

Punjabi Articulation Locus/Placelessness/Errors in the Cochlear Implant Children**L. Kaur¹, Inderpreet Kaur², Neena Mehta³, Jaimanti Bakshi⁴, Ritika Dutta⁵, Harmesh Kumar⁶, Dharam Vir⁷**¹Ph.D. Fellow, School of Education and Social Sciences, Rayat Bahra University, Mohali²Professor & Head, School of Education and Social Sciences, Rayat Bahra University, Mohali³Professor, Department of Dental College, Rayat Bahra University, Mohali⁴Professor and Unit Head, Dept. of Otolaryngology and HNS, PGIMER, Chandigarh⁵Intern, Speech and Hearing, Dept. of Otolaryngology and HNS, PGIMER,⁶Licensed Clinical Psychologist, Concord, USA⁷Assistant Professor, Speech and Hearing, Dept. of Otolaryngology and HNS, PGIMER, Chandigarh

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Conflict of interest: Nil

Abstract:**Background:** Around 15.8% of children in India are suffering from sensory neural hearing loss out of which nearly 7% have profound degree of loss and requires cochlear implant surgeries to develop speech and language.**Objective:** The aim of the study is to assess the common articulatory locus/placelessness/errors in children with Cochlear Implant (CI) surgery using Punjabi Articulatory Test (PAT).**Methodology:** Total 18 patients who underwent cochlear implant surgery were included in the study. Three groups were formed based on the hearing age of children viz., Group 1- 12 months to 24 months; Group 2 – 25 months to 48 months; and Group 3 ->48 months. Punjabi Articulation Test was administered on each participant by a professional Punjabi speaking speech and language pathologist. Speech errors were identified. Common errors between groups were also assessed using 4-point Likert scale.**Results:** Alveolars, glides and liquids were common errors made by 3 participants whereas fewer errors were observed for labiodentals and nasals. Similar to group 1 glides and liquids were the errors most frequently seen in group 3. In contrast with group 1 and 2 group 3 showed maximum errors in velars followed by glides and liquids. Nasals, Bilabials and Labiodentals showed least errors.**Conclusion:** The current study showed that with age the articulatory locus/placelessness/errors also vary. Anterior sounds are easy to produce in comparison to posterior sounds similarly like typically developing hearing age matched children.**Keywords:** Alveolars, glides, liquids, speech, hearing.This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Around 15.8% of children in India are suffering from sensory neural hearing loss out of which nearly 7% have profound degree of loss and requires cochlear implant surgeries to develop speech and language [1]. Cochlear implant surgery significantly enhance the linguistic competence of children [2].

Speech intelligibility is affected in pre linguistic deaf children as they were unable to appreciate the acoustic changes in speech due to poor speech perception. Speech intelligibility improves significantly after cochlear implantation [3]. After hearing age of approximately 4 years children had some intelligibility in their connected speech [3]. Improvement in Speech intelligibility is considered to be significantly enhanced by using multi-channel

cochlear implants [4]. Phonemes like /t, s, z, l, θ/ develops slow and remains common error in children with CI even after 6 years of implantation [5].

The aim of the study is to assess the common articulatory locus/placelessness/errors in children with Cochlear Implant surgery using Punjabi Articulatory Test.

Material and Method

Patients who underwent cochlear implant surgery in ENT department of PGIMER, Chandigarh, India were included in the study. All participants underwent tympanometry and threshold estimation using free field audiometry to rule out any middle ear pathology and poor hearing benefit for implant

respectively. Initially 30 individuals were enrolled but later 18 were selected for final study after failing in inclusion criteria. Only those participants who were using cochlear implant for more than 10 hours a day, type A tympanogram and aided thresholds under speech spectrum/banana were included in the study. 18 pre lingual severe-profound participants with age range from 3-18 (mean 7: SD 3.8) were included. Three groups were formed based on the hearing age of children viz., Group 1- 12 months to 24 months; group 2 – 25 months to 48 months; and group 3 ->48 months. Group 1 consists of 3 participants whereas in group 2 and 3 there were 8 and 7 participants respectively.

Punjabi Articulation Test was administered on each participant by a professional Punjabi speaking

speech and language pathologist. Speech locus/placelessness/errors were identified in all three-word position i.e., Initial, Medial and Final. 0 and 1 coding was done to denote errors where 0 denotes presence of error and 1 denotes absence. Common errors between groups were also assessed using 4-point Likert scale. Errors in all three position is denoted with 3, error in 2 positions with 2, error in one position with 1 and no error on any position as 0.

Results

Frequency of different speech locus/placelessness/errors: The frequency of errors in different word position is summarized in table 1.

Table 1: Frequency of articulatory errors in three-word position- initial medial and final

Locus/Placelessness/Errors	Initial	Medial	Final	Total
Velar (V)	66%	66%	66%	66%
Affricates (A)	55%	66%	66%	62%
Alveolar (AL)	66%	72%	66%	68%
Dental (D)	61%	66%	72%	66%
Nasal (N)	50%	55%	55%	53%
Bilabials (B)	27%	66%	61%	51%
Labiodentals (LB)	0%	83%	27%	36%
Glides (G)	77%	77%	77%	77%
Liquids (L)	77%	77%	77%	77%

Table 1 depicts the percentage of occurrence of different articulatory errors in three-word position. Maximum articulatory errors occurred in medial word position followed by final and least in initial position. Glides and Liquids were common articulatory errors (77%) while Bilabials (51%) and Nasals (53%) least. No error was observed for Labiodentals in initial position whereas maximum error (83%) was observed in medial position for the same (Table 1).

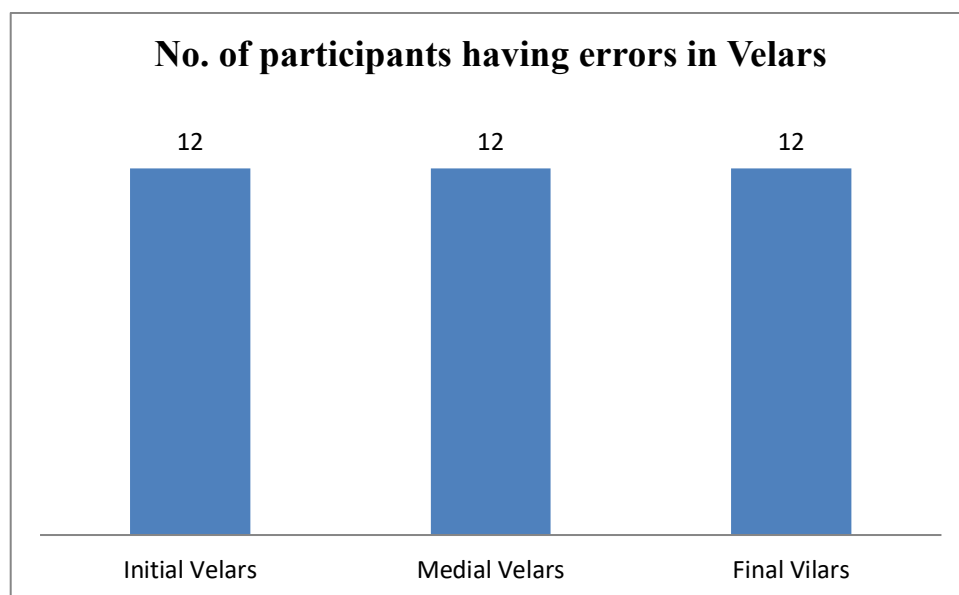


Figure 1: Number of participants having errors in velars

Out of 18 participants 12 have errors in producing velars in all three-time point (Figure 1).

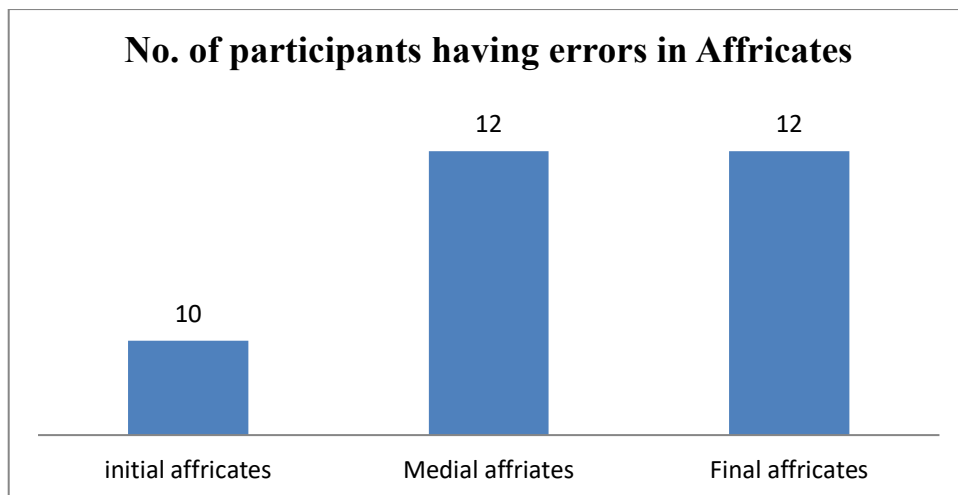


Figure 2: Number of participants having errors in affricates

10 children out of 18 had errors in initial word position for affricates, whereas when affricates were present in medial and final positions 12 children showed articulatory errors.

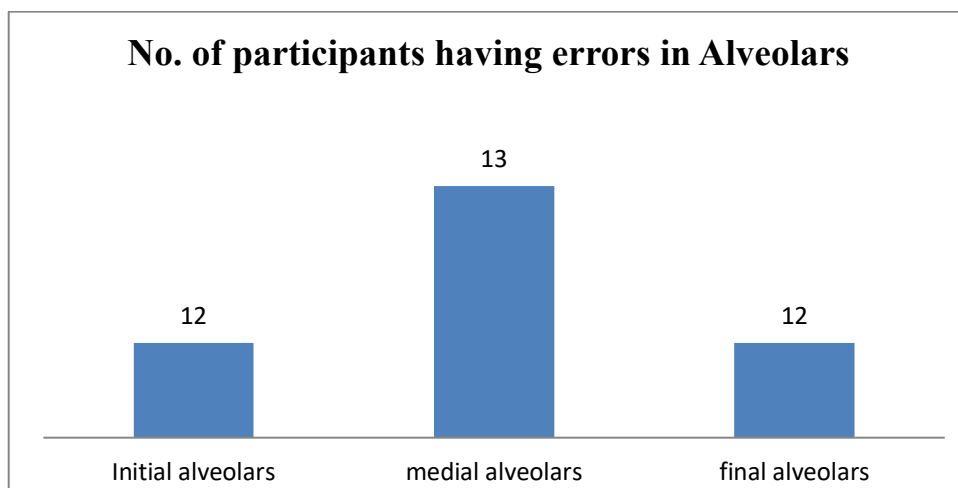


Figure 3: Number of participants having errors in alveolars

12 children had articulatory errors in initial and final word position level whereas 13 had difficulty in medial position (Figure 3).

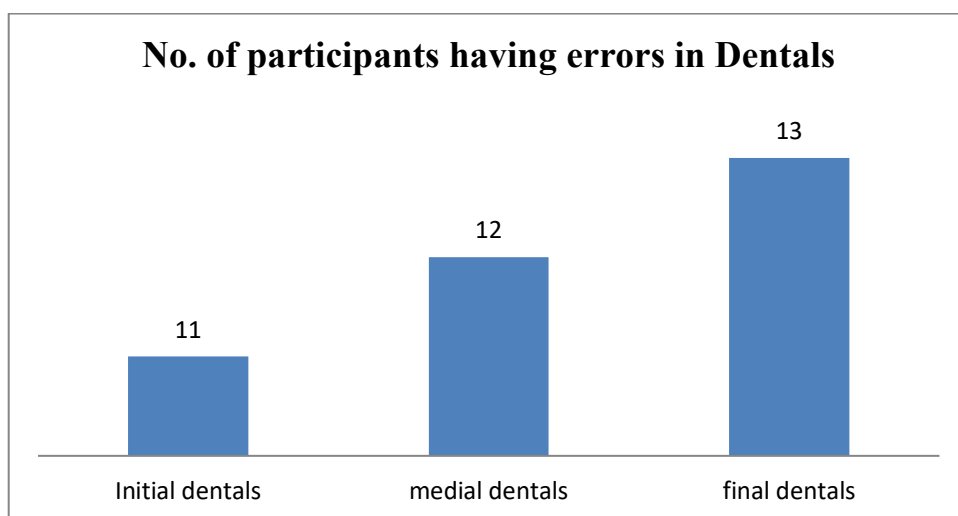


Figure 4: Number of participants having errors in dentals

From figure 4 it was depicted that in initial, medial and final word position 11, 12 and 13 participants had difficulty respectively.

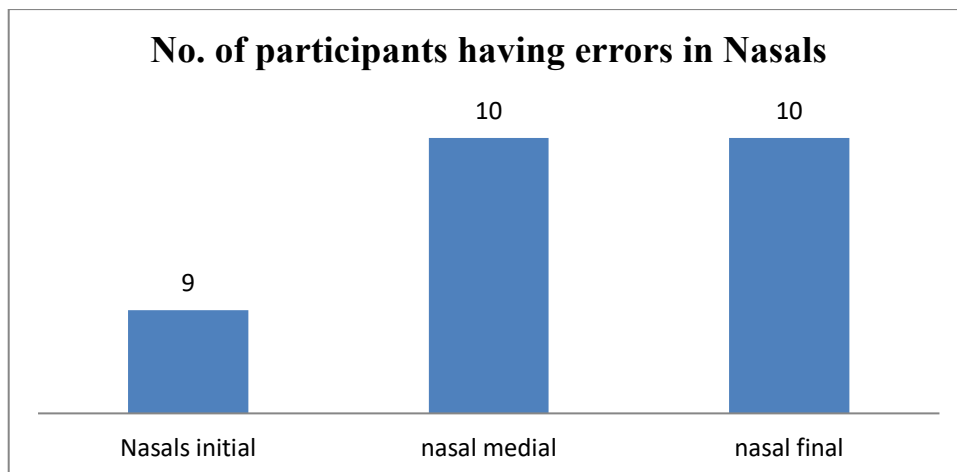


Figure 5: Number of participants having error in nasals

50% (9) of the participants had difficulty in nasals in initial position. 10 participants showed errors in medial and final positions of nasal words (Figure 5).

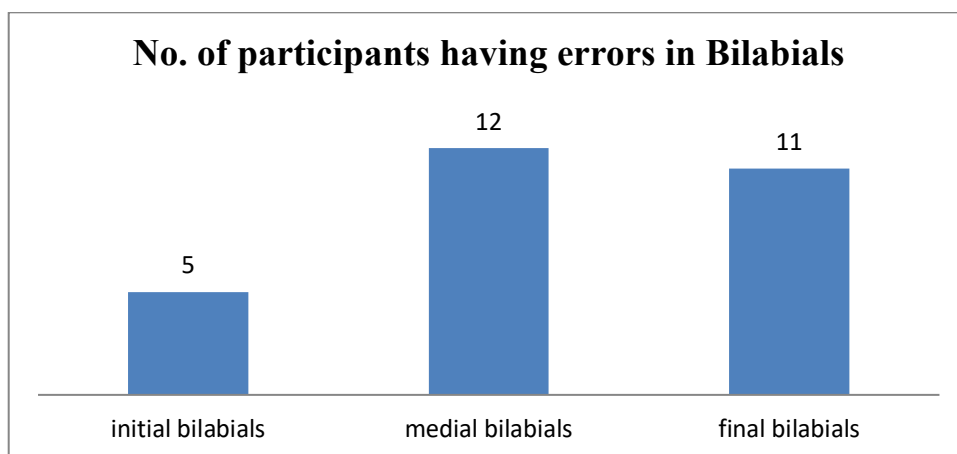


Figure 6: Number of participants having errors in bilabials

From figure 6 it can be inferred that only 5 participants had difficulty in bilabials in initial word position, whereas for medial and final is 12 and 11 respectively.

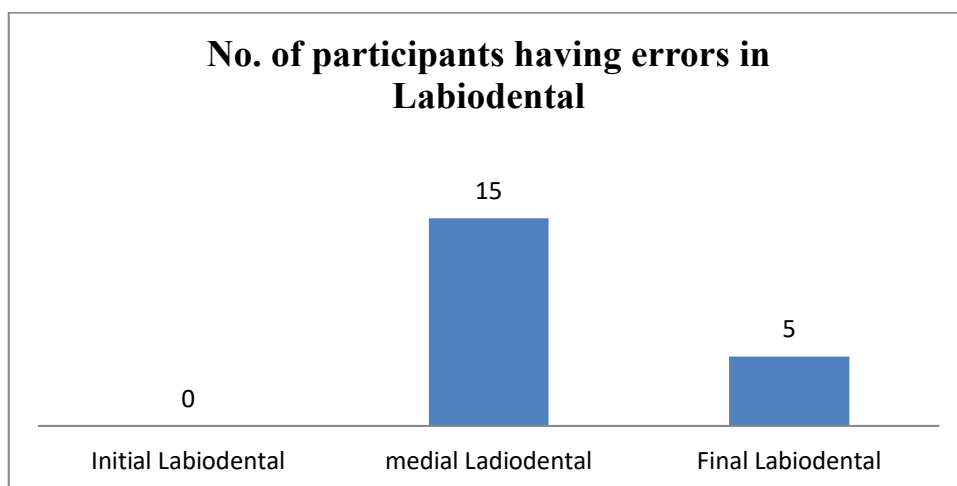


Figure 7: Number of participants having errors in labiodentals

No participants showed any error when labiodentals come in initial word position. Maximum participants (15) had difficulty in producing labiodentals in medial position and only 5 showed errors for final word position (Figure 8).

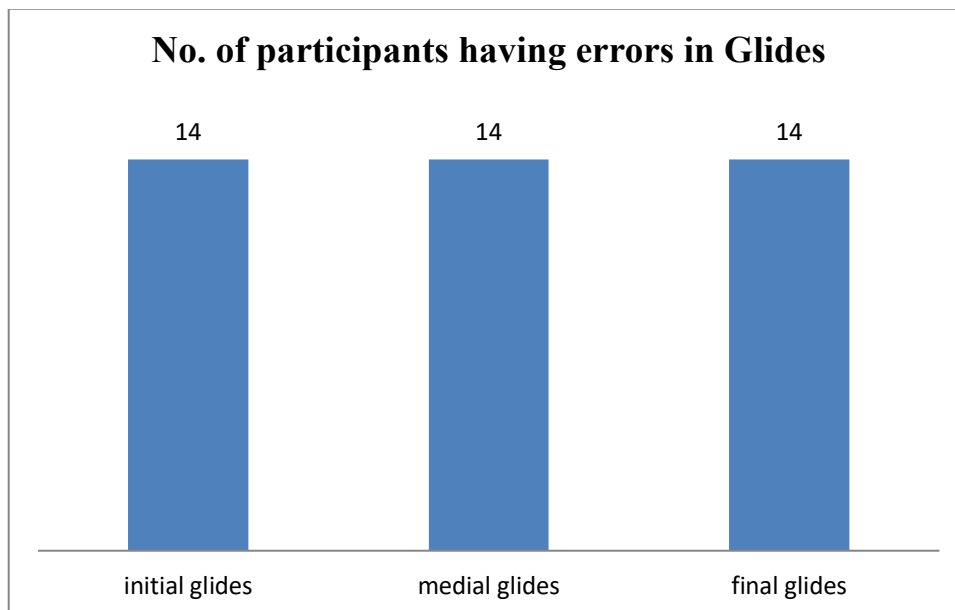


Figure 8: Number of participants having errors in glides

14 participants showed difficulty in producing glides in all three-word position (Figure 8).

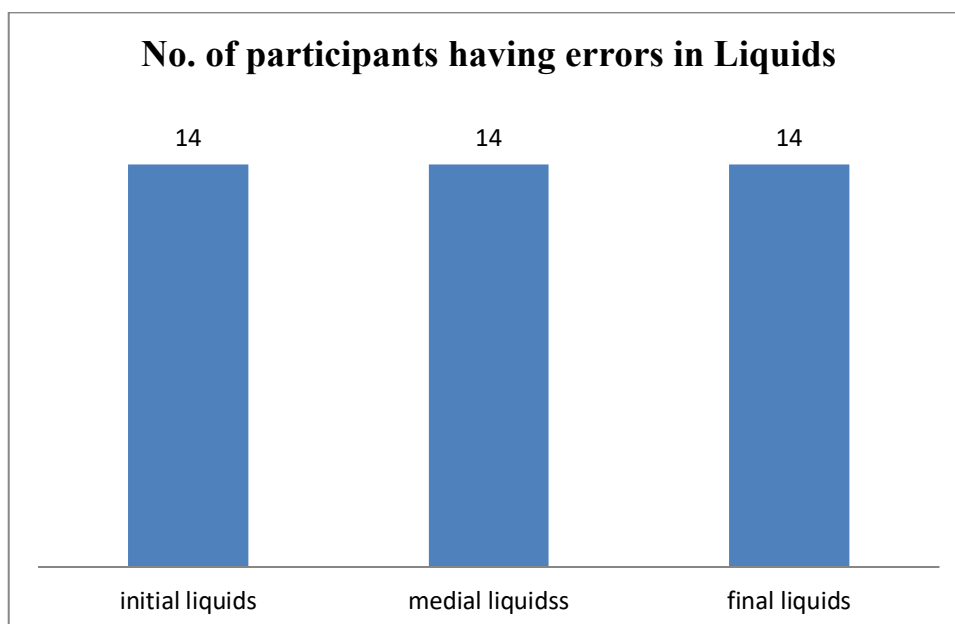


Figure 9: Number of participants having errors in liquids

Similarly, like glides 14 participants showed articulatory errors while producing liquids in all three-word positions.

Identification of common errors in all three groups

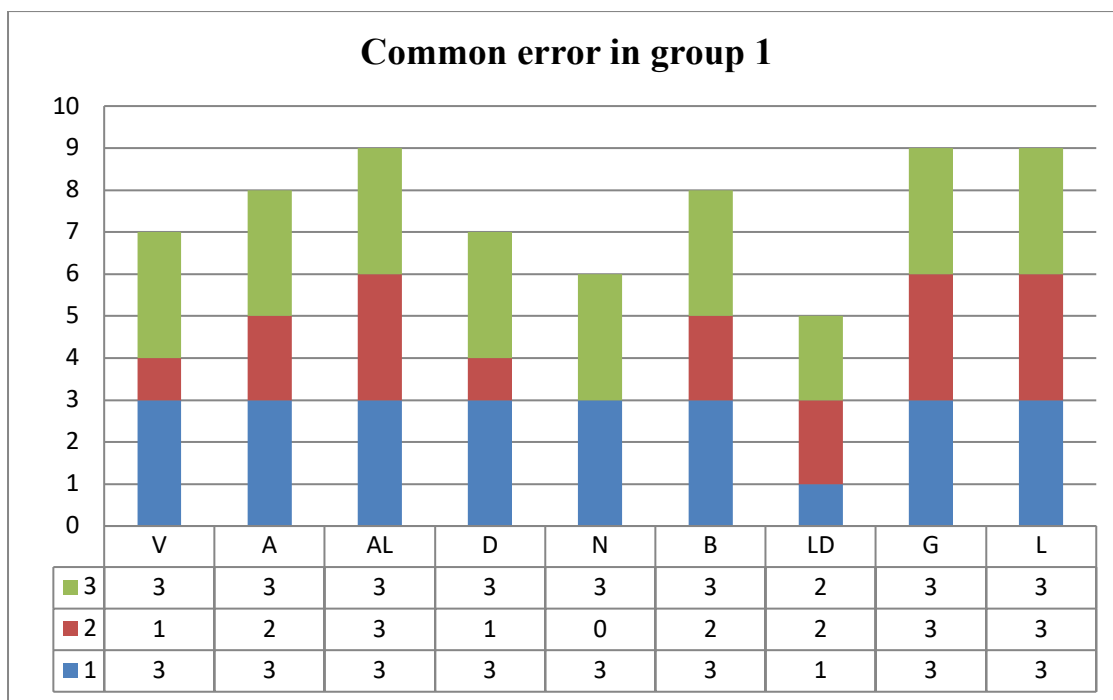


Figure 10: Common errors in group 1

Participants in Group 1 had hearing age of 12 months to 24 months. The data of the three participants with their common errors was depicted in figure 10. Alveolars, Glides and Liquids were common errors made by 3 participants whereas fewer errors were observed for Labiodentals and Nasals.

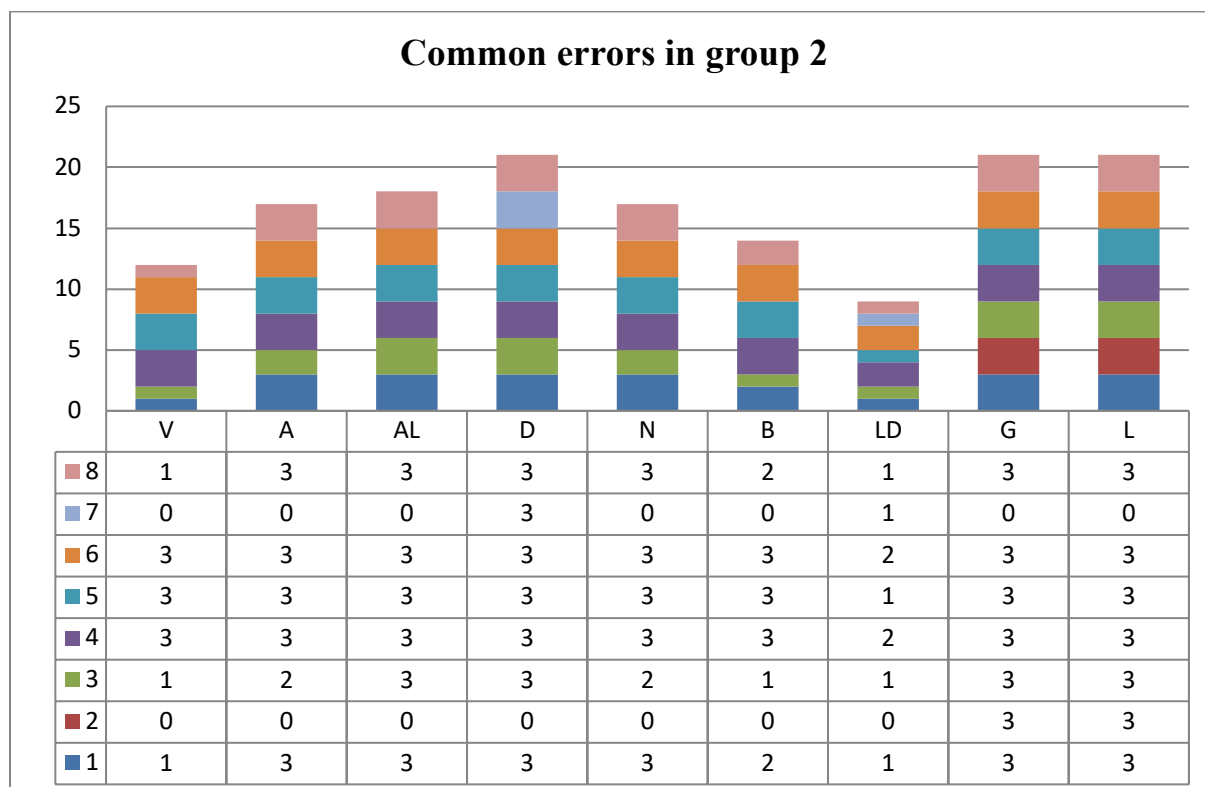


Figure 11: Common errors in group 2

In group 2 participants with hearing age of 25 months to 48 months were evaluated. Common errors made by 8 participants were shown in figure 11. Similar to group 1 Glides and Liquids were the errors most frequently seen in this group. Additionally, Dentals were also seen as common error. Labiodentals and Bilabials showed fewer errors.

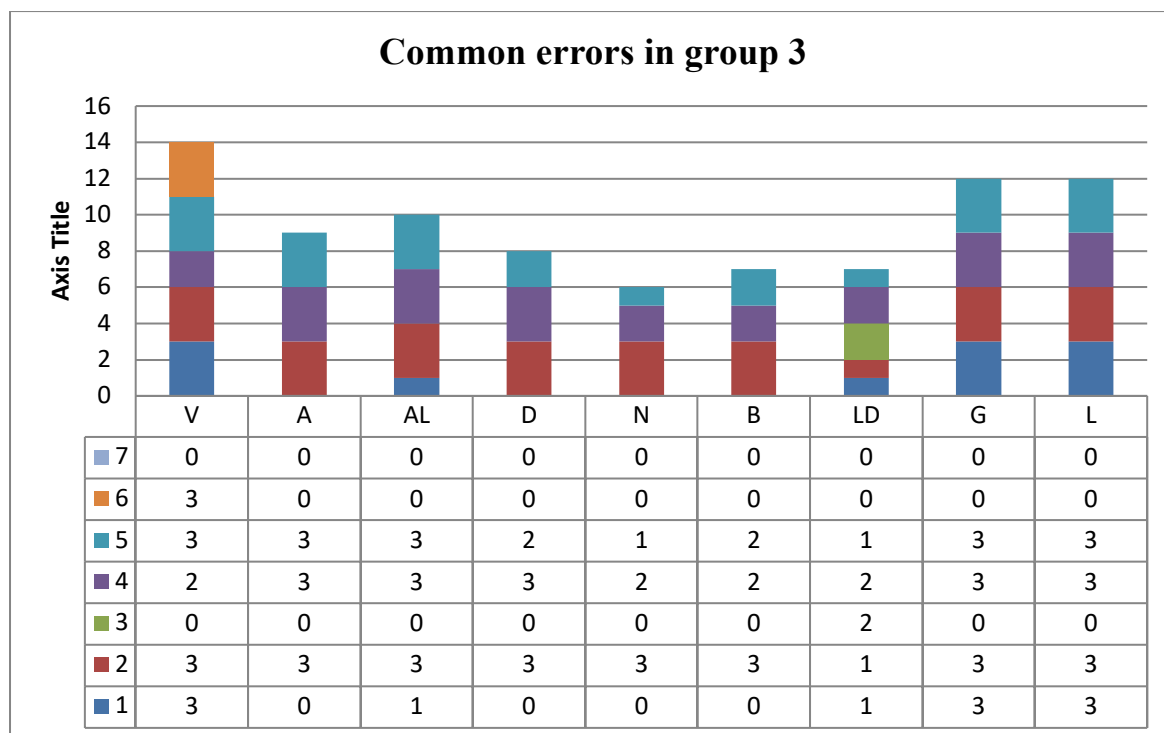


Figure 12: Common errors in group 3

In contrast with group 1 and 2 group 3 showed maximum errors in velars followed by glides and Liquids. Na-sals, Bilabials and Labiodentals showed least errors.

Discussion

Speech intelligibility in Cochlear Implant (CI) children improves with age of implantation and starts showing significant improvement from 3 to 4 year post implantation. [6] In a typically developing normal child Bilabials develop first in comparison to the Velars, similarly Nasals and Stops develop before Affricates and Affricates. [7] Similarly in this study we found that the participants made fewer errors in Nasals and Bilabials in comparison to the posterior sounds.

Occurrence of errors with age of implantation also varied from initial to medial to final. Initially errors were present in almost all categories of sound in all three-word positions. Gradually with increase in age the errors start to disappear and fewer errors were seen in anterior sounds (dentals and bilabials). Anterior sounds are easy to learn because of their high visual feedback. The posterior sounds are difficult to interpret visually and show maximum error.

No participant showed any difficulty in nasal sound in initial level and only 27% participants showed error in Bilabials at initial level. These further strengths the claim that these 2 sounds develop before other sounds.

Medial level word sounds show maximum difficult in comparison to initial and final position. The

effect of coarticulation can be the possible reason for the most articulatory errors in medial position. Proceeding and suc-ceeding consonant and vowels plays major role in consonant identification. [8] This aspect of speech with the articulation deficit in medial word level position needs to be explored more.

Affect of implantation age, regular speech therapy and academic performance needs to be explored more in future. We only studied the articulatory locus/placelessness/errors at word level. To understand speech intelligibility in cochlear implant children, articulatory errors in isolation and sentence combination need to be explored in future studies in Punjabi speakers.

Conclusion

The current study showed that with age the articulatory errors also vary. Anterior sounds are easy to produce in comparison to posterior sounds similarly like typically developing hearing age matched children.

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