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Impact of timing of Palatal repair on Speech Errors in Children with CLP

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Abstract

Surgery of palate is one of the important rehabilitation for children with cleft lip and palate. In most of the children with cleft lip and palate (CLP), speech errors persist even after surgical repair of the palate. However, the timing of palatal repair plays a vital role. The associated problems in children with cleft lip and palate differ based on the timing of the palatal repair. Resonance and articulation are the crucial measures of disordered speech and they form the important areas of therapeutic interv2ention for children with repaired cleft lip and palate (RCLP). Thus, the present study aims at profiling resonance and consonant production errors (CPEs) in children with RCLP among early intervention group (EIG) and delayed intervention group (DIG). The research design employed was standard group comparison. The participants consisted of eight Kannada speaking children with RCLP (6 to 12 years) in each group (EIG and DIG). They were asked to repeat 10 meaningful bisyllabic words loaded with pressure consonants to assess the resonance and 8 non-meaningful bisyllabic words loaded with stop consonants to check CPEs. The responses were recorded in a sound-treated room and were presented to three Speech Language Pathologists for assessing resonance and CPEs using Henningsson's protocol. The results revealed a statistically significant reduction in the resonance and few CPEs in EIG than in DIG. 'Nasalized voiced pressure consonants' and 'weak oral pressure' were found to be significantly lesser in EIG than DIG. The present study concludes that early surgical intervention has a direct impact on reducing hypernasality and CPEs in children with CLP. Children with CLP require early surgical intervention and therapy to establish appropriate oral motor skills that are necessary for normal speech production.

Keywords: Repaired cleft lip and palate, early intervention, resonance, consonant production errors, Henningsson's scale

1. Introduction

Speech errors in children with CLP are associated with hypernasality, nasal air emission, weak pressure consonants, and compensatory articulation due to the impairment of the velopharyngeal closure. Hypernasality is the

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disturbance in the resonance of vowels, vocalic consonants, glides and liquids which gives rise to deviant voice quality in speech production. Nasal air emission is the nasal airflow which accompanies during the production of pressure consonants (stops, fricatives, and affricates). A compensatory articulation is a term which is often used clinically to embrace any non-English consonant realization (Harding & Grunwell, 1996). It occurs when articulation placement is altered in response to the abnormal structure of the oral cavity. That is, when there is velopharyngeal dysfunction, it is difficult to maintain adequate oral pressure for pressure consonants, so the place of articulation may be changed to maintain adequate air pressure.

Hence, children with CLP require early surgical intervention to establish appropriate oral motor skills that are sufficient for normal speech production.

Over the decades, researchers have opined that an early cleft palate repair may reduce hypernasality, decrease the likelihood of the child developing compensatory articulation errors and help in better functioning of the velopharyngeal port (Hardin-Jones & Jones, 2005). Henningsson and Karling (1984) described hypernasality and articulation in 38 children with early palate closure (before 18 months) and 30 children with delayed palatal closure (after 18 months). The results revealed that early closure group had fewer incidences of hypernasality and articulation errors than the delayed closure group. Similarly, Rohrich, Rowsell, and Dniry (1984) also found that significantly more articulation errors in the delayed closure group than early closure group in children with CLP. Likewise, Chapman, Hardin-Jones, Goldstein, Halter, Robert, Havlik and Schulte (2007) examined the impact of age and lexical status at the time of primary palatal surgery on speech outcome on 40 preschoolers (33 to 42 months) with cleft palate. They concluded that children who were less lexically advanced and younger at the time of palatal surgery exhibited better articulation and resonance outcomes at 3 years of age.

Recently, Bruneel, Luyten, Bettens, D'haeseleer, Dhondt, Hodges and Van Lierde (2017) compared resonance and articulation characteristics of 15 Ugandan participants with CLP who had delayed (≥8 years) primary palatal closure across age and gender-matched Ugandan participants without CLP. They found that individuals with CLP had a significantly higher prevalence of more articulation errors, hypernasality and higher nasalance values for all oral and oro-nasal speech samples. They concluded that delayed palatal repair is insufficient to eliminate nasal airflow errors, resonance abnormalities, and articulation disorders which leads to unintelligible speech.

In Indian context, Murthy, Sendhilnathan, and Hussain (2010) studied the speech outcome of 131 individuals with CLP who underwent primary palate repair after the age of 10 years. Baseline assessment was done and all the individuals were counseled, oriented, and demonstrated the correct place and manner of articulation for the phonemes misarticulated by them. Though postoperative speech samples assessment revealed improvement in speech intelligibility, there were residual speech problems in most of the individuals with repaired cleft lip and palate (RCLP), requiring further

evaluation and appropriate treatment. They concluded that more residual speech problems are found with late palatal surgical intervention.

Recently, Pushpavathi, Kavya, and Akshatha (2017) compared the speech characteristics of three toddlers with RCLP who underwent surgery before 1.6 years of age (Early Intervention Group) with three toddlers with RCLP who underwent surgery after 1.6 years of age (Delayed Intervention Group). All the toddlers had Kannada as their native language and they were in the age range of 2-3 year. The baseline was established and measures such as type and pattern of the vowels and consonant inventory were analyzed for the toddlers in both the groups. The post-therapy measurement was done after 20 speech and language therapy sessions. The results revealed that the early intervention group had better and diversified phonetic inventory when compared to the delayed intervention group. They concluded that the timing of the surgery of cleft lip or cleft palate plays an important role in shaping the future communicative abilities.

Though studies have been conducted on focusing the parameters such as hypernasality and articulation in children with CLP, only limited studies have been conducted on investigating compensatory articulations or consonant production errors. Nikhila and Prasad (2017) investigated the impact of timing of surgery by analyzing the compensatory articulation errors across the early surgical group (before 2 years) and delayed surgical group (after 2 years) in 40 Telugu speaking children with RCLP. They also provided data on compensatory errors in Telugu speaking children with RCLP. The mean percentage of occurrence of compensatory errors in early and delayed surgical group respectively, were as follows: Glottal stops - 20% and 10%, Pharyngeal stops - 20% and 50%, Pharyngeal fricatives - 45% and 70%, Pharyngeal affricates - 0% and 05%, Pharyngeal backing - 15% and 35%, Posterior nasal affricates - 60% and 20%, Nasal fricatives - 30% and 45%, Nasal emissions - 55% and 60%, Mid Dorsum fricative stops - 0% and 30%, Mid Dorsum palatal fricative - 0% and 0%, Velar fronting - 5% and 10%, Velar palatal - 0% and 20%, Cluster reduction - 05% and 15%, Mild hypernasality - 30% and 55%. They concluded that children in the early surgical group showed less compensatory errors when compared to the late surgical group.

Researchers have discussed speech errors in children with CLP/RCLP in several ways. Trost-Cardamone (1981) said that compensatory articulations in individuals with history CLP can be classified into 6 specific types. They are mid-dorsum palatal stop, Posterior nasal fricative, Velar fricatives, Pharyngeal fricatives, Pharyngeal stop, and Glottal stop/plosive. Many investigations have been done to account for the compensatory articulations in individuals with cleft palate.

Later, Sell, Harding and Grunwell (1994) gave a comprehensive speech assessment tool called “Great Ormond Street Speech Assessment”, a screening tool for describing the speech characteristics commonly associated with CLP. In this, they broadly grouped consonant production errors into, place of articulation (Imprecise tongue tip movements, Double articulation, Backing – velar/uvular, Compensatory articulations) and manner of articulation (Nasalised weak consonants, Nasal emission accompanying consonants, Nasal fricatives, Lateralisation, Palatalisation).

In 2008, a new descriptive term 'Consonant Production Errors' (CPEs) was proposed by Henningsson, Kuehn, Sell, Sweeney, Trost-Cardamone, and Whitehill. They gave a system of universal parameters for reporting speech outcomes in individuals with cleft palate, where consonant error production is divided as (a) abnormal backing of oral targets to post-uvular place (Pharyngeal and Glottal), (b) abnormal backing of oral targets, but place remains oral (Mid Dorsum Palatal, Velar and Uvular), (c) Nasal Fricative, (d) Nasal consonants for oral pressure consonants, (e) Nasalized pressure consonants, (f) Weak articulation, and (g) Other oral misarticulations. So the present study used this standardized system of universal parameters to study the CPEs in children with early versus delayed palatal repair.

Most professionals recommend correcting the structure at the earliest to provide the child with better speech potential. Once the structure is normalized, correction of resonance and compensatory productions is much earlier and easier. But, even with early surgical repair of the cleft, speech errors persist in most of the children with CLP. These speech characteristics related to resonance and articulation problems in children with CLP requires a detailed assessment by Speech-Language Pathologists (SLPs). Detailed speech and language assessment include both perceptual as well as instrumental evaluations like Nasometry, Nasal Visualization System evaluation, Naso-endoscopy etc, but the perceptual assessment is considered as the gold standard (Kuehn and Moller, 2000) for the analysis of speech. Resonance and articulation are the crucial measures of disordered speech and an important goal of therapeutic intervention for children with RCLP. Thus carrying out the perceptual judgment of speech errors are important in order to measure the speech outcomes and to determine appropriate treatment plans.

1.1. Need for the Study

There have been limited attempts in the Indian context to study the impact of timing of surgery on resonance and consonant production errors in children with RCLP. In particular, there have been no studies on profiling CPEs in children with RCLP undergoing early and delayed surgical intervention using standardized Henningsson's perceptual rating scale. Hence, the present study attempted to explore these parameters in the early surgical group and delayed surgical group using Henningsson's scale.

1.2. Aim

The aim of the present study is to profile the speech characteristics of the early intervention group versus delayed intervention group in children with repaired cleft lip and palate.

1.3. Objectives

1.3.1. To compare resonance across the early intervention group and delayed intervention group in words.

1.3.2. To compare consonant production errors (CPEs) across the early intervention group (EIG) and delayed intervention group (DIG) in words.

1.3.3. To document the occurrence of overall CPEs in children with RCLP.

2. Methodology

2.1. Participants

The research design employed was standard group comparison. Sixteen non-syndromic Kannada speaking children with RCLP between six to 12 years served as participants for the present study. The participants will be selected based on convenience and purposive sampling methods. Equal numbers of participants were considered in both early intervention group (EIG - who underwent palatal surgery before 1.6 years of age, Henningssson & Karling, 1984) and delayed intervention group (DIG - who underwent palatal surgery after 1.6 years of age, Henningssson & Karling, 1984), as shown in table 1. All the participants considered for the present study had Kannada as their native language and the language abilities were age adequate. Individuals with other associated problems like hearing loss, intellectual disability and nasal pathologies were excluded from this study. The present study was conducted with the clearance from the AIISH Bio-behavioral ethical committee. A written consent was taken from parents/caregivers of children with CLP where the parents/caregivers were provided with the information about the aim, objective and approximate duration of the testing procedure.

Table 1
Participants details in EIG and DIG

	Name	Age	Gender	Age at which first Palatal Surgery was done
EIG	X1	8 years	Male	8 months
	X2	8 years	Male	18 Months
	X3	8 years	Male	8 Months
	X4	7 years	Male	10 Months
	X5	6 years	Female	1 Year
	X6	6 years	Female	11 Months
	X7	6 years	Female	10 Months
	X8	10 years	Female	14 Months
DIG	Y1	9 years	Male	3 Years
	Y2	10 years	Male	5 Years 5 Months
	Y3	10 years	Female	2 Years
	Y4	7 years	Female	7 Years
	Y5	11 years	Female	4 Years
	Y6	12 years	Female	2 Years
	Y7	5 years	Female	2 Years
	Y8	7 years	Female	2 Years

Note- EIG: Early Intervention Group, DIG: Delayed Intervention Group

2.2. Materials and procedure

The speech stimuli included ten meaningful Kannada bisyllabic words loaded with pressure consonants (/bassu/, /ʧaṭa/, /ḍabbI/, /ka:ḍU/,

/kasa/, /ko:t̪I/ ˌ /pa:pU/ ˌ /paṭa/, /sara/ and /d̪aḍa/) to assess resonance. Eight non-meaningful bisyllabic words loaded with stop consonants were used to check CPEs. In non meaningful words, the unvoiced stop consonants like /p/, /ṭ/, /t̪/, /k/ and voiced stop consonants like /b/, /ḍ/, /d̪/, /g/ were used with the combination of vowel /a/ [/papa/, /ṭaṭa/, /t̪aṭa/, /kaka/, /baba/, /ḍaḍa/, /d̪aḍa/ and /gaga/]. Participants were made to repeat words after the tester. The responses were recorded using Brüel & Kjær Sound Level Meter (Type 2250-s Hand Held Analyzer) in a sound-treated room.

The recorded speech samples were presented to three Speech Language Pathologists (SLPs) through the headphones (Sennheiser HD 457) for rating hypernasality and articulation error analysis. The SLPs were well-versed in the area of CLP with a minimum of three years experience. The orders of speech samples presented to SLPs were randomized. SLPs have to listen to the meaningful words and rate the hypernasality on a four-point rating scale (Henningsson et al., 2008), where 0 = normal, 1 = mild, 2 = moderate and 3 = severe and each individual's total score varied from 0 to 30. Similarly, non-meaningful words were presented to the SLP's and they are requested to document the CPEs based on a standardized rating scale developed by Henningsson et al. (2008). In CPEs, there can be more than one error for the single speech stimuli. Instructions for the evaluation were provided to the SLPs both orally and in written form. SLPs evaluated samples in a quiet room situation. The final rating for resonance and CPEs for each speech sample is based on the consensus among the three judges.

2.3. Statistical Analysis

Obtained data were subjected to statistical computation using IBM Statistical Package Social Sciences software (version 20). Average mean values, median values, mean rank values and standard deviation of all the variables were calculated separately. Shapiro-Wilk test of normality was applied to check the normality, where the test revealed the normal distribution of the data ($p>0.05$) for resonance and non-normal distribution of the data ($p<0.05$) for CPEs. Independent samples t-test was carried out to check if there was any difference in resonance across EIG and DIG. Mann-Whitney U test was carried out to check if there is any difference in CPEs across EIG and DIG. Cronbach's alpha showed higher inter-judge reliability among three judges ($\alpha > 0.70$).

3. Findings

The present study is one of the preliminary attempts in the Indian context to profile the speech characteristics of the early intervention group versus delayed intervention group in children with RCLP. The obtained results are discussed under following sub-sections.

3.1. To compare resonance across early intervention group and delayed intervention group in words

The total mean score and standard deviation for resonance were calculated in words for EIG and DIG, as shown in table 2.

Table 2
The mean and standard deviation of resonance at word level across groups

	Resonance		
	Mean	**SD**	**p-value**
EIG	11.13	2.35	*0.007
DIG	15.88	3.52	

Note- EIG: Early Intervention Group, DIG: Delayed Intervention Group.

The total mean scores of resonance rated by the 3 SLPs were comparatively greater in DIG than in EIG. The results clearly indicated that, as the values increased, the performance of the participants deteriorated. Conversely, lower scores indicated better performance. Independent two-sample t-test was conducted to compare resonance across EIG and DIG. It was observed that there was a significant difference in resonance [$t(14)=3.028, p<0.05$] across EIG and DIG.

3.2. To document and compare consonant production errors (CPEs) across the early intervention group (EIG) and delayed intervention group (DIG) in words.

The mean and standard deviation of CPEs across EIG and DIG for words were calculated across EIG and DIG, as represented in table 3.

Table 3
The mean and standard deviation of CPEs across EIG and DIG

	Consonant Production Errors		**Mean**		**SD**	
			EIG	**DIG**	**EIG**	**DIG**
1.	Abnormal backing of oral targets to post-uvular place	Glottal Stops	3.12	2.75	5.02	4.23
2.		Pharyngeal Stops	0.25	0.25	0.70	0.70
3.	Abnormal backing of oral targets, but place remains oral	Mid Dorsum Palatal Stops	0.50	0.12	1.41	0.35
4.		Velar Substitutions	1	0.5	1.77	1.41
5.		Uvular Substitutions	0	0	0	0
6.	Nasal Fricatives		0	0	0	0
7.	Nasal consonant for oral pressure consonant		1.37	4.25	2.44	3.41
8.	Nasalized voiced pressure consonants		0.25	5.37	0.70	5.82
9.	Weak Oral Pressure		6.37	1.62	5.09	1.30
10.	Other Errors	Dental Substitutions	1	0.37	1.19	0.74
11.		Labio Dental Substitutions	0.25	0	0.46	0
12.		Voicing Errors	0.62	0.62	0.91	1.40
13.		Double Articulations	0	0.5	0	0.92
	Total		**14.75**	**16.37**	**2.37**	**2.38**

Note- EIG: Early Intervention Group, DIG: Delayed Intervention Group.

The mean values of overall CPEs were less in EIG when compared to DIG. Mann-Whitney U test was carried out to check if there is any difference in CPEs across EIG and DIG. The mean rank of CPEs in EIG and DIG were calculated as represented in table 4.

Table 4
Mann-Whitney U test results of CPEs across EIG and DIG.

	Consonant Production Errors	Mean Rank		Z	P (*p≤0.05)
		EIG	DIG		
1.	Glottal Stops	8.31	8.69	0.165	0.869
2.	Pharyngeal Stops	8.50	8.50	0	1
3.	Mid Dorsum Palatal Stops	8.56	8.44	0.091	0.927
4.	Velar Substitutions	9.44	7.56	1.035	0.301
5.	Uvular Substitutions	0	0	0	0
6.	Nasal Fricatives	0	0	0	0
7.	Nasal consonant for oral pressure consonant	6.50	10.50	1.760	0.078
8.	Nasalized voiced pressure consonants	6.25	10.75	2.174	0.030*
9.	Weak Oral Pressure	10.94	6.06	2.072	0.038*
10.	Dental Substitutions	9.69	7.31	1.152	0.249
11.	Labio Dental Substitutions	9.50	7.50	1.464	0.143
12.	Voicing Errors	8.94	8.06	0.448	0.654
13.	Double Articulations	7.50	9.50	1.464	0.143
	Total	**6.50**	**10.50**		

Note- EIG: Early Intervention Group, DIG: Delayed Intervention Group.

The overall CPEs were less in EIG when compared to DIG but there was no significant difference (Z=1.868; p=0.062>0.05). It revealed that glottal stops, nasal consonant for oral pressure consonant, nasalized voiced pressure consonants, double articulations were less in EIG when compared to DIG. Other CPEs like mid-dorsum palatal stops, velar substitutions, weak oral pressure, dental substitutions, labio-dental substitutions, and voicing errors were more in EIG than DIG. Pharyngeal stops were the same in both the groups and there were no uvular substitutions and nasal fricatives found in the participants considered for the present study. But, significant difference across EIG and DIG was found only for nasalized voiced pressure consonants (Z=2.174; p=0.030<0.05) and weak oral pressure (Z=2.072; p=0.038<0.05). There was no significant difference across EIG and DIG for other CPEs.

3.3. To document the overall combined CPEs in children with RCLP.

The mean scores and standard deviation of overall combined CPEs in children with RCLP were calculated, as represented in table 5.

Table 5
Mean and standard deviation of overall combined CPEs in children with RCLP

	Consonant Production Errors	Mean	SD
1.	Glottal Stops	2.93	4.49
2.	Pharyngeal Stops	0.25	0.68
3.	Mid Dorsum Palatal Stops	0.31	1.01
4.	Velar Substitutions	0.75	1.57
5.	Uvular Substitutions	0	0
6.	Nasal Fricatives	0	0
7.	Nasal consonant for oral pressure consonant	2.81	3.22
8.	Nasalized voiced pressure consonants	2.81	4.80
9.	Weak Oral Pressure	4	4.35
10.	Dental Substitutions	0.68	1.01
11.	Labio Dental Substitutions	0.12	0.34
12.	Voicing Errors	0.62	1.14
13.	Double Articulations	0.25	0.68

The mean scores of combined CPEs in children with RCLP were found to be more in weak oral pressure, followed by glottal stops, nasal consonant for oral pressure consonant, nasalized voiced pressure consonants, velar substitutions, dental substitutions, voicing errors, mid-dorsum palatal stops, pharyngeal stops, double articulations, labio dental substitutions, uvular substitutions, and nasal fricatives.

4. Discussion

The present study investigated the impact of timing of palatal repair by comparing resonance and CPEs across EIG and DIG in children with RCLP. In resonance, EIG had lower scores than DIG which was statistically significant, i.e., hypernasality was less in EIG when compared to DIG. This result is in consonance with the findings of the following previously done studies: Bruneel et al. (2017) who found a significantly higher prevalence of hypernasality in Ugandan participants with CLP who had delayed primary palatal closure age; Henningsson and Karling's (1984) who reported that early complete closure group had a significantly lower incidence of hypernasality than the delayed closure group; Chapman et al. (2007) who found a better resonance outcome in 40 preschoolers who underwent early palatal surgery. When the child undergoes early surgical intervention, the structures involved in the velopharyngeal closure are corrected in the earlier stage of speech and language acquisition resulting in a better function of the velopharynx. This suggests that early surgical intervention has a direct impact on reducing hypernasality in children with CLP with better speech outcome.

With respect to the CPEs across EIG and DIG, the overall CPEs were less in EIG than in DIG (but it was not statistically significant). This result is in consensus with the findings of the following previously done studies: Henningsson and Karling (1984), who reported that early complete closure group had lower articulation errors than the delayed closure group; Rohrich et al. (1984), who reported more articulation errors in the delayed closure group than early closure group; Murthy et al. (2010), who reported more

residual speech problems with 131 individuals with CLP who underwent late palatal surgical intervention, Bruneel et al. (2017), who also found a higher prevalence of articulation errors in Ugandan participants with CLP who had delayed primary palatal closure age; Nikhila and Prasad (2017) who found that the children in early surgical group showed less compensatory errors when compared to the late surgical group.

This suggests that children who have undergone an early palatal surgery have a better velopharyngeal closure. Early palatal surgery helps to improve the place and manner of articulation and avoids the development of compensatory productions, which can be difficult to eliminate in late palatal surgery. Compensatory articulation productions often develop due to the open palate or persistent velopharyngeal insufficiency. Also if the child is surgically intervened within the critical age period, the acquisition of speech and language skills is easier and better. This supports the findings of Pushpavathi et al. (2017) who found a better and diversified phonetic inventory in toddlers with RCLP who underwent palatal surgery before 1.6 years.

Within CPEs, a statistically significant difference was found only in the following: (a) Nasalized voiced pressure consonants, which were found to be significantly lesser in EIG which indicated that early palatal surgery helps in reducing nasality in oral consonants due to better velopharyngeal closure than DIG. (b) Weak oral pressure, which was found to be significantly more in EIG. This is because the oral pressure was not adequate which can be considered as weak oral pressure but not a nasal substitution or a nasalized consonant. Whereas, most of the children in DIG nasalized the oral consonant or substituted the oral consonant with the nasal consonant. These errors cannot be put under weak oral pressure as the oral pressure is absent or negligible.

The most frequently occurring CPEs in children with RCLP are weak oral pressure, glottal stops, nasal consonant for oral pressure consonant, and nasalized voiced pressure consonants. Similar results were reported by Hardin-Jones and Jones (2005) on examining the speech of 212 preschool and school-aged children with cleft lip and palate. Their results reported that approximately 13% of the children used nasal substitutions and 25% used compensatory articulation errors, specifically glottal stop substitutions. It also supports the findings of Sell, Harding, and Grunwell (1994) who opined that glottal stops occur frequently and consistently among other compensatory articulations. Few CPEs like uvular substitutions and nasal fricatives were not evidenced in the present study.

The disparity between the present study and the previous studies can be attributed to various aspects such as speech therapy, type of speech stimuli, type and extent of the cleft, type of palatal surgery, number of palatal surgeries, maturity and motivation, family support, socio-economic status, etc. Wherein, Speech therapy could be one of the major factors. Speech therapy could maximize the outcome of the palatal surgery and it is usually recommended as soon as the surgical correction of the palate. The present study did not consider the factors related to speech and language intervention and its strategies undertaken by the participants.

The present study used stop consonants with the combination of the vowel /a/ (CVCV) as the speech stimuli to compare CPEs across EIG and DIG, where a significant difference was obtained only in nasalized voiced pressure consonants and weak oral pressure. A significant difference in the other CPEs could have also been obtained with the inclusion of other pressure consonant categories like fricatives and affricates with the combination of the vowel /i/ and /u/ as well. Another major factor influencing the generalization of the results is the number of participants in the study. Present study considered only 8 participants in each group, exhibiting diverse speech errors limiting the ability to generalize the findings of the current study. The severity of resonance and articulation problems might vary with respect to the type and extent of the cleft palate but this aspect was not considered in the present study, thus being one of the limitations. Other factors like maturity, motivation, and family support were also not discussed in the present study which could have been the factors contributing to the results of the present study.

5. Conclusion

The present study concludes that early surgical intervention has a direct impact on reducing hypernasality and consonant production errors in children with RCLP. Children with CLP require early surgical intervention to establish appropriate oral motor skills that are necessary for normal speech production.

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