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# Aspects of Vowels Analysis for Speech & Hearing Diagnostics
# Volume 2

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**8**

# Some Notes on Vowel Omissions in Conversations of Congenital SNHL after their Completions of Long Term Speech and Language Therapy VIII

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## Introduction

Several types of vowel error typologies are discussed in previous papers on speech in conversational corpora of congenital SNHL (Gayathri 2016; 2019, vowels II submission LII). These were grouped under conventional SODA and auxiliary vowel error typologies. This paper focuses on vowel omissions in congenital SNHL with different hearing devices. Specifically, consonant omissions are reported but the vowel omissions are not reported in SNHL literature. As a part of series of vowel studies in congenital SNHL, vowel omissions are the focus in this study.

**Keywords** congenital, sensorineural hearing loss, analogue BTE , programmable digital BTE , cochlear implants , conversation, corpora, vowels ,phonetics , SODA, omissions ,articulation ,grammatical markers , lexicon ,feedback .misarticulation

## Methods

The approach to participant selection, data collection, conversation speech sampling and transcriptions is same as in previous studies on vowel series in congenital SNHL (Gayathri 2019 Vowels I, Gayathri, S. G. 1982, 1988). After the audio recording of dyadic conversations, the phonetically transcribed speech data

bases was created for speech errors for 18 congenital SNHL participants in parent study for previous research (table 1, Appendix ). They comprised of three hearing domains, namely, analogue behind the ear level hearing aid users (D1), programmable digital behind the ear level hearing aid users (D2) and the cochlear implanted (D3). Their speech corpora were examined for vowel omissions in lexicons. These were examined and analyzed for their characteristic features. Table 2 below represents some samples of vowel omissions in lexicons extracted from speech conversations.

## Results

Kannada has a lexical closure rule according to which all lexicons end with vowels. ( Upadhyaya 1972) . Thus, vowels in Kannada lexicons occur in word initial, medial and final positions. superficial examination of the completely tabulated data of vowel omissions reveal that they occur only in word final positions in SNHLD1 only, all of whom have completed LT-CAOSLT. Given below are the findings in five different D1 speakers who show vowel omissions.

Table 2 Representative sample of vowel omissions in lexicons of conversational speech corpora in D1

| ApsnD1 | Aspsnno2 D1 | AspsnD1sib2 | AmssnD1 | CmssnD1 |
|---|---|---|---|---|
| mA{n}(r)(D)((u-)<br>bA(a)da((ne-)<br>bA(a)da((ne-)<br>bada( ne-)<br>n{A~>}(a){nn>}(n)}((ge-)<br>b{a.u<}(-r)t((e-<br>Ayit((u-<br>bE{n} (r)(e-)<br>AmEl(e-)<br><br>- | (-A))wAg+<br>+mADikOt((Ini-)<br>mA{t}(Dt)In((i-)<br>mADu{t}(tt)i((ni-)<br>mADu{tt<}(tt)A((re-)<br>)<br>tindbiDu{t}(TT)((u-)<br><br>{s}(S)abA{Ss}(S)<br>ye{lap}(lp)u<br>{m}(b){aeae}(E){Ss<}(SS)<br>{m}(b){aeae}(E){Ss<}(SS | attomba(ttu-)<br>nodiddii(ni-)<br>{-}(r)OT(i-)<br>rOT<(i-)<br>rOT<(i-)<br>mAt(DtAne-)<br>satO{@}(s)wAyit(u-)<br>k{uo<}(u)Lit(u-)<br>mADut(ttAre-)<br>t{Uo<}(o)LE{dt<}(d)(u-) | aiwatai((du-)<br>AmEl((e-)+<br><br>+ba{tt}(rt)ad((e-)+<br><br>mU((ru- | {E~>}(E)n((u-)<br>{E~}(E)n((u-)<br>{a~}(a){m}(mm)((a-)<br>yesar((u-)<br>Ogutt{A}((Ini-)<br>id{A}((Ini-)<br>(-n))aDeyuttA>((ne-)<br>mADut{A}(Ini)<br>mADi{l}(ll)((a-)<br>{A~}(A)m((Ele-)<br>{E}(A){m^}(m)((Ele-)<br>{a~}(A)mE~}((le-)<br>(A){mm}(m){a~}(E)((le-)<br>{E}(A)m((Ele-)<br>{E~}(A)m((Ele-)<br>{A~>}(A)m((Ele-)<br>Am((Ele-)<br>{A~}(A)m{e}(E) ((le-)<br>m{O}(o){t}(S){O}(a){l}(L)((e-)<br>y{i}(e){l }(ll)(i-)<br>ti((NDi-)<br>p{ei<}(ai)s((a-)<br>{s}(sk)Ul<br>Am{e~}(E)((le-)<br>pAT((a-) |

1. Vowel omissions are significant characteristic of some D1 speakers only
2. Vowel omissions are absent in D2 and D3 speakers

3. Vowel omissions are absent in an ApsnD1 and Ahif SNHL. Judgments on vowel omissions from Apsnsib2D1 and CpsnD1 are not made due to unintelligibility of their words.
4. Vowel omissions as residual errors are identified only at end of word structure in congenital SNHL post LT-CAOSLT. Either the omissions are part of syllabic deletions or they are vowel deletions only. Only one exception to this is in Aspsnno2D1 who shows a r are sample of word initial vowel deletion.

**5. Nature of omitted vowels in lexicons in different D1 speakers**

**5.1**. In ApsnD1 vowel omissions indicate incomplete lexical articulation *Ayit((u-* .Some vowel omission examples also indicate omission of dative suffix –ge *n{A~>}(a){nn>}(n)}((ge-)*

**5.2.** In Apsnno2 D1 has more advanced speech and language development than ApsnD1 . She has simple , compound and complex words and agglutinated words in her speech corpora . Her vowel omissions are mainly part of lexicons ending in few grammatical markers – reflexive marker for e.g. in *(-A))wAg+mADikOt((Ini-), mA{t}(Dt)In((i-), mADu{t}(tt)i((ni-)* and conjunction deletion of –u. However, she had borrowed foreign word in her speech corpora such as 1.{*s}(S)abA{Ss}(S), 2. m}(b){aeae}(E){Ss<}(SS,3.{m}(b){aeae}(E){Ss<}(SS and 4.ye{lap}(lp)u*,. 1,2,3. are accurate which are borrowed from Hindi . She applies also the Kannada lexical closure rule where appropriate like her other Kannada lexicons with vowel in 4. *ye{lap}(lp)u*. she did not have incomplete lexicons in her repertoire like in 5.1

**5.3. Aspsnsib2 D1** has combination of both 1 and 2 **.** This means that he has 1.incomplete lexical closures , and 2.vowel omissions due to omissions of grammatical markers 1. *{-}(r)OT(i-),rOT<(i-),rOT<(i-), satO{@}(s)wAyit(u-).* Unlike Apsnd1, he has compound words in his speech corpora. 2. *k{uo<}(u)Lit(u-), mADut(ttAre-),t{Uo<}(o)LE{dt<}(d)(u-).* Some of his syllabic deletions comprised more than one syllable also.

**5.4. AmssnD1** Even though AmssnD1, is a relatively fluent speaker like Apsnno2D1 he has vowel omissions of nature of lexical completion types at numeral *aiwatai((du-)*calculation . Some of his lexicons appeared to have vowel omissions .but on examination of subsequent lexicons in his conversations, they are paused agglutinated compound words ***AmEl((e-)++ba{tt}(rt)ad((e-)+mU((ru- taviraa> "afterwards comes three thousand " for expression aameelbartad(barutt)mUr sAvira>*** .

**5**.5. Child mssnD1 on the other hand who was yet undergoing speech and language therapy, with language experience of 7 years , has a large number of deletions of final vowels in her lexicons . *m{O}(o){t}(S){O}(a){l}(L)((e-),y{i}(e){l }(ll)(i-),ti((NDi-).* she like 5.3, 5.2 and 5.4demostrates deletion of word final grammatical inflections of Kannada Ogutt{A}**((Ini-),**id{A**}((Ini-),(-**n))aDeyuttA>(**(ne-).** In these processes, she may delete either one syllable or a word ending vowel.

**Inferences and discussions** Vowel omissions are part of conventional SODA articulation defects. They manifest different findings in D1 D2 and D3 hearing domains in congenital SNHL.

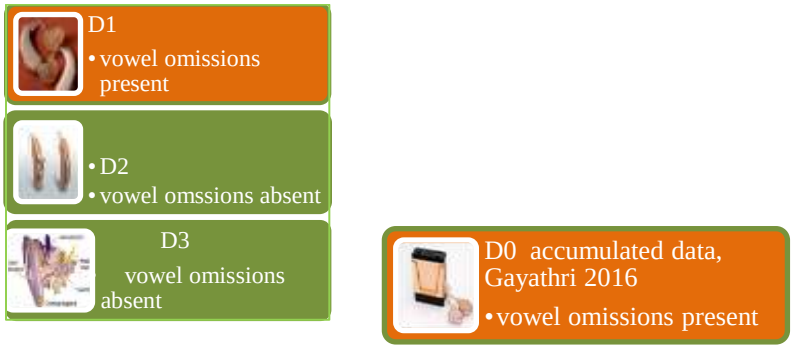


**Figure 1 Vowel omission occurrences in D1, D2 and D3 (and D0 Gayathri 2016)**

Inferences from analyses of current study are listed below.

1. Vowel omissions are completely absent in advanced hearing domains D2 and D3 while some D1 users have this vowel disorder(figure1 ) .
2. Residual vowel omissions occur in word final position in general after LT-CAOSLT.
3. The vowels may be deleted or they are deleted a part of final syllable deletions.
4. The vowel omissions differ in that they are either deletion of word final vowels or they are deletion of grammatical inflections
5. Child mssnD1 who is undergoing speech and language therapy show greater proportions of word final deletion than grammatical marker deletions. On the other hand, fluent speakers such as an ASpsnno2D1 has large number of vowel omissions connected to grammatical marker deletions .Some words appear to have final word deletions. But on examination of subsequent lexicons in conversations, it is evident that they are paused agglutinated complex words as in AmssnD1.Asimialr example is found in Aspsnno2D1 e.g. : *(-A))wAg + mADikOt((Ini-)* .

6. Otherwise, this participant has sporadic vowel omissions only.
7. When child and adult mssnD1 are compared, child mssD1 demonstrates lexical acquisition phase with final vowel omissions. This is completely overcome by AmssnD1.
8. Aspsnno2D1 has few borrowed words in her speech corpora .Some interjections are in use in Kannada that are borrowed from Hindi. E.g. *{s}(S)abA{Ss}(S),ye{lap}(lp)u,{m}(b){aeae}(E){Ss<}(SS),{m}(b){aeae}(E){Ss<}(S*SShe retains this rule for borrowed word as they are and as is routine in colloquial Kannada .But with borrowed word help , she also applies word final vowel ending which is also accurate like in colloquial Kannada *ye{lap}(lp)**u.*** Focus here is on only on vowel omissions and hence other phonetic defects in this word is not discussed

9. Aspsnno1D1 , AhifSnD1,in D1 hearing domain have no instances of vowel omissions .

10. Vowel omissions seem to be connected to both degree and type of hearing loss and speech language acquisition phases. Thus, vowel omissions traverse between word ending omissions from profound SNHL to lesser proportions or their absence in less severe degree of hearing loss in AmssnD1 .Proportions of vowel omissions connected to grammatical inflections deletion increase with increase in language experiences and fluency as in Aspsnno2D1 . On a similar count, Child mssnD1 with limited language experience shows large proportions of word final vowel omission deletions and relatively few grammatical connected vowel omissions .this is because she like ApsnD1has not yet applied these rules as often as Aspsnno2D1. Lastly, Aspsnno1D1 and AhifsnD1 have overcome all these vowel omission defects. The latter has better auditory access to vowels and Aspsnno1D1 is also an advanced fluent speaker who had completed LT-CAOSLT. Previous study in D0 users also has identified absence of residual vowel omissions in AhifSnD0( Gayathri 2016) .the adult profound SNHL with analogue hearing aids have word final residual vowel errors .Similarly ,parllels are seen in D1 and Do users in Ahif congenital SNHL . Ahifsn analogue users with residual hearing in los frequencies have no vowel omissions in their conversations .

11. Lastly, not all lexical vowel omissions need be a lexical acquisition problem. Apsnsib2D1 appeared to be like ***speaking for the sake of the listener*** at dyadic conversations. He wears analogue behind the ear hearing device like all D1. He was in the habit of rounding up the word articulations when he gets the cue that the listener has got his speech expressions as in

*{-}(r)OT(i-),rOT<(i-),rOT<(i-)* which followed with conclusive nod 'over' . He is in the habit of terminating the word much early than is required for completion of complete word articulations. With his relatively degraded auditory feed back at speech production and rigid auditory visual interaction at speech conversations like all other D1 users, he has acquired this habit of termination of words. Better auditory feedback in D2 and D3 may be facilitating factors to overcome these early word final vowel terminations.

**12.** Accumulation of findings from previous study (Gayathri, 2016) in Apsnd0 ( adult profound SNHL , analogue body level hearing aid user ) speaker also indicates presence of final vowel omissions in conversations .

## Conclusions

Vowel omissions are not reported in literature of congenital SNHL. This study identifies that they are found in D1 speakers only and not in D2, and D3 speakers. While better hearing accessibility has contributed to overcoming this disorder in D2 and D3, in D1 both years of language experience, speech language acquisitions and degree and type of hearing loss are contributing factors to their persistency and inter speaker variability. Some word final vowel omissions happened to be paused agglutinated complex words in two D1 speakers .Residual final vowel omissions of either word ending omission forming incomplete lexicons or vowel omissions of grammatical markers are highly conspicuous .But ,these are successfully overcome in D2 and D3 speakers . Analogue hearing device users , of , D1 and D0 congenital profound SNHL continue to have vowel omissions after more than 15 years of LT-CAOSLT . However , congenital profound SNHL with D3 have zero vowel omissions who have completed LT-CAOSLT in 3-4 years . D2 users which comprise only Aspsn types also have no vowel omissions throughout their fluent conversations.

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Appendix Table 1 clinical details of participants D1 D2 ad D3

1. Apsn_Domain1
2. Aspsn_Domain1 n=2
3. Amssn_Domain1
4. Ahifsn_Domain1
5. Cpsn_Domain1
6. Cmssn_Domain1
7. Apsnsib2 Domain1
8. Aspsnsib2 Domain1
9. Aspsn D2 Domain- n=3
10. D3 Domain - n=6

All participants except CpsnD1 and CmssnD1 had completed speech and language therapy
D1= Analogue BTE hearing aid user, both ears
D2=Digital programmable hearing aid user. All were children, both ears
D3= Multi channel Cochlear implanted (in one ear), age @sampling – 8-10 years, post speech and language developmental period
Sib2=second congenital SNHL sibling in family
C, D1= child, ongoing speech therapy and language experience for 7 years, parallels with child D3
A=Adult
Criteria of sampling – Completion of long term aural- oral speech and language therapy, congenital bilateral symmetrical SNHL, main streaming to normal schools;
Incidental Sampling; Total n=18
**TABLE 1**
(More details in vowels series paper 1,Gayathri 2019)

# Native Diphthong Articulations in Kannada Conversational Speech Corpora of Congenital SNHL post Long Term Speech Language therapy IX

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## 9

**Abstract**

As part of comprehensive vowel studies diphthongs are analyzed in dyadic conversations of three groups of congenital SNHL with different hearing devices. They had competed long term speech language therapy. Only two native diphthongs exist in Kannada. Cochlear implanted, and the programmable digital hearing device and adult high frequency hearing loss using analogue hearing devices had no diphthong misarticulations. On the other hand, in analogue hearing device users [ai] were acquired by all participants. [au] was absent in some participants .Further, substitutions, overall durational variation and nasalization are some noted diphthong articulation defects.

**Keywords** diphthongs, articulations, misarticulation, Kannada, phonetics, congenital, hearing aid, cochlear implant, digital, programmable, analogue. conversation, speech, corpora, deaf, sensorineural hearing loss, double , vowel, glide , degree, type , behind the ear , body level .

**Abbreviations** – A= adult, C= child, sib2= second incidence SNHL sibling in family, no – participant number.
*Conventional abbreviations* – SNHL –sensorineural hearing loss, p= profound, sp=severe profound, ms=moderate severe, hif=high frequency

### Introduction

In spite of nearly a century of research and landmark technological revolutions in hearing devices vowel defects persist in speech of congenital SNHL. Few investigators have focused on diphthong articulation in this population. Numbers (1936) was the first to report diphthong misarticulations in the deaf. He had identified splitting of the diphthongs, dropping off the final member of diphthongs or separating it into its component parts in his study on 87 deaf children.

Reduction of diphthong into 2 vowels or creation of 2 syllables were the strategies reported by Hudgins and Numbers (1942, cited from Ling 1976) .Monsen (1978) concluded that while the deaf misarticulate > 56% of all diphthongs they attempted and the partially hearing impaired misarticulated nearly 10% of the diphthongs. Thus degree of SNHL is according to him an important factor in misarticulation of diphthongs Osberger & Mc Garr (1980) in their review on speech of the hearing impaired ( on D0 group analogue body level hearing aid users) mention that very little research is conducted on diphthongs with the exception of works by Hudgins and Numbers ( 1942) . Later, Markides (1983) added that diphthongs are also substituted by vowel ə, or they have errors involving separate distinctive components, or they are dropped. Markides (1967, 80 )have also described diphthong errors in their 8 yr old SNHL .Not only dropping of 2nd element , neutralization of diphthongs were seen but marked excess prolongation of first component of diphthongs were reported . In a wider study by Nober (1967), on 3-15 years D0 population identified that diphthongs were associated with highest freq of correct articulation.

Several reports have accumulated on diphthongs in D3 (cochlear implanted speakers). Lee (2003) that competent monophthongs ability is prerequisite to diphthongs acquisition in his Cantonese speaking D3 speakers. Hearing experience was hence beneficial to diphthong production. .Cheung (1990) found that eight Cantonese diphthongs appeared before the mastery of secondary vowels /y, J/ developmentally in D3 speakers. These developmental studies are possible in D3 due to early identification of congenital SNHL and early hearing rehabilitation followed by intensive auditory verbal therapy and speech language programmes which did not exist at the time of D0 use with congenital SNHL in the western and developed countries. In India , we have congenital SNHL who use analogue behind the ear level hearing aid users (D1), programmable digital behind the ear level hearing aid users (D2) and the cochlear implanted (D3) .In some regions of India yet body level hearing aids are in use. Alternatively, these types are in use already by the SNHL who have now achieved adolescent and adult stages either at occupation or in vocational programs in their community. These populations specifically show reluctance to alternative modern hearing aids. A recent massive programmable digital hearing aid fitting to replace the analogue pocket level hearing aids (D0) to children of deaf schools has proved unsuccessful. This information emerged at the time of survey with teachers of the deaf (PC). Thus, they have continued to use D0.

Compound vowel acquisitions were acoustically examined in another recent study by Yang and Xu (2017) in Mandarin D3 2.9 to 8.3year old D3 speakers and age matched normal hearing children. Their language contains both triphthongs and diphthongs as compound vowels. Their findings included firstly, that the D3 children produced significantly longer durations for all six compound vowels under the study . Secondly, the ability of D3 to produce formant movement for the compound vowels varied considerably. While, Some CI children produced relatively static formant trajectories for certain diphthongs others produced certain compound vowels with greater formant movement than did the NH children. Thirdly, the D3 group, roughly followed the NH children on the pattern of magnitude of formant movement, but they showed a slower rate of formant change than the NH children .lastly, they inferred that prelingually deafened children with D3, during the early stage of speech acquisition, had not established appropriate targets and articulatory coordination for compound vowel productions. Tye-Murray **&** Kirk **(**1993**)**after receiving a cochlear implant: 6 months, 12 months, 18 months, and 24 or 36 month diverse and approximate normalcy overtime . Salas-Provance, Spencer, Nicholas & Tobey (2013) found an accuracy lag in diphthong articulation in their analyses in D3 speakers when compared with normal hearing children Five children with profound deafness who received cochlear implants (CI) between 19 and 36 months of age and five normal hearing (NH) children participated between 7 and 24 Months of Cochlear Implant Use.

Study of diphthongs or double vowels in hearing impaired is interesting, as these phonetic segments demand articulatory phenomena of starting from one vowel position and gliding into the other vowel. Unlike consonant clusters, they are relatively slow and successive formations in real time. How these are managed in Kannada by the D1, D2 and D3 speakers at conversations who had completed long term comprehensive aural oral speech language therapy (LT-CAOSLT) is the focus of this study. This study is also undertaken as a part of series of vowel studies in these there hearing domains (Gayathri 2019, I to VIII vowel series ,submission to LII ).

**Methods**

This study is a part of ongoing parent study on conversational speech of congenital SNHL begun in 2007 .The parent study contains 18 congenital SNHL subjects who had completed intensive comprehensive long-term oral- aural speech and language therapy (LT-CAOSLT). Their mother

tongue and regional tongue was Kannada. They also wore three different contemporary hearing devices: Analogue BTE hearing aid, Digital behind the ear hearing aid and the Cochlear implanted named as D1, D2, D3 rehabilitated hearing domains ( see figures 1,2,3,4) . Table1 provides clinical details of 18 participants in this study.

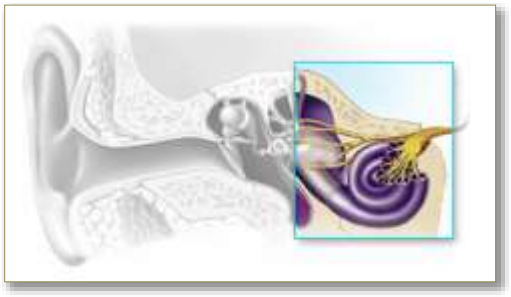

**Figure 1. Affected parts of ear in irreversible congenital SNHL.**

**Figure 2: D1, Domain 1, Analogue behind the Ear Hearing Aids.**

Conversation section 12.3, of a test coined as TELS HI /Kannada developed at Central Institute of Indian Languages; Mysore (Thirumalai and Gayathri 1982, 1988) after many years of its clinical use was administered to the congenital SNHL participants in a silent room in face-to-face context. The same was recorded with high quality Sony digital audio recorder connected to high quality microphone. Perceptual approach was adapted to make judgments of vowel phons and transcriptions.IPA transcription was adapted with fine attributions where needed for phonetically abnormal word units up to their utterances. Further details of methodology adapted can be seen in Gayathri (Vowel I, 2019).

**Figure 3. D2, Domain2, Digital Programmable Behind the Ear Hearing Aids.**

A novel approach to document lexical transcription was adapted. Word by word transcription was undertaken systematically in each lexical transcription, flower brackets are used for subject's phonetic segment misarticulation with target phone written in regular brackets adjacent to it. E.g. if [ADalla] is target lexicon, misarticulated phones within this target lexicon was documented as [A{d}(D)a{l}(ll)a].IN [A{d}(D)a{l}(ll)a] those phones in flower brackets are defective : {d}and {ll} . Their target phones are [D] and [ll] are by their side in regular brackets. This approach provides for simultaneous phonetic examination of the error word with normal word within square brackets. It also facilitates for simultaneous analogous examination of abnormal phonetic segment with target phonetic segment in flower brackets and regular brackets in their lexical contexts. By skipping flower brackets participants target word is read, and by skipping regular brackets, misarticulated word is read. By observing, the units within square brackets judgments were done in word context. Thus, the phonetics of target and participant's phon production can be compared in this method of new coding providing space for uttered word contexts.

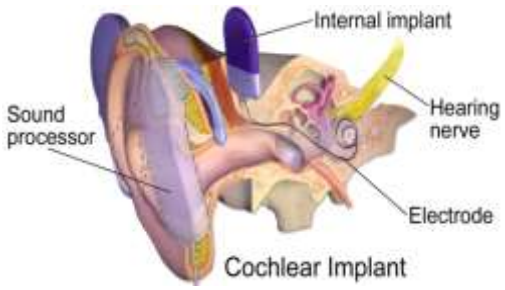


**Figure 4 D3, Domain3, the Multichannel Cochlear Implanted**

Native diphthongs of Kannada are only two in number [ai] and [au].Conversation corpora of three groups of participants which comprised the error lexicons are explored to identify target [ai]and [au] . If they were uttered accurately at least 2 times then the diphthong is marked as acquired. That means the subject is adept in the articulation of [ai] and [au]. Otherwise, the lexicons in which the diphthongs are misarticulated are tabulated. This data is analyzed in the following section.

**Results**

1. Diphthong [ai] occurred in all SNHL participantsD1,D2 and D3 but ,[ au] are not found in some D1 speakers Both diphthongs are present in all D2 and D3 speakers.

2. ApsnD1 for example has no [au] in his speech corpus. Similarly, child mssnD1 has no [au] in her speech corpus .

3. ASpsn-no1 and no2 domain1 and mssnl domain1 had both [ai] and [au] in their inventory subjects who had complete diphthong inventory [ai] occurred more often than [au] . This is in par with frequency of occurrence probability in Kannada that [ai] is more common than [au] (Ranganatha 1982 ).

4. Diphthongs [ai] in CmssnD1 demonstrate accuracy in articulation. Otherwise, diphthong substitutions with alien diphthong or vowel substitutions are seen .She also exhibits both duration and nasalization changes in her diphthongs in m{ai~>}(ai){t}(s)Ur.

   *T{E>}(ai)mu*
   *k{aeae}(ai)ge*
   *k{aeae}(ai)ge*
   *p{ei<}(ai)s((a-)[paisa]*
   *{ei}(ai)du*
   *m{ai~>}(ai){t}(s)Ur*

5. Cumulating of preliminary findings Words with [ai] for example in mai{t}(s)U{r*}(r){A.a~}{-r-)m{a~}(a){nn}(n)e is seen in this subject D0.

6. Ahifsnhl D1and D0 ,AspsnD1no1 and no2 normal diphthongs .

7. Aspsn sib2domain1 *m{ai~}(ai){s*}(s)Uru* . Nasalization of vowels was also a characteristic feature in this subject ( Gayathri 2019, vowels VII, Submission LII).

8. Aspsn no2 has both [ai ]and [au] in her speech corpus *.m{ai<}(ai) {s*}Uru", audA?, Audu.*

9. Double diphthongs n AmssnD1 wad aiawatai((du-)"*A{n}(rn)Ur<aiwattu",ombaiU.u(-r)')",mai{t}(s)u((ru-)" haudu, fail kai.*

10. AspsnD1no1 who shows 16 occurrences of [ai] in his speech with only one occurrence of [au] *aidgA{T}(NT)E.,* maisUr , *audaalla* ?

**Inferences and discussion**

Kannada has only two diphthongs [ai] and [au].Their accurate articulation is important as they have phonemic significance with vowels of Kannada( Ramachandra 1999) . Their phonemic contrastive nature can be seen in examples of [ai] and [au] in [aidu, oudu ,mauna, maina] ( Upadhyaya 1972, Nayak , MRanganatha1982 , Ramachandra 1999, Srikantaiah 2015). They are also contrastive with other vowels [aidu] [audu][idu][adu][Odu][Udu]. Hence, a collapse of this contrast leads to semantic confusions (Ramachandra 1999 ,examples pp2-8).

The diphthong [ai] occurs in all three word positions but not [au] which does not occur in word final position in Kannada. They are termed as closing diphthongs by Ramachandra (1999). Ramachandra (1999) has described the diphthong articulation of Kannada with respect to tongue movements as closing diphthongs ,which rise from low lingual position to high lingual positions . He also mentions of varying lip positions at their utterances. These are schematically represented below in figures 5 and 6. [ai] takes a forward upward closing glide and [au] takes backward upward closing glide .

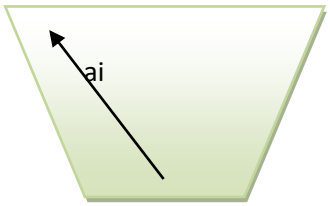


**Figure 5.[ai] occurs in Initial Medial and Final word positions – frontal rising or closing type in Kannada**

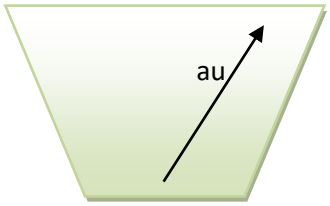


**Figure 6 [au] occurs in Initial and Medial word positions - posterior rising or closing type in Kannada**

Their frequency of occurrence is however low : [ai] and [au] occur 1240 and 365 times respectively in sampling of one lakh words, with percentage frequency of occurrences being 0.23% and 0.07% (Ranganatha 1982). As regards their length, Srikantaiah (2015) calls it as equivalent to *diirgha swara* , which is it is equivalent to duration of *long vowel* in Kannada . But, considering the rate at which spoken speech corpus accumulates approximately 125 words per minute is identified as reading rate ( Ravikumar, Supraja , Savithri , 2008) , and their contrastive nature, it is imperative to probe into the diphthong acquisition in SNHL speaker who has completed speech and language therapy programme . Data on diphthongs in Indian languages is however minimal. Only Rajapurohit (1982) and Jha( 1985) have explored acoustics of diphthongs in Kannada and Maithili languages respectively .

Residual diphthongs errors are absent in D2 and D3 and in AhifSNHL and in few D1 such as Aspsnno1 D1, post LT-CAOSLT. Occurrences of [ai] are more common in all participants. Some D1 speakers did not have lexicons containing [au] in their speech corpus .This can be attributed to either absence of [au] diphthong in their speech , or backward gliding or due to the limitation of conversational sampling method adapted in this study .

D1 group which shows diphthong misarticulations show at least four types of diphthong articulations in their conversation corpora.

1. Accuracy in diphthong articulations.
2. Nasalization of diphthongs as in AspsnD1sib2. He in addition has vowel nasalization defects in his speech corpus.
3. Overall short diphthong duration in Aspsnno2D1.She exhibits short duration of vowels in her speech corpora.
4. Substitution of diphthongs .
   4.1 by alien diphthong [ei] in CmsD1 .This, alien diphthong does not affect phonemic contrasts parameter .
   4.2 Substitution of diphthong by native lengthened vowel [e>] for [ai] in CmssnD1.
   4.3 Substitution of diphthong by long alien vowel [aeae] for [ai] in CmssnD1.
   4.4 Omissions ,and additions defects of diphthongs of SODA misarticulations are not noted in D1.
   4.5 Substitution of diphthong [ai] by its long nasalized diphthong is also seen in CmssnD1.

**Other findings on diphthongs in D1 include**

1 CmssnD1 shows absence of vowel [au] like AmssnD1sib2, ApsnD1 and ApsnD0 ( from data of preliminary study Gayathri 2016)

2 On the other hand, adult mssnD1 has none of the diphthong articulation errors exhibited by child mssnD1 (4, 5, and 6) . In fact , his speech has double diphthong articulations in same word .He also has both diphthongs in his speech repertoire with more number of [ai] than [au]. Thus increase in language experience help overcome the diphthong errors in AmssnD1 compared with CmssnD1.

3 Another participant who is skilled at diphthong articulation is AspsnD1no1 who shows 16 occurrences of [ai] in his speech with only one occurrence of [au] . His

narrative context elicited at conversation was on his project which contained lexicons with many diphthongs. Some of them are borrowed words such as *saikallu ,fail, saiD* in addition to Kannada words in conversations and narrations corpus such as *kaige, aidu, aidgaNTe ,kaiyalli* .

4 In D1 Ahifsn who has, low frequency residual hearing like AhifsnD0 is a fluent speaker with absence of diphthong errors.

5 Similarly, relatively better auditory access in D2 and D3 has helped overcome diphthong errors in their fluent speech. Unlike developmental studies cited for D3 in current paper, this study is only on those D3 participants who have completed LT-CAOSLT (figure 7).

6 Unlike diphthongizations identified in previous study (Gayathri 2019, vowel series V, submission language in India V) in D1, none of diphthongs showed deviances of different duration in their phonetic vowel elements diphthongs.

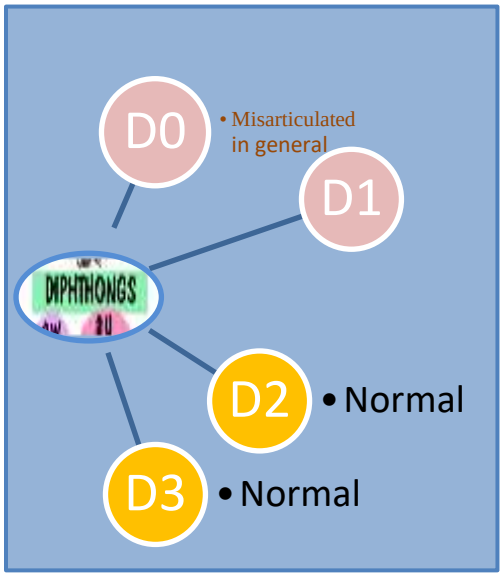


**Figure 7 Kannada Diphthong articulations in D0, D1, D2 and D3**

## Conclusions

Residual diphthong errors in analogue hearing aid users in D1 or D0, do not follow the patterns of splitting of diphthongs, omission of one of its vowel elements reported in the literature (Numbers 1936) . In addition the less frequent diphthong [au] is absent in some

conversation corpora of D1 speakers this is attributed to limitation of conversation sampling of current study or the virtual absence of diphthong itself in these participants or even the remote explanation of presence of back vowel element in diphthong [au] . On the other hand, alternate alien diphthong substitutions, alternate native or alien vowel substitutions ,duration variances and nasalizations as diphthong errors are encountered in D1 in current study. On the other hand, there are no residual diphthong errors in D2 and D3 speakers with better auditory accesses. In general, glides of Kannada are acquired by all hearing domains under current study.

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# 10

# Notes on Residual Vowel Additions in Congenital SNHL Post LT – CAOSLT, X.

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**Abstract**

As part of comprehensive series of research on nature of vowels and residual vowel errors in congenital SNHL, vowel additions are explored in their dyadic conversational corpora in Kannada. They are noted only in child moderate severe SNHL speaker with analogue behind the ear level hearing aid who had completed only 7 years of speech and language therapy. these are absent in other speakers with analogue BTE , digital programmable hearing aid devices and in the cochlear implanted .Further additions are seen only in word initial positions in conversations .adult with similar SNHL and hearing aid use ,who had completed speech and language therapy has no vowel additions.

**Keywords** Vowel additions, articulations, misarticulation, Kannada, phonetics, congenital, hearing aid, cochlear implant, digital, programmable, analogue, conversation, speech, corpora, deaf ,sensorineural hearing loss, behind the ear , body level , auditory feedback ,resting position ,posture ,preparatory .

**Abbreviations** – A= adult, C= child, sib2= second incidence SNHL sibling in family, no – participant number, LT-CAOSLT = long term comprehensive aural oral speech and language therapy
*Conventional abbreviations* – SNHL –sensorineural hearing loss, p= profound, sp=severe profound, ms=moderate severe, hif=high frequency

## Introduction

Research in last one century has focused on nature of speech defects of congenital SNHL (figure1) and in their auditory rehabilitative and therapeutic removals. Of these simple vowel articulations yet also sustain with defects in speech of SNHL. At the time of identifications and labeling of vowel error typologies, vowel additions were encountered in conversations (Gayathri 2019 vowel series II, submission language in India II). These are explored in participants of parent study whose goal is to explore comprehensively the segmental nature in SNHL in rehabilitated hearing domain groups analogue behind the ear level hearing aid users (D1), programmable digital behind the ear level hearing aid users (D2) and the cochlear

implanted (D3). No information could be traced with vowel additions in speech production of congenital SNHL.

## Methods

The approach to participant selection, data collection in Kannada langauge, conversation speech sampling and transcriptions is same as in previous studies on vowel series in congenital SNHL (Gayathri 2019 Vowels I- submission LII, Gayathri, S. G .1982, 1988). After the audio recording of dyadic conversations, the phonetically transcribed speech data bases was created for speech errors for 18 congenital SNHL participants in parent study for previous research (table 1 ). Results from preliminary studies on two participants are also cumulated in present observations with two participants in D0 (figure2 D0, Gayathri 2016) hearing domain (analogue body level hearing aid user). This study integrates and infers nature of vowel additions in four hearing domains, namely, D0, analogue behind the ear level hearing aid users (D1 figure 3), programmable digital behind the ear level hearing aid users (figure 4 D2) and the multi channel cochlear implanted (figure 6,D3). Their speech corpora were examined for vowel additions in lexicons. Table 1below represents some samples of vowel additions identified and listed in lexicons from conversations of SNHL participants extracted from speech conversations (table 2). These were examined and analyzed for their characteristic features**.**

**Figure 1. Affected parts of the ear in irreversible congenital SNHL.**

**Figure 2.domain 0,D0, analogue body level hearing aid**

**Figure 3: domain 1,D1, analogue behind the ear hearing aids**

**Figure 4: domain 2,D2 programmable digital behind the ear hearing aids**

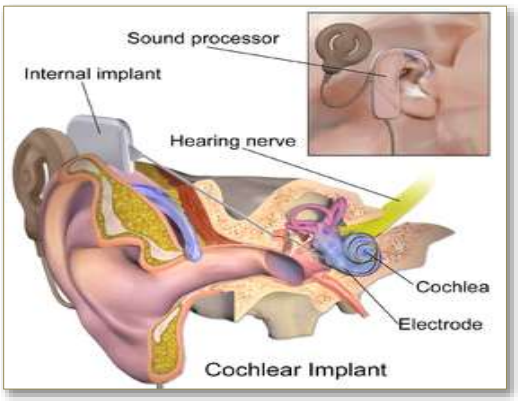


**Figure 5: Domain 3,D3 the Cochlear Implanted**

| **Language** | **Therapy** | **Aural Oral Speech Therapy since age** | **Age @ data collection** | **Expansion of subject coding** | subject | Table 1 – details of participants with congenital SNHL<br><br>All are bilaterally symmetrical<br><br>D1= analogue behind the ear hearing aid user, n=9<br><br>D2 =programmable digital BTE user,n=3<br><br>D3=multi channel cochlear Implanted [UL],n=6<br><br>n=18 |
|---|---|---|---|---|---|---|
| Word ,phrases , simple sent s. | Completed | 4 y, 1/12 | 17y11/12 | Adult profound D1 | ApD1 | |
| Word, phrases partial, complete sent s. | Completed | No1-3 y,2/12<br><br>No2- at 6 months | 22y,2/12<br><br>18y,7/12 | Adult severe profound D1<br>2 subjects | AspD1 | |
| - " - | Completed | 4y,5/12 | 19y,7/12 | Adult moderate severe D1 | AmsD 1 | |
| Complete sent s. Fluent. | Completed | 5y,8/12 | 19y,1/12 | Adult high frequency D1 | AhfD1 | |
| Complete sent s, Fluent. | Completed | No1 – 2 y,9 /12,33/2<br>No2 - 3y, No3-4 , 10 | 18y,1/12,20y<br>27y,10/12 | Adult severe profound D2 | AspD2 | |
| Complete sent s. Fluent | Completed | 3y ,4 /12<br>2y,8/12<br>2 y, 1/12<br>3 y<br>3 y1/12<br>2y,5 /12 | 9 y<br>8 y1/12<br>9 y 5//2<br>10y, 4/12<br>9y, 7/12<br>9 y, 3/12,<br>10y, 5 /12 | 4 profound 2 severe profound =6 cochlear implanted.<br>Sampling Criteria after 4-5years post speech and language therapy ; D3 | D3 | |
| Word ,phrases | for 7years - ongoing | 3y,1/12 | 11y, 7 /12 | Child profound D1 | CpD1 | |
| Word , phrases | for 7years - ongoing | 4y,2 /12 | 11 y,4 /12 | Child moderate severe D1 | cmsD1 | |
| Word .phrases | Completed | 8months | 19 y | Adult profound sib2D1 | Apsib 2D1 | |
| Word, phrases, simple sent s. | Completed | 1 y,4/12 | 19 y, 3 /12 | Adult severe profound sib2D1 | Asp sib2D | |

## Results

There are many vowel additions in lexicons of one child mssn D1 only out of total of 20 participants in D0, D1, D2 and D3. One sporadic instance was noted in AspsnD1 no2 .All D0, D2 and D3 speakers have no vowel addition speech defect. The list of vowel additions in lexicons of child mssnD1 who has7 years of language experience with ongoing therapy is listed below. The findings from analyses on vowel additions are listed below.

Table 2 . **Vowel additions in D1**

| CmssnD1 | Cpsn | Apsn sib2 | Aspsnno2 |
|---|---|---|---|
| {u<+}{p<}(b)bAs<br>{A+}y{i>}(i)lla<br>{A+}illa<br>(A+){pp}(p)U{r>}(r)I<br>(A+){pp}(p)U{r>}(r)I<br>{A+}yilli<br>{A+}{p<b}(b)A{r>}(r)ati<br>{A+}yi{dd}(d)a(e)<br>{A+}y{I}(i){dd}(d)e<br>{A+}tinDi<br>{u+}lOTa<br>{A+}{n<}(n){A~}(A)kUware<br>{A+}mO{r}(I)e(a).<br>{A+}yi<lla.<br>{A+}la{kASA~m}(kSm)i<br>{A+}la(kASA~mm)(kSm)i<br>{A+}{ny}(n)Anu | u(+)n(s)ima~ | {A+}rA{d}(j)a<br>{A+}rUpa<br>{A+}bidde<br>{A+}ga{TT}(NT)e | *{a+}kate* |

1. Residual vowel additions are mainly with [A+] often and rarely with[u+]
2. Residual vowel additions occur only in word initial position unlike vowel omissions in word final positions only (Gayathri 2019 VIII) .
3. A sporadic vowel addition in a lexicon was noted in fluent speaker Adult spsnD1*{a+}kate* and a child psn sib2 D1 *u(+)n(s)ima~*. The former is fluent speaker and the latter has limited vocabulary with many unintelligible words.
4. A sib2 with profound SNHL D1 with limited vocabulary has few vowel additions.
5. Another child participant with psnD1 as with highly unintelligible speech has only a sporadic evidence of residual vowel additions. His vocabulary is far limited than CmssnD1 Impacts of vowel additions on semantics is nil.
6. AdultpsnD1 sibling2 with limited language also shows vowel additions *{A+}rUpa*
7. Residual vowel additions are absent in D2 and D3 speakers and all Adult D1 speakers.

## Discussion and Conclusions

It is evident from the above results that D2 and D3 as a whole have no vowel additions (figure 6).They might have even not have faced vowel addition in their early speech acquisitions with enablement of better auditory feedback like AhifsnD1 and D0 . In addition, D0 which has only Apsn and Ahifsn have no vowel additions like in the D1group. CmssnD1 with limited years of language experience shows many

vowel additions. Otherwise, Apsn sib2 D1 has few vowel additions only. CpsnD1 and AspsnD1 have one example of remnant vowel addition. [A+} and [u+] were common vowel addition types, that occurred in only lexical initial position .Probable , reason for this behavior is that initiation of voice is first begun in the utterance of lexicon and then integration articulation of segments follow in the lexicon in child mssnD1. In others with sporadic vowel additions, they are possible remnants of vowel additions. Good auditory access helps overcome these vowel additions in Ahifsn D1, D0 ; D2 and D3 speakers. Apsn in both D1 and D0 have no vowel additions. These with rest of ASpsnD1 have overcome vowel additions in their speech. Probable resting posture of oral speech mechanism at voice initiation contributes to nature of vowel addition of ether [+A] or [+u]. Unlike vowel omissions they occurs in word initial position only ( Gayathri 2019 ,vowel series VIII)

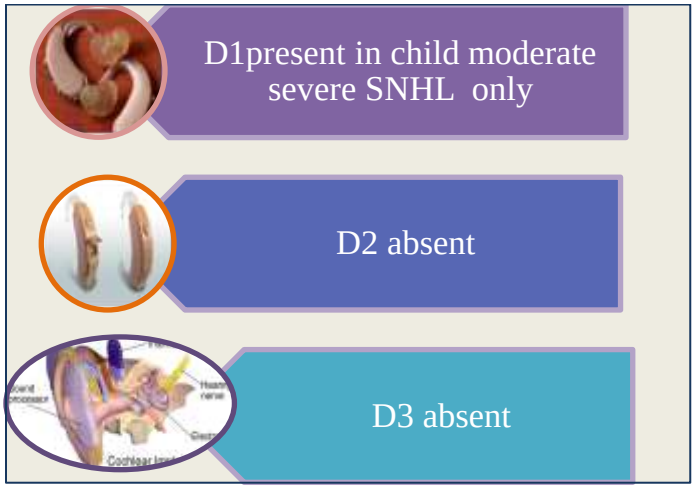


**Figure 6. Vowel additions in D1, D2 and D3**

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Gayathri, S. G .2019 i Some Notes on Vowel Omissions in Conversations of Congenital SNHL after their Completions of Long Term Speech and Language Therapy VIII.( submission, vowels VIII, Language in India jl

# 11

# Rare Post- Velar Places of Articulations Consonant Substitutions to Vowels Discovered in Congenital SNHL Dyadic Conversations, XI.

**S Gayathri Gokulan, M Sc (Speech& Hearing), PGD Nutrition and Dietetics, Telemedicine**

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**Abstract**

Analyses of 20 dyadic conversational speech corpora for vowel defects has helped discover rare residual consonant substitutions to vowels in congenital sensorineural hearing loss speakers with analogue behind the ear hearing aid and programmable digital hearing aid users not reported in the literature . Four consonants[R] [ʢ] [h] [ʔ] are found substituted for vowels in either word initial or word medial positions. Except [h] all others are non native Kannada consonants. [ʔ] and [**R**] are highly conspicuous speech defect to listener. Commonality to rare consonant substitutions to vowels included oral consonant and post velar articulatory activations. Neither nature of auditory access or degree of language experiences could be related to their occurrences. Reason for these least visible, deep posterior consonant occurrences, replacing native vowels is not known. These are also not reported in literature of congenital sensorineural hearing loss speakers.

**Keywords** vowel articulations, misarticulation, Kannada, phonetics, congenital, hearing aid, cochlear implant, digital, programmable, analogue, conversation, speech, corpora, deaf ,sensorineural hearing loss, behind the ear , body level , consonant, substitution, glottal, epiglottal , trill , stop , uvular ,laryngeal, fricative, guttural ,pharyngeal , post velar .

**Abbreviations** – A= adult, C= child, sib2= second incidence SNHL sibling in family, no – participant number, long-term comprehensive aural oral speech and language therapy (LT-CAOSLT).

*Conventional abbreviations* – SNHL – sensorineural hearing loss, p= profound, sp=severe profound, ms=moderate severe, hif=high frequency,

## Introduction

Impact of irreversible congenital sensorineural hearing loss (figure1) on their speech and language production is an interesting field of research with the pitching in of new and advanced technological devices for hearing rehabilitation. Vowel studies in SNHL began in 1936 which continues with the

present day cochlear implanted (Gayathri 2019 vowels I , Submission language in India ) as series of vowel investigations in speech of congenital SNHL in four rehabilitated hearing domains which are in use in India is undertaken in dyadic conversations in Kannada . Rehabilitated hearing domain groups analogue behind the ear level hearing aid users (D1, figure 2), programmable digital behind the ear level hearing aid users (D2, figure3) and the cochlear implanted (D3,figure 4) are involved in these studies, with accumulation of findings from preliminary studies(D0) (Gayathri 2016).

At the time of initial audio data transcriptions, and at the data searching, sorting, labeling and classification of vowel error typologies in previous series of vowed studies (Gayathri vowel series II, 2019) several consonant substitutions to vowels were encountered which were logged as under vowel substitution patterns. In addition, at the time of alternate vowel substitution to vowel studies under the frameworks of linguistic vowel shifts (Gayathri 2019, vowel series IV) consonant substitutions to vowels were logically eliminated from examination. None of the studies in speech of congenital SNHL has reported consonant substitutions to vowels.

## Methods

The approaches to participant selection, data collection, conversation speech sampling and transcriptions are same as in previous studies on vowel series in congenital SNHL (Gayathri 2019 Vowels I- submission LII, Gayathri, S. G .1982, 1988). After the audio recording of dyadic conversations, the phonetically transcribed speech data bases was created for speech errors for 18 congenital SNHL participants with

**Table 1. Clinical detail of participants D1, D2 and D3**

| | |
|---|---|
| 1. | Apsn_Domain1 |
| 2. | Aspsn_Domain1 n=2 |
| 3. | Amssn_Domain1 |
| 4. | Ahifsn_Domain1 |
| 5. | Cpsn_Domain1 |
| 6. | Cmssn_Domain1 |
| 7. | Apsnsib2 Domain1 |
| 8. | Aspsnsib2 Domain1 |
| 9. | Aspsn D2 Domain- n=3 |
| 10. | D3 Domain - n=6 |

All participants except CpsnD1 and CmssnD1 had completed speech and language therapy
D1= Analogue BTE hearing aid user, both ears
D2=Digital programmable hearing aid user. All were children, both ears
D3= Multi channel Cochlear implanted (in one ear), age @sampling – 8-10 years, post speech and language developmental period
Sib2=second congenital SNHL sibling in family
C, D1= child, ongoing speech therapy and language experience for 7 years, parallels with child D3
A=Adult
Criteria of sampling – Completion of long term aural- oral speech and language therapy, congenital bilateral symmetrical SNHL, main streaming to normal schools;
Incidental Sampling; Total n=18
**TABLE 1**
(More details in vowels series paper 1,Gayathri 2019)

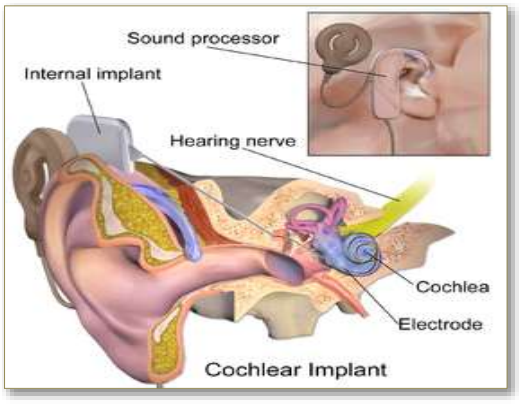
long-term comprehensive aural oral speech and language therapy (LT-CAOSLT) in parent study for previous researches (table 1). They comprised of three hearing domains, namely, analogue behind the ear level hearing aid users (D1), programmable digital behind the ear level hearing aid users (D2) and the cochlear implanted (D3). Their speech corpora were examined consonant substitution for vowel in lexicons. These were examined and analyzed for characteristic features of consonant substitutions to.

**Figure 1. Affected parts of the ear in irreversible congenital SNHL.**

**Figure 2: domain 1, D1, analogue behind the ear hearing aids**

**Figure 3: domain 2, D2 programmable digital behind the ear hearing aids**

**Figure 5: Domain 3, D3 the Cochlear Implanted**



## Results

Table 2 below represents complete sets of samples of rare consonant substitution for vowel in lexicons are extracted from speech conversations. Perceptually loud consonant substitutions are marked in bold fonts. Results indicate that five out of 18 congenital SNHL after the completion of LT-CAOSLT, exhibit consonant substitutions to vowels. These include participants from D1 and D2. D3 as a group do not have consonant substitutions to vowels. These errors are identified, sorted and tabulated in table 2 below.

1. Any of the five vowels in vowel sets of Kannada [a, i, e, u o] is susceptible to consonant substitutions.
2. Uvular trills, pharyngeal trill, laryngeal fricatives and glottal stops [**R**] [ʕ] [h][**ʔ**] are four consonants which replace vowels .
3. Of the above consonants listed fewer than 2 above, only [h] is native consonant of Kannada.
4. Aspsnno1, Aspsnno2, Aspsnsib2, CmssnD1, and one AspsnD2 show these consonant substitutions to vowels in conversational corpora.
5. It may be noted that all consonants which have replaced vowels are oral and post -velar or guttural consonant types.
6. They make their occurrences in word either initial or medial positions.
7. The consonants have replaced not only pure vowels but they also take positions of V-V hiatus after deletion of medial consonants in deletion of medial [shw]-resulting V–V hiatus substituted by glottal stop[**ʔ**] in Aspsnsib2D1 . Deletion of medial [shw]-resulting is V–V hiatus substituted by glottal stop in Aspsnsib2. Glottal stop did not occur in other V–V hiatus in his data. They also substitute few consonants in this participant.
8. Two types of consonant substitutions can be identified from speech samples listed in table 2

8.1. Single consonant replaces vowels R/a, h/a, R/e, R/i, **ʔ**/o, **ʔ**/a, **RR**/i, **RRR**/E

8.2. Single consonant replaces vowels and adjacent segments **RRR**/Tre, **RRR**/Ag

9. Glottal stop {**ʔ**} is perceptually very loud relative to other s speech in the speech corpora of Aspsnsib2.
10. Nature of uvular trill [R] also varied perceptually from participant to participant (see table 2).

10.1 . Uvular trills [R] are of normal consonant length or uvular trills of long durations.

10.2 .Perceptual loudness of uvular trill [**R**] unlike other segments in speech corpora is an extremely loud uvular trill.

10.3 . Uvular trill [R] is either of breathy nature in AspsnD2 or of non breathy nature in CmssnD1, Aspsnno2, Aspsnno1.

10.4. Extremely loud explosive onset in bursts, breathy, and harsh quality of uvular trills [**R**] possibly masking adjacent segments in words in AspsnD2.

10.5. [R] Starts with pre - onset of alternate substituted vowel and continues to [R]in Aspsnno2; VC/V.

10.6. Uvular trills[R] are generally of long duration .They are much longer in the AspsnD2.

10.7. Uvular trills [**R**] in the AspsnD2 are also substitutions for other consonants in his speech corpora.

10.8. Both pharyngeal [ʕ] and uvular [**R**] as vowel substitutions are seen only in Aspsnsib2.

10.9 Trills are the only types of consonant substitutions in CmssnD1, Aspsnno2 and an AspsnD2.

11 [R] is seen in 4/5 participants , [h]and [ʔ][ʕ] are seen in only one out of five participants

12 [**R**] and [ʔ]are perceptually more conspicuous disorder than [h].

13 All consonant substitutions to vowels are rare in speech corpora limited to findings tabulated in Table 2.

14 Both [h] and [ʔ] have glottal place of articulations. Pharyngeal [ʕ] is perceptually of average loudness like rest of speech segments in conversation corpus of AspsnD2no2 than his [**R**].

15 Overall places of origin of consonant substitutions seem to involve post velar positions such as the uvula, pharynx and glottis on bases of perceptual audio transcriptions.

16 Integration of data from preliminary study in D0 (fig 6 analogue body level hearing aid user) hearing domains (Gayathri 2016) has shown absence of consonant substitutions to vowels in both ApsnD0.

**Figure 6 D0 rehabilitated hearing domain**

and AhifsnD0.

17 Ahifsn D1 and D0, ApsnD1 and D0 and AmssnD1 have zero consonant substitutions to vowels like in D3 (Gayathri 2016,1983).

Table 2 List of consonant substitutions to vowels in their lexical contexts in D1 and D2. {}=substituted segment ( )=target segment .Bold fonts indicate conspicuous loud phonetic outcomes relative to rest of segments in speech corpora

| Aspsnno1 | Aspsnno2 | Aspsnsib2 | CmssnD1 | An AspsnD2 |
|---|---|---|---|---|
| p{R}(a)kkad<br>{h}(a)nda<br>p{R}(e)TT{u}(i)ge<br>p{R}(e)TT{R}(i)ge<br>{h}(a)dakke | b{aRR}(E)Da<br>b{aRR}(E)Da | A{w}(Sw){ʔ}(a)ttu<br>**{ʔ.ʔ}**(a)(-shw)(a)ttu<br>ann{ʔ}(o)ndu<br>{ʔ}(a).{-}(NN)a<br>santO.ʔ (-sh)(a)wAyi{t<}(t){u-} | r{R>}(A)m{RR>}(u)<br>Ar{R>}(A)mu<br>A{d}(L){RR}(i)lu<br>A{d}(L){RR}(i)lu | **{RRR}(**Tre**)**kking ,<br>gott{**RRR}**(Ag**)**lilla<br>b{**RRR}(e)**Da bis{**RR}**(i)lu<br>b{ʕ}(I)ruulli<br>v{ʕ}(O)Tu<br>y{ʕ }(A)wdU illa<br>ad{ʕ }(o)ndEnE yArAdr{ʕ }(E)nantE<br><br>b{ʕ}/(i)dh illwall{ʕ }(A)nthELbiTTn alla? |
| R/a; h/a; R/e; R/i | aRR/E | ʔ/a.<br>Deletion of medial [shw]-resulting V–V hiatus substituted by Glottal Stop. ʔ/o | R>/a, RR/i | |
| Short [R]<br>[R] is of average loudness of R<br>[R] is not breathy<br>[h] is voiceless<br><br>[R] is voiced<br>[R]is not breathy | Starts with an alternate substituted vowel and continues to[R] VC/V average loudness of<br><br>[R]is not breathy<br>[R] is voiced | Loud glottal stop<br><br>ʔ/ a, ʔ/o<br>ʔ in V V hiatus after deletion of NN , sh ,( ash and wa)<br><br>But, Consonants are also substituted by loud glottal stop<br>ou{ʔ}(S)A>di<br>{ʔ}(-han){O}(o){d}(nd)u | Long R with average loudness as substitution for vowels<br>[R ]is not breathy<br>[R] is voiced | 1.loud ,long , vibratory ,breathy , explosive onset , harsh long **R** masking adjacent segment or perceptual absence of vowel or consonant segment .CV ,C1C2V or |

| | | | | |
|---|---|---|---|---|
| | | | | VCS are affected by [**R**]simultaneously<br>**RRR**/Tre<br>**RRR**/Ag<br>**RRR**/E<br><br>2. Only one vowel in a lexicon is substituted by **R**.<br>e.g. ;**RR**/i<br>3.[**R**]is of long duration than other participants<br>4. [**R**] is voiced<br>5. [**R**]is breathy and explosive.<br>6.But,consonants are also substituted by this same[**R**]<br>e.g. naa**RR**u/naaku<br>7. [ʕ]/I [ʕ]/E [ʕ]/A or [ʕ]/O ,[ʕ]/i |

18 Degree of auditory access in rehabilitated hearing domains was thus not a primary parameter for consonant substitutions to vowels due to ambiguous findings of these errors. Severe degree of SNHL ApsnD1 and D0 compared with AspsnD1 and CmssnD1 have no consonant substitutions to vowels. At the same time, better auditory access in D3, other two AspsnD2, and AhifsnD1, AhifsnD0 also have zero consonant substitutions to vowels. In similar line of arguments participant with low auditory access D0 psn has no consonant substitutions to vowels.

19 Greater degree of language experience cannot be also attributed to elimination of consonant substitutions to vowels in speech corpora. This is because both AspsnD1 and AspsnD2 who show consonant substitutions to vowels have fluent speech with agglutination properties in their speech with relatively long lexical strings, with larger number of

compound and complex words, contradicting the factor of language experience. Their language experience is more than 17, 6/12 years and 20+ years respectively. In addition, for the former participant AspsnD1 was begun on D1 and long-term comprehensive aural oral speech and language therapy (LT-CAOSLT) by age 6 months. Aspsnno1 who shows uvular trills and laryngeal fricatives in his speech corpora is also a fluent speaker. In addition , he is the only participant n D1 group who shows better articulations ,with only similar vowel substitutions under vowel shift framework studies( Gayathri 2019 vowel series IV , submission language in India ) and vowel nasalization studies ( Gayathri 2019 vowel series VII , submission language in India) .

**Discussions**

The results listed above lead to inferences that in these 5 participants discussed above, the gross vowels and consonant contrast is disturbed. From clause 1 to 20 , it is evident that rare consonant substitutions to vowels occurs in five participants in a total of 20 participants ranging from D0 to D3 post long-term comprehensive aural oral speech and language therapy (LT-CAOSLT) in Kannada . Both D1 and D2 have demonstrated consonant substitutions to vowels. They are totally absent in D3, AhifsnD0 and D1 , ApsnD1 and D0 , and other D1 and D2 participants incorporated in this study .

[**R**] [ʕ] [h][**ʔ**] are four consonants which replace vowels in either word medial and word initial positions . It was possible to capture these rare occurrences of consonant substitutions to vowels due to adaption of conversation corpora in methodology. Degree of language experience and degree of auditory access in rehabilitated hearing domains were not primary parameters for consonant substitutions to vowels due to ambiguous findings of these errors. This study refutes earlier observations (Thirumalai and Gayathri 1982, 1988) that point out that both the profoundly hearing impaired and the partially hearing subjects do not ever substitute a consonant for a vowel or vice-versa.

**Discussion within theoretical articulatory framework**

All four consonants substituted for vowels are oral consonants. [**R**] [ʕ] [h] [**ʔ**] are also guttural, in the sense that they are articulated in post velar positions in speech mechanisms for articulations. Except [h], consonants which are substituted for vowels in congenital SNHL D1 and D2 listed above do not show adherence to regulations within the dimensions of Kannada phonetics .This is stated because, additional posterior places of articulation not found in Kannada are involved at vowel articulations, with consonant characteristics. Glottis, uvula, and pharynx are involved for either non native trill or stop articulations in

consonant substitutions to vowels. The following paragraphs enumerate the nature of these post velar substitutions under articulatory framework of research studies in this area.

Extensive work on post velar consonants and vowels is done by Esling (1996, 1999) under post-velar phonetics-phonology taxonomy**.** Commencing from deep posterior non native consonant with the [**ʔ**] that is produced by obstruction of glottis, reasons for perceived loud glottal stop is not known. Loud glottal stop in ApsnD1sib2 who spoke word after word in dyadic conversations added to a sort of perceptually incised speech particularly at the moment with two adjacent glottal stops in V-V hiatus. They also occur as substitutions to other consonants in this same participant. In his discussion on back velar consonants Esling (1996, 1999) has added epiglottal [EPL] feature specification. He states that the glottal fricative [h] entirely lacks EPL specification and hence it is the most 'purely glottal' sound possible. In glottal stop articulations, there is no [constricted glottis] feature; glottal stop is the realization of new feature, constricted epiglottal tube [cet] with [glottal]. Phonetically this is interpreted as a moderate epilaryngeal stricture yielding ventricular incursion suitable to inhibit vocal fold motion. Articulatory nature of glottal stops should be interesting to investigate in future along with the loud glottal stop types reported in table 2. Yegnarayana, Rajendran, Worku and Dhananjaya (2008) have investigated the acoustic nature of glottal stops in continuous speech. It is also possible that glottal stops existed in this subject in many numbers in his early speech acquisitions.

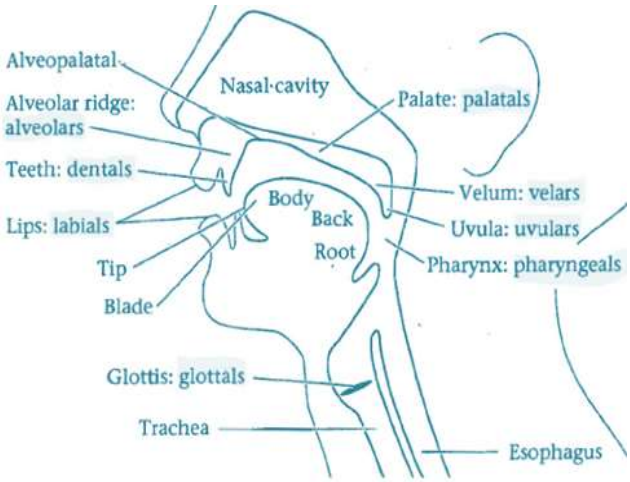
Uvulars are consonants articulated with the back of the tongue against or near the uvula ( figure 7) . They are not breathy, with average duration and loudness in Apsnno1D1, Aspsnno2D1 and CmssnD1. vowel- **R** sequence substitutions are additional rare findings in AspsnD1no2( table2 ) . She starts with an alternate substituted vowel and continues to[R] in VC/V forms.

The long, explosive, pushy, perceptually loud nature of voiced uvular trills [**R**] in AspsnD2 associated with breathy outcome indicates possible forceful expulsive pulmonic air pressure at their articulations. They are even more perceptually conspicuous than uvular trills in other three congenital SNHL. Apart from these, pocketing of vowels in the low back oral cavity with back focus is seen in this same participant (Gayathri 2019, Vowel series IV, Submission language in India). He also shows alternate Cul De Sac speech quality in his conversations. **.**

On the other hand, the voiced pharyngeal trills, [ʕ]in this same participant AspsnD2 are not as loud like **[R**], with shorter duration than **[R].** The pharyngeal articulations are also considered as epiglottal articulations (Esling 1996)**.** In some spoken languages it was observed that its place of articulation is epiglottal, which means it is articulated with the aryepiglottic folds against the epiglottis. The two non- native consonants**[R]** ,[ʕ] with 'alternate' Cul De Sac speech quality( Gayathri 2019 ,

vowels VIII and IV, submission language in India ) and back focus vowel behaviors together add to the inferences of deep back focus of misarticulations and voice outcomes in participant AspsnD2.

**Figure 7. Speech mechanism showing uvula, pharynx, epiglottis and glottis**(cited from Google)




It is evident that in the participants listed above, their oral consonant substitutions to vowels extend their articulatory places of articulation further back and beyond the model of native Kannada phonetics. They are identified in both D1 and D2 speakers. However, they are absent in D3, AhifsnD1 D0 speakers and in few other D0, D1 and D2 types. D3 and Ahifsn have better auditor access. But, at the same time, severely degraded auditory access in psn D1 and D0 also do not have these consonant substitutions to vowels. With these particular consonant behaviors studied in this research , then the golden thumb rule that the front phonetic segment selections occurs due to their better visibility in congenital SNHL in at least these five participants is contradicted. In D2, his additional back consonants add to his back -focus speech behavior. But, neither language experience nor degree of auditory access proved to be influencing parameter for this aberrant speech behavior.

**Conclusions**

Of twenty congenital SNHL participants who had completed LT-CAOSLT under D0, D1, D2 , D3 rehabilitated hearing domains , five participants have shown rare residual deep back consonant substitutions to vowels in dyadic conversations. They also indicate lack of consonant vowel contrast in

these 5 participants. Six D3 users, two D0 users, and few D2 and D1 users have no such behaviors in general. Articulatory places of articulations are extended far back and beyond velar consonants of Kannada. Uvular, pharyngeal/epiglottal or laryngeal places of articulations are activated at these vowel errors, taking the form of nonnative consonants (figure 7) . Stops, trills or fricative manners of articulations are generated at these places of articulations to replace vowels of Kannada.

**Limitations**

This study is based on perceptual inferences of audio samplings of dyadic conversations only. Instrumental observations such as those of Esling (1996, 1999) should provide definite articulatory nature of the post velar consonants. Multi equivalent motor movements for similar perceptual outcomes of speech segments should also be borne in mind beyond these discussions .

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