Sreedevi, 2016; Amulya, 2017) for speech sound correction in children with misarticulation. However there is a dire need for such research in various languages for better speech therapy outcome in child language disorders. Articulatory errors seen in individuals with hearing impairment affect speech intelligibility severely. Hence, the present study aimed at identifying the facilitatory phoneme position for correct production of affricate, /tʃ/ and /dʒ/ and fricatives, /s/ and /ʒ/ in Malayalam speaking children with hearing impairment

Six native Malayalam speaking children in the age range of 3 to 7 years were recruited for the study. They were diagnosed as severe to profound hearing impairment with misarticulation of affricates and fricatives. Since the error phonemes were different in each participant, the number of participants considered for intervention varied for each phoneme. Phonetic placement technique was utilized for intervention. Bisyllabic non-words (consonant harmonized and consonant non-harmonized) were used as the stimuli. The children were assessed three times. Pre-therapy assessment was conducted before initiation of therapy, a mid-therapy assessment during therapy and a post-therapy assessment on termination of therapy. The results were subjected to statistical analysis and also graphically illustrated. The intelligibility scores were also calculated during the pre and post-therapy sessions using real words from Malayalam Articulation Test- Revised (Neenu and Sreedevi, 2011)

Affricates /c/ and /j/ were most facilitated in the medial position both in harmonized and non-harmonized sets of stimuli. This was clearly observed in graphical representation. Statistically there was no significant difference seen due to less number of participants. As per two studies of Divya and Sreedevi (2010) and Neenu and Sreedevi (2011) in typically developing Malayalam speaking children, larger percentage of children acquired affricates in the medial position first compared to initial position in the early stages of development. The same findings are seen in the hearing impaired children in the present study.

For the fricatives, /s/ and /ʃ/ , initial position was observed to be the better facilitating in both harmonised and non-harmonised sets of stimuli. Since there was no significant difference statistically, graphical representation was used to depict the results. The visual inspection of the graphs revealed that initial position was facilitating for fricatives in most of the participants. In Malayalam, Neenu and Sreedevi (2011), tested the acquisition of different consonants in initial and medial positions in the age range of 3 to 4 years. They found that fricatives were acquired earlier in initial position in most of the typically developing. The hearing impaired children in the present study also followed the same pattern for the acquisition of fricatives.

The intelligibility scores showed improvement across pre-therapy and post-therapy assessments. This shows articulation therapy focusing on affricates and fricatives in the most facilitating position can show improvement in speech intelligibility. Similar research on different phonemes can effectively guide speech language pathologists to carry out effective intervention for children with various communication disorders. It helps speech language pathologist to follow a

methodological plan based on facilitating phoneme position for articulation intervention.

Limitations of the study

1. The stimuli considered for intervention of participants were non-words.
2. The intelligibility scores were based on less number of words.
3. The findings cannot be generalized to all children with hearing impairment

Future directions

1. Future research can include real words as stimuli for intervention.
2. Generalization from non-words to real words can be studied.
3. Post-intervention measures can be carried out few months after termination of therapy to ensure maintenance of the target phoneme acquired in real words.
4. Similar study can be carried out in other child language disorders and in different languages.

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Appendix

Target phoneme	Harmonized	Response (✓)/(✗)	Non harmonized set-I (target phoneme in initial position)	Response (✓)/(✗)	Non harmonized set –II (target phoneme in medial position)	Response (✓)/(✗)
/c/	/caca/		/capa/		/paca/	
			/caba/		/baca/	
			/cata/		/taca/	
			/cada/		/daca/	
/ʃ/	/ʃa ʃa /		/ʃapa /		/paʃa/	
			/ʃaba /		/baʃa/	
			/ʃata /		/taʃa /	
			/ʃada /		/daʃa /	
/s/	/sasa/		/sapa/		/pasa/	
			/saba/		/basa/	
			/saʃa/		/tasa/	
			/saɖa/		/dasa/	
/ʃ/	/ʃaʃa/		/ʃapa/		/paʃa/	
			/ʃaba/		/baʃa/	
			/ʃata/		/taʃa/	
			/ʃada/		/daʃa/	

