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Impact of articulation therapy on perceptual characteristics of bilabials in children with repaired cleft lip and palate

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ABSTRACT

Purpose: The study's objectives were to assess the effect of articulation therapy for bilabials on SODA errors, cleft type errors (CTEs), and percentage of correct consonants-revised (PCC-R) in children with repaired cleft lip and palate. **Methods:** Single-subject with multiple baselines research design was used to investigate the changes in bilabials across four-time points. Four participants with repaired cleft lip and palate (RCLP) between 4 and 7.11 years were considered. For the assessment, pictures of six words were visually presented, and the participants were asked to name them. Three speech-language pathologists identified SODA errors and cleft type errors (CTE), based on which PCC-R was calculated. Participants underwent ten intensive articulation therapy sessions: phase I focused on auditory discrimination training and phase II on production training. The production training mainly focused on the phonetic placement approach, shaping the target sound, and improving the oral airflow. **Results:** Overall, SODA error analysis revealed substitution and distortion errors during the baseline assessment. CTE analysis indicated weak oral pressure consonant followed by a glottal stop, nasalization of voiced pressure, nasal consonants for oral pressure consonants, and voicing errors. PCC-R scores ranged from 0% to 83.33%. Assessment 4 indicated only distortion errors during SODA error analysis, weak oral pressure consonants during CTE analysis PCC-R was 100%. The obtained results indicate an improvement in the articulation placement and oral airflow; thus, the participants benefited from the intervention program.

Key words: Articulation therapy, bilabials, percentage of correct consonants-revised, perceptual, evaluation, repaired cleft lip and palate

INTRODUCTION

Individuals with cleft palate with or without lip exhibit errors due to structural deficits (obligatory errors) or incorrect articulatory placements (compensatory articulation [CA]).[1] Obligatory/passive errors may result in hypernasality, nasal emission/turbulence, and weak production of the pressure consonants.[2] CAs are believed to be learned early in speech acquisition due to the strategies developed to overcome the structural inhibitions by the child with repaired cleft lip and palate (RCLP). Once the atypical placements are learned, the CA remains in the phonetic repertoire and becomes part of the child's phonology.

CAs, are also termed as cleft type errors/active errors. They are further classified into different errors based on the place of contact of the articulators by authors (Peterson- Falzone *et al*.,[2] & Kummer[1]). Henningsson[3] developed a universal parameter rating for reporting speech outcomes in individuals with cleft palate with or without a cleft lip. Here the consonant errors were classified into abnormal backing of the oral targets in post uvular places, abnormal backing of oral targets, nasalized voiced pressure consonants, and weak oral consonants.

In the Indian context, Deepthi and Pushpavathi[4] reported typically developing children (TDC) exhibited substitution errors in the medial position, compared

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to children with RCLP, who exhibited substitution, omission, and distortion errors, in initial and medial positions. Further, plosives were substituted by glottal stop/pharyngeal stops/glottal fricative or their nasal counterparts. Muralikrishna and Pushpavathi[5] reported percentage of correct consonants-revised (PCC-R) scores of 3–4 years TDC to be significantly different from children with RCLP in the preceding and following context of the Kannada language. Further, Affricates were most affected, followed by stops and fricatives. The mean PCC-R scores in the preceding context for stop consonants were 98%–99.24% in TDC and 12%–36.42% in children with RCLP. In the following context: 90%–99.62% – TDC and 23.75%–38.88% – RCLP.

The presence of CA in R/CLP even after surgery and the advances in surgical management[6,7] calls attention to speech therapy. CA's are categorized as "treatable errors" by the American Speech and Hearing Association (ASHA), with the objectives of the therapy being; to correct the oral place of articulation and establish the oral pathway of airflow.

Over the decades, studies have been conducted to understand the effect of articulation therapy in individuals with RCLP. Van Denmark and Hardin[8] investigated the effectiveness of articulation after the multi-sound approach and 9-month follow-up. Thirteen children between 6 and 12 years reported an improvement in articulatory defectiveness and nasality, and eight reported improvement in a conversational speech at the end of 4 h, 26 days of articulation therapy. However, no improvement was reported in articulatory defectiveness, and nasality and overall improvement in conversational speech when posttherapy and follow-up were compared. Progress in the participants was less and slower than expected, which was attributed to the possible specific and complex problems than that of an average child with a cleft. The authors also opined the use of adequate measures to assess the articulation, as some improvement in terms of change in the type of error is not reflected, as it is still an error. They also exemplify our lack of knowledge concerning variables that contribute to the success of the therapeutic process and stress the requirement of further research.

Bessell *et al.*[6] reviewed 17 articles to inspect the effectiveness of theoretical modes of speech and language interventions. The data obtained consisted of randomized and nonrandomized controlled trials with nonsyndromic and syndrome participants between 10 and 90. Research studies focused on the motor movement specifically to the context of the speech to study the primary motor approach, which included focus stimulation and whole word approach, contrasts between the traditional approach and the phonological linguistic approach, visual feedback, and the motor phonetic approach. Even though various intervention programs were used, there was no sufficient evidence to support any particular approach about the optimum length setting or age of integration even though a beneficial posttherapy outcome of speech and language intervention program.

Derakhshandeh *et al.*[9] reported the usefulness of a combination approach, Motor phonetic and phonological approach, in children with CLP and velopharyngeal dysfunction (VPD), non-oral and passive cleft speech characteristics (PCSCs) at different time points. A reduction in nonoral cleft speech characteristics was reported in all participants, whereas PCSCs decreased in three cases and increased in two cases. The increase in the PCSC's and decrease in the nonoral cleft speech characteristics suggest the intervention has changed the non-oral CSC's to PCSC's. The authors opine that some obligatory errors may be due to the individual's habitual articulations associated with an unrepaired palate, and with intervention, there is a possibility for velopharyngeal closure or near closure. Korah[10] reported an increase in the phonetic inventory with increased production in vowels, labial, labiodental, dental, alveolar, retroflex, and palatal sounds. Distortion errors, cluster reductions, reduced glottal stops, and overall improvement in intelligibility also reported post 16 sessions of therapy focusing on phonetic placement approach in a four-year-old child with RCLP.

Alighieri *et al.*[11] studied intensive speech therapy's effectiveness in five Uganda patients with CL/P. They reported decreased nonoral cleft speech characteristics, improved PCC in four patients, and decreased resonance problems in two patients. Further, all the patients reported that they were satisfied with speech after the therapy and in the long term. Thus supporting intensive speech therapy in reducing the articulatory and resonatory errors in the long term also. Alighieri *et al.*[12] studied the effectiveness of 6-h, 3-day speech intervention by comparing a motor phonetic speech intervention and phonetic- phonological speech intervention in eight patients. An increase in consonant proficiency and decreased passive and nonoral CSC's errors were reported irrespective of the approach. Further, the analysis revealed an increase in the PCC in subjects who used phonetic-phonological treatment,

suggesting the phonological approach may be beneficial for patients with CL/P.

CA is one reason for reduced speech intelligibility, making it a requirement to eliminate/reduce the errors in speech in children with RCL/P. Individuals with R/CLP are a heterogeneous population as they differ on the type and severity of the cleft, type, and effectiveness of surgical repair and age at which intervention was initiated. An average result will mask the individual performances, as the results of a group design suggest the generalization to be the sample to a group and will be less focused on individuals. Thus, a study focusing on individual performance will provide more accurate information. A single-subject design is best for this purpose, as they are more flexible than group designs in documenting the evidence-based practice in communication disorders.[13]

Hence, the present study was designed to investigate the effect of articulation therapy for words with bilabials in the initial position for children with RCLP. The study's objective was to analyze the impact of articulation therapy in children with RCLP based on Substitution, Omission, Distortion and Addition (SODA) errors, CTE, and PCC-R.

METHODS

Participants

Four participants, with a mean age of 6 years, participated in the present study. The inclusion and exclusion criteria are given in Table 1.

Ethical clearance was obtained from the institute's review board, and the nature of the study was explained to the caregivers of all the participants; only those who consented to the study in writing were considered. The details of the participants are presented in Table 2.

Stimuli for baseline assessment and therapy

Stimuli for assessment consisted of six meaningful, picturable, and age-appropriate bilabial Kannada words with /a/, /i/, and /u/ in the initial position. The words selected were chosen from the articulation drill book for cleft palate population,[14] KDPAT,[15] government prescribed Kannada textbook for primary school children, and Kannada Dictionary. The words were additionally rated as familiar by preschool teachers. The words considered for the assessment across the four time points were /paṭa/, /piṭilu/, /puri/, /baLe/, /billu/ and /buṭṭi/. Appropriate color pictures of the same were obtained.

Speech recording for assessment

The speech recording was done individually, where each participant was seated comfortably in a quiet room and presented with color pictures on a 15.6-inch display screen laptop (Asus Vivobook 15) using Microsoft office PowerPoint (2013). In instances where the participants found it difficult, the investigator produced the target word, and the participant was asked to repeat the word. The audio recording was done by placing the microphone (Mipro MM-107) 3 cm away from the participant's mouth using *Praat software version 5.3.35*(Paul Boersma and David Weenink Phonetic Sciences, University of Amsterdam Amsterdam The Netherlands)[16] on a personal computer. The second repetition was considered for analysis. Speech recording for assessment was done at four-time points, including one during baseline and three-time points post-therapy.

Speech recording and reliability

Three judges (including the primary investigator) with a minimum of three years of clinical and research experience in CLP between 26 and 45 years of age served as judges and analyzed all the samples. The judges were trained for auditory perception tasks in three sessions for 1 h each. During the analysis, the judges were given instructions and a glossary of terminologies and the parameters' descriptions to be analyzed. The samples which were used to train the judges were not used in the main study.

Research design

The study followed a single-subject design with multiple baselines. The details of the procedure followed are discussed below:

Table 1: Inclusion and exclusion criteria for the participants

Inclusion criteria	Exclusion criteria
Children with normal hearing threshold	Associated neurological problems
Cleft lip surgery and primary palatal surgery <2 years of age	Other structural anomalies
Age adequate receptive and expressive age-(M-RELT[14])	Dental anomalies hindering the production of bilabials
Presence of CA-(KDPAT[15])	
Mild to moderate hypernasality	
Previously attended therapy for a maximum of 30-40 sessions, which primarily focused on language development	
Presence of VPD through visual inspection by the SLP and plastic surgeon	

VPD: Velopharyngeal dysfunction, CA: Compensatory articulation, M-RELT: Modified-receptive and expressive language test, KDPAT: Kannada diagnostic photo articulation test, SLP: Speech language pathologist

1. Baseline (B): Auditory-perceptual analysis as part of baseline assessment was carried out.
2. Intervention: Articulation therapy was provided to the participants by the investigator. The sessions were at a frequency of three times a week, with each session lasting for 1 h.
3. Assessment Phase 2–4 (A1-A3): Auditory- perceptual analysis was carried out at an interval of ten sessions, at different time points
    - A1- Assessment 1 was done after ten sessions at the time of termination of therapy for bilabials
    - A2–20 sessions after baseline assessment
    - A3–30 sessions after baseline assessment.

The intervention session between A1 and A3 addressed the other error productions and are not reported in the present study. The procedure followed is illustrated in Figure 1.

Analysis

The recorded words were subjected to perceptual analysis, and the parameters considered are given in Table 3.

Table 2: Gender, age, type of cleft, and surgery details of the participants

Participant code	Gender	Age (years)	Type of cleft	Surgery details	
				Lip	Palate
P1	Male	4.5	(R) UCLP	3.5 months	9 months
P2	Male	4.6	(R) BCLP	6 months	1 year
P3	Female	7.6	(R) UCLP	6 months	2 years
P4	Female	7.4	(R) BCLP	6 months	1 year

P1: Participant 1, P2: Participant 2, P3: Participant 3, P4: Participant 4, (R) UCLP: Repaired unilateral cleft lip and palate, (R) BCLP: Repaired bilateral cleft lip and palate

Table 3: Perceptual parameters considered for analyses in children with repaired cleft lip and palate across conditions

Perceptual parameters		
SODA analysis	Cleft type errors*	PCC-R**
S-substitution	GS	PCC-R=Number of correct consonants/total number of intended consonants *100
O-Omission	VL	
D-distortion	NCPC	
A-addition	NVPC	
	WOPC	

*Based Henningson *et al.*[3] and Sankar[7] **Formula by Shriberg *et al.*[17]. SODA: Substitution omission distortion addition, GS: Glottal stop, VL: Velar, NCPC: Nasal consonants for oral pressure consonants, NVPC: Nasalized voiced pressure consonant, WOPC: Weak oral pressure consonant, PCC-R: Percentage of correct consonants-revised

Therapeutic intervention procedure

Postbaseline assessment, based on the error, articulation therapy was initiated. The investigator provided therapy in two phases; Phase I – auditory discrimination training based on traditional approach. Inter and intra discrimination activities were carried out to discriminate between the error and correct production. When the participant was able to discriminate the target sound eight on ten times, phase II was initiated.

Production training (Phase II) was a combination of correct phonetic placement of the target phoneme, shaping the same, and channelizing the airflow through the oral cavity (guidelines given by ASHA). Initially, place maps and puppets were used to identify the correct place of articulation. Aids such as tongue depressors were used to indicate the correct place of articulation on the participant. Simultaneously, activities focusing on channelizing the airflow through the oral cavity were carried out. Additionally, tactile, auditory and visual cues were given for the same. When the participants were able to produce the target sound in the initial position, six on ten times, the therapy progressed, addressing the other error sounds. The present study focuses on only bilabials; hence the other phonemes are not discussed. A structured home training was given to the caregivers, excluding the words used for the assessment. They were also instructed to consciously not to use the 6 words that were used for assessment.

RESULTS

The participants underwent articulation therapy for words with bilabials. Overall, SODA error analysis revealed substitution and distortion errors in all four participants during baseline assessment. CTE analysis indicated the presence of WOPC followed by GS, NVPC, NCPC, and voicing error (VE). PCC-R scores ranged from 0% to 83.33% during the baseline assessment. Each parameter and the change associated with each participant across four-time points are discussed below.

SODA error analysis: Pre and post-therapy

Baseline SODA error analysis indicated the presence of 12 substitution and 11 distortion errors altogether. A1 indicated 18 distortion errors and one substitution error, A2:12 distortion errors and four substitution errors,

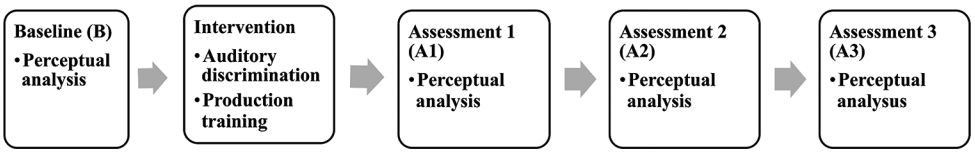

Figure 1: Illustration of the procedure followed in the present study

and A3:13 distortion type of errors only. Overall, a change from substitution errors to distortion errors was observed in P2, P3, and P4. At the same time, Participant 1 (P1) exhibited a change from substitution errors to distortion errors to eventually normal production (NP). The results of the same by each participant are given in Table 4.

Baseline assessment of P1 exhibited substitution and distortion errors for all target words except /ba/, produced as NP. Posttherapy, A1 indicated a change of substitution and distortion errors to NP except for /pu/, which remained distorted. A2 and A3 indicated a consistent NP in all the target words. In P2, baseline-assessment revealed substitution error for /pi/, /pu/ and /bi/ and distortion for /pa/, /ba/ and /bu/. Post-therapy analysis, A1 indicated, previously observed substitution error to have changed to distortion error for /pi/ /pu/ and /bi/, whereas distortion error remained the same for /pa/, /ba/ and /bu/. A3 indicated a change in the error pattern to NP for /pa/ and /ba/, but others remained distorted.

P3 exhibited substitution errors for voiced bilabials and distortion errors for their unvoiced counterparts. A1 revealed the errors pattern to be the same, except/bi/ and /bu/, where a distortion type of error was observed. A2 indicated distortion errors, A3 indicated the presence of NP for /pa/ and /ba/ and distortion for the other targets. P4 presented with substitution and distortion errors. A1 showed the presence of distortion errors overall. A2 revealed distortion error for unvoiced bilabials and substitution error for their voiced counterparts. A3 revealed NP for /pa/ and distortion errors for other target words.

Table 4: Substitution omission distortion addition error analysis for bilabials across participants

Participants	Target phoneme	Time points			
		B	A1	A2	A3
P1	/pa/	D	NP	NP	NP
	/pi/	S	NP	NP	NP
	/pu/	D	D	NP	NP
	/ba/	NP	NP	NP	NP
	/bi/	D	NP	NP	NP
	/bu/	D	NP	NP	NP
P2	/pa/	D	D	NP	NP
	/pi/	S	D	D	D
	/pu/	S	D	D	D
	/ba/	D	D	NP	NP
	/bi/	S	D	D	D
	/bu/	D	D	S	D
P3	/pa/	D	D	D	NP
	/pi/	D	D	D	D
	/pu/	D	D	D	D
	/ba/	S	S	D	NP
	/bi/	S	D	D	D
	/bu/	S	D	D	D
P4	/pa/	S	D	D	NP
	/pi/	S	D	D	D
	/pu/	S	D	D	D
	/ba/	D	D	S	D
	/bi/	S	D	S	D
	/bu/	S	D	S	D

P1: Participant 1, P2: Participant 2, P3: Participant 3, P4: Participant 4, D: Distortion, S: Substitution, NP: Normal production, B: Baseline assessment, A1: Assessment 1, A2: Assessment 2 and A3: Assessment 3

Cleft type errors analysis: Pre and post-therapy

CTE analysis during baseline assessment indicated 10WOPC, 8GS, 2 VE, 2NCPC, and 1NVPC. A1- 15WOPC, 3NVPC, and 1NCPC, A2- 12WOPC and 4VE and A3- 13WOPC. On the whole, change from GS/NVPC/NCPCVE to WOPC was observed in P2, P3, and P4. Whereas P1exhibited a change from GS to WOPC errors to eventually NP. The results obtained after CTE analysis are given in Table 5.

CTE analysis of P1 exhibited the presence of WOPC and GS during baseline assessment. A1 indicated GS change to WOPC, and WOPC of /pa/,//bi/, and /bu/ were produced normally, whereas /pu/ remained WOPC. A2 and A3 indicated NP for all target phonemes. P2, exhibited presence of WOPC (/pa/,/ba/ and /bu/) and GS (/pi/, /pu/ and /bi/) during baseline-assessment. A1 indicated a change of GS to WOPC. A2 indicated WOPC to persist for all target phonemes, with VE for /bu/. Further, A4 indicated the presence of WOPC for all target phoneme except for /pa/ and /ba/, which were NP.

P3 exhibited the presence of WOPC, NCPC, and VE during baseline assessment. A1 remained the same with minimum variations. Further, A3 indicated NP for /pa/ and /ba/, whereas the other phonemes remained as WOPC. P4 presented with GS, NCPC, and VE during baseline assessment. A1 indicated a change of GS to WOPC for voiceless phonemes and /bi/ and NVPC for /ba/, indicating a change in the error patterns posttherapy. A2 indicated WOPC for unvoiced bilabials and VE for their voiced counterparts. A3 indicated NP for /pa/ and WOPC for other targets. The change observed across the four-time points in each participant is presented in Table 5.

Percentage of correct consonants-revised scores: Pre- and post-therapy

PCC-R reflects the efficacy of producing the consonant correct in the particular language. In the current study, it was assessed at four-time points for each participant. Overall, the baseline assessment indicated 83.33% in P1, 50% for P2 and P3, and 0% for P4. PCC-R scores increased to 100% and remained the same during A1,

Table 5: Cleft type error analysis for bilabials across participants

Participants	Target phoneme	Time points			
		B	A1	A2	A3
P1	/pa/	WOPC	NP	NP	NP
	/pi/	GS	NP	NP	NP
	/pu/	WOPC	WOPC	NP	NP
	/ba/	NP	NP	NP	NP
	/bi/	WOPC	NP	NP	NP
	/bu/	WOPC	NP	NP	NP
P2	/pa/	WOPC	WOPC	NP	NP
	/pi/	GS	WOPC	WOPC	WOPC
	/pu/	GS	WOPC	WOPC	WOPC
	/ba/	WOPC	WOPC	NP	NP
	/bi/	GS	WOPC	WOPC	WOPC
	/bu/	WOPC	WOPC	VE	WOPC
P3	/pa/	WOPC	WOPC	WOPC	NP
	/pi/	WOPC	WOPC	WOPC	WOPC
	/pu/	WOPC	WOPC	WOPC	WOPC
	/ba/	NCPC	NCPC	WOPC	NP
	/bi/	NCPC	WOPC	WOPC	WOPC
	/bu/	VE	NVPC	WOPC	WOPC
P4	/pa/	GS	WOPC	WOPC	NP
	/pi/	GS	WOPC	WOPC	WOPC
	/pu/	GS	WOPC	WOPC	WOPC
	/ba/	NVPC	NVPC	VE	WOPC
	/bi/	VE	WOPC	VE	WOPC
	/bu/	GS	NVPC	VE	WOPC

P1: Participant 1, P2: Participant 2, P3: Participant 3, P4: Participant 4, WOPC: Weak oral pressure consonant, GS: Glottal stop, NVPC: Nasalization of voiced pressure consonants, NCPC: Nasal consonant for oral consonant, VE: Voicing error, NP: Normal production, B: Baseline assessment, A1: Assessment 1, A2: Assessment 2, A3: Assessment 3

A2, and A3 for P1. P3 exhibited a constant increase in PCC-R, with scores reaching 100% during A2 and remaining the same during A3. P2 and P4 exhibited an increase in A1, a dip A2, and 100% during A3. The same is depicted in Figure 2.

DISCUSSION

The present study employed SODA error and CTE analysis to identify the errors. During the baseline assessment of SODA error analysis, the predominant errors were substitution and distortion errors. These results differed from the results obtained by Deepthi and Pushpavathi[4] and maybe due to the different age ranges considered in the study. Another reason may be previous therapy attended by the participants in the present study; even though the previous therapy focused on language skills, this may have facilitated better production. The baseline CTE analysis indicated the presence of WOPC, followed by GS, NVPC, NCPC, and VE; these results support the findings of Bessell *et al.*[6] Sankar,[7] and Deepthi and Pushpavathi,[4] who report the persistence of articulatory errors in the speech of children with

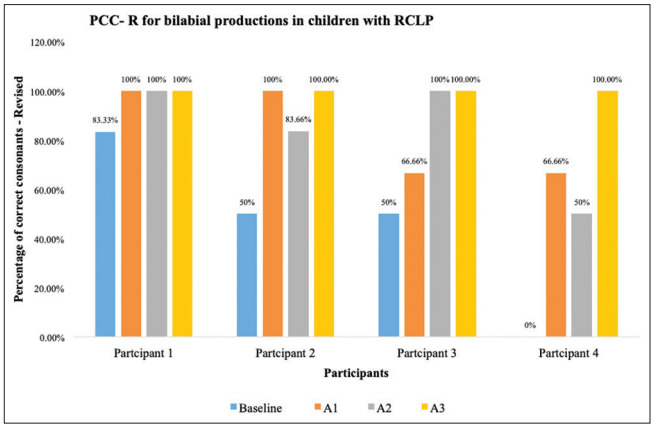

Figure 2: Percentage of correct consonants – revised for words with bilabials in four participants with repaired cleft lip and palate

RCLP post-surgery. Baseline PCC-R scores ranged from 0% to 83.33% in the present study, whereas Muralikrishna and Pushpavathi[5] reported PCC-R scores to be 12%–36.42%. The present study results observed a greater range, indicating the presence of more substitution type of errors.

Impact of articulation therapy on SODA errors, cleft type errors and percentage of correct consonants-revised in children with repaired cleft lip and palate

The results indicated a decrease in the SODA errors and CTE and improved PCC-R scores over the four-time points for bilabials with therapy. A change from substation errors to distortion errors/NP was observed in all the participants. The present study results are partially in coherence with the study conducted by Korah[10] who also reports distortion errors posttherapy using the phonetic placement approach. CTE analysis indicated GS, NVPC, VE, and WOPC during baseline assessment, and A3 indicated the presence of only WOPC. These results are similar to the study by Derakhshandeh *et al.*[9] Korah,[10] Alighieri *et al.*,[11] and Alighieri *et al.*[12] Contrary to it, results obtained by Van Denmark and Hardin[8] reported slower improvement in their participants and opined that this slower improvement might be due to more specific complex problems than the average child with a cleft substantiating the heterogeneity of the group. The present study reports the errors at each point, allowing a better understanding of the attempt made by the participant in reaching the goal, as speech improvement in the form of a change in the type of error is appreciated.[8]

The presence and persistence of distortion/WOPC/obligatory error in P2, P3, and P4 may be due to the leakage of air through the nasal cavity, which can be

attributed to the history of the cleft and persistence of VPD indicating the possible requirement for further surgical intervention. Whereas P1, who initially presented with majorly WOPC/distortions, achieved the NP, indicating normal/near-normal velopharyngeal function, thus creating an oral constriction with the correct placement.[2,9]

PCC-R ranged between 0% and 16.66% during baseline assessment and 100% during the A3, indicating an increase in scores. Similar results were obtained by Alighieri *et al*.[11] Alighieri *et al*.[12] Along with the improvement in the production of bilabials, it was observed that the participants were much slower in the production of words. It may be that the slow production of words allows more time for accurate contact of the articulators. It was also observed that most of the participants achieved the target place of articulation by the end of the 10th session but could not appropriately channelize the airflow through the oral cavity; this can be attributed to the VPD. Overall, as the SODA errors and CTE decreased, the PCC-R scores increased, implying an inverse relationship between SODA/CTE and the PCC-R scores.

CONCLUSION

Four participants with RCLP and presence of CA underwent articulation therapy, mainly focusing on words with bilabial place of articulation. The participants were provided with ten therapy sessions focusing on the correct placement of articulation of bilabials and channelizing the airflow through the oral cavity. Assessments were carried out at baseline and post therapy, results indicate an improvement in the articulation placement and oral airflow, thus implying the benefit from the intervention program. The overall SODA error analysis, cleft type error analysis and PCC- R indicated a positive change in the participant's production, which is validated through the multiple perceptual assessments.

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Conflicts of interest

There are no conflicts of interest.

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