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Speech services by speech volunteers for children with cleft lip and palate in professional lacking area: Pilot study

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ABSTRACT

Background: Cleft lip and cleft palate are the most common birth defects. Children with cleft lip with or without cleft palate (CP±L) face a vary of challenges, depending on the type and severity of the cleft including speech difficulty, dental problems, feeding difficulty, ear infections and hearing loss. Articulation error is the most common residual defect in children with cleft palate with or without cleft lip.

Objective: To compare the numbers of pre- and post- articulation errors after using the Model of Speech Therapy by Volunteers (STV) for children with CP±L**.**

Materials and methods: 9 children, aged range 6; 4-14; 2 years old, were included in this study and completely participated in the study. Pre- and post-articulation tests by Myanmar Articulation, Resonation, Nasal Emission and Nasal Turbulence Test were assessed at Mahamuni Monastery, and Thiriyadana Guha Pone Htoon Shan Monastery, Tachileik, Myanmar. STV is composed of a 3-day speech camp (1st month), 3 times 1-day site visits for complicated cases (2nd, 6th, and 10th months) and 3 times of 1-day follow-up speech camps (4th, 8th, and 12th months), Phonological approaches, traditional strategies, and specific techniques for speech correction in children with CP±L were taught to speech volunteers (SVs) and caregivers. Homework was assigned to SVs and caregivers. SVs provided a session of 45-minute speech correction every week. Caregivers practiced 5 sessions of 30 minutes in speech exercises /weeks at home.

Results: STV revealed significant reductions in the numbers of articulation errors including articulation screening test [median difference: MD=6 (95% confident interval: CI=5.2-9.2)]**,** and Myanmar articulation standard test at both word and sentence levels; [MD=8 (95% CI=6.5-10.8) and MD=5 (95% CI=4.2-8.3), respectively].

Conclusion: STV significantly decreased a number of articulation errors in children with CP±L of Myanmar, a professional lacking area, and could be applied in any area that has a similar situation. The result was a primary study, the further research should enroll more participants for generalization.

Introduction

Primary repair was conducted within the first 6 months of life in children with cleft palate with or without cleft lip (CP±L).[1] Most children with CP±L generally performed cheiloplasty or lip repair at 3 months old and palatoplasty at 1 year.[2] For children with CP±L in lower-income and lower-middle-income countries (LMIC), palatoplasty is often performed around the age of 1 year.[3] Primary surgery was conducted within the first 6 months of life in Myanmar.[1]

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For Myanmar, prevalence of CP±L was found to be 1-1.3/1,000 live births.[4] The residual abnormalities after repair or after primary palatoplasty were commonly articulation disorders (71.2-88.6%), hypernasality (43.3-69 %) especially from velopharyngeal insufficiency (VPI), voice disorders (19.1), and delayed speech and language development (16.3%).[5-8] Compensatory articulation disorders (CAD)(Abnormal articulation placement due to abnormal structure) are very common and require prolonged periods of speech intervention in children with CP±L.[6,7,9,10]

Normal speech is the goal for treatment in children with non-syndromic CP±L. The limited access to intervention and guidance for parents on comprehensive care in speech intervention is a major challenge in developing countries.[11,12] particularly in LMIC. Different models and strategies were implemented to solve the lack of speech services, for example: speech summer camp, phonologic-based intervention and articulatory or phonetic-based intervention, and naturalistic intervention in Mexico[11,14,15] and paraprofessional training in Lao People's Democratic Republic *(*LPDR*).*[16] as well as training for speech assistants, community-based speech model and speech camps in Thailand.[17-21]

In Myanmar, surgical treatment and speech therapy services are limited. Similar to LPDR, speech services are in a shortage or none because of a lack of speech and language pathologists (SLPs). There was only SLP who worked in private hospitals and no speech service was available in general hospitals. The purpose of this paper was to investigate the effectiveness of Speech Therapy by Volunteers (STV) for Children with CP±L to reduce the numbers of articulation errors.

Materials and methods

Design**:** A prospective one-group pre-post study

Setting**:** Mahamuni Monastery, and Thiriyadana Guha Pone Htoon Shan Monastery, Tachileik, Myanmar.

Participants

Inclusion criteria: children with CP±L, who had already lip and palate repair, aged ranged 4-15 years old, lived in Eastern Shan State, Myanmar.

Exclusion criteria: children with CP±L who had any condition as follows: 1) no articulation errors based on pre-articulation tests; 2) syndromic CP±L; 3) hearing loss problems (>40 dB both ears); 4) learning disorders; 5) other cognitive disorders or global delayed development.

There were 12 children with CP±L. Two of them were excluded because of no articulation defects after pre-assessment. 10 children with CP±L, ages ranged 6 years 4 months-14 years 2 months old, were enrolled in this study. They understood Burmese which the official language is used in school. None of them had received previous speech therapy. A boy (C07) withdrew from the study because he moved to continue his education in another city at the 2nd follow-up speech camp. 9 children along with their caregivers were enrolled in the complete study.

Seven speech volunteers (SVs), who had Burmese literacy and were non-paraprofessionals (a company employee, 5 teachers, and a 4th-year university student, who worked in a community nearby children's home) and they were speech assistants. SVs committed to join the project. Each SV was assigned to practice 1-2 children based on geographics.

Five research assistants (RAs) who fluently spoke and wrote both Thai and Burmese were interpreters.

Procedures

Study design

This study was a prospective one-group pre-post study, the design outline was shown in Figure 1.

Assessment:

The study included 2 tests that cover speech characteristics of cleft types (characterized by hypernasality and compensatory articulations) based on universal reporting systems[22-24] as follows:

1. Myanmar Articulation Screening Test with pictures: composed of 4 connected sentences that cover all sounds in Burmese and focus articulation on connected contexts,
2. Myanmar Articulation, Resonation, Nasal Emission, and Nasal Turbulence Standard Test with pictures

Tests included all the Burmese phonetic sounds composed of 32 initial consonants and 7 basic vowels 3 tones. Each test is composed of 2 versions:

a) Myanmar version with pictures for testing. This version was Burmese language so that SVs, Ras, and caregivers could understand the meaning.
b) Myanmar-Thai version with pictures (composed of both Myanmar and Thai reading pronunciation, as well as translation of the meaning to Thai) for Thai speech and language pathologists (TSLPs) to understand the meaning and identify articulation errors.

Tests gave information on parameters of articulation, resonance, voice, understandability, acceptability, nasal emission and turbulence, and facial grimace.

1. Myanmar Articulation Exercises included 2 versions composed of 2 versions: 3.1) Myanmar Version 3.2) Myanmar-Thai version.[25]
2. Daily home record for speech correction. This was recorded by SVs and caregivers to monitor speech correction.[26]
3. Language tests: The Burmese Early Language Screening Test (adapted and translated from Thai Early Language Milestones)[27] and Utah test[28] for language screening.

Examination, pre- and post-perceptual assessments were performed as follows:

- Speech and language pathologist (SLP) performed an oral examination for detection of the anatomical defects.
- A short conversation between the child and SLP was carried on to elicit understandability and acceptability of speech.

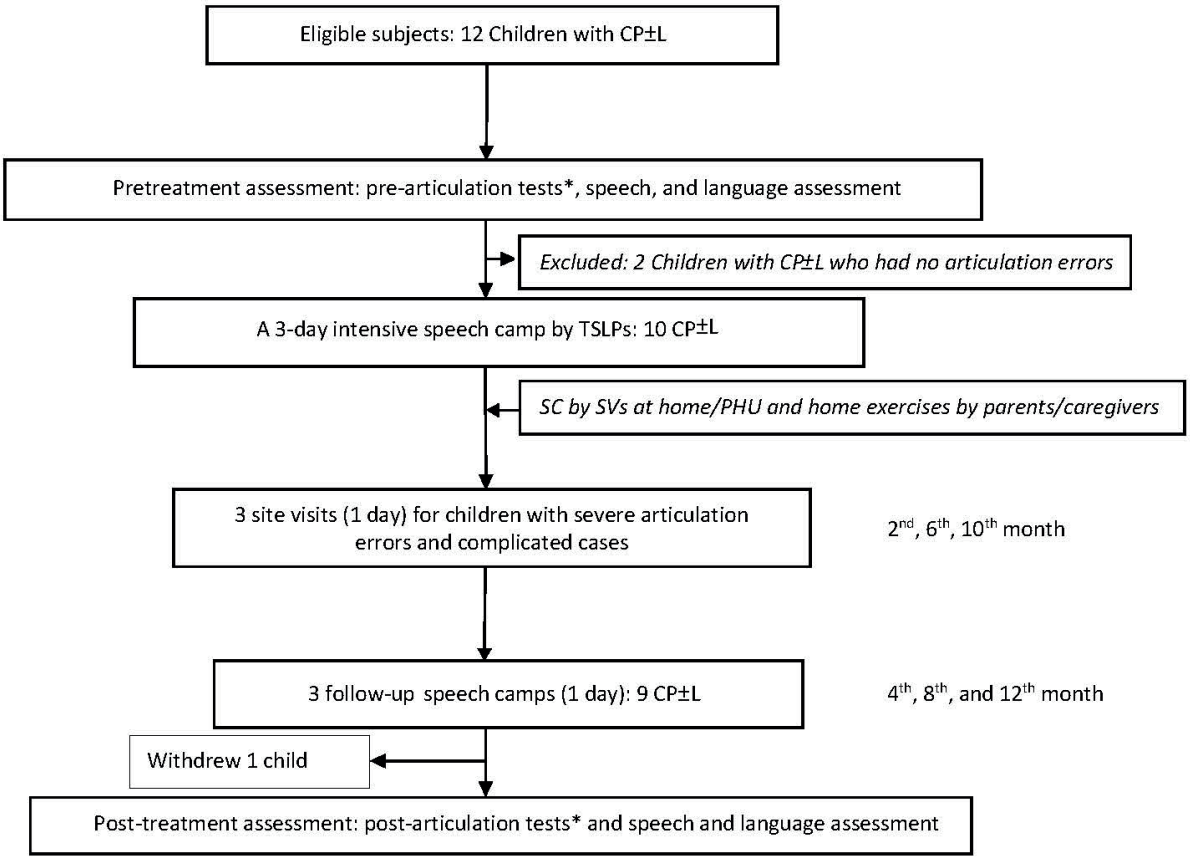

Figure 1. *Design outline. 1: Myanmar Articulation Screening Test, 2: Myanmar Articulation, Resonation, Nasal Emission and Nasal Turbulence Test, CP±L: Cleft palate with or without cleft lip, TSLPs: Thai speech and language pathologists; PHU: Primary Health Care Unit, SVs: Speech volunteers, SC: Speech correction by speech volunteers.*

- Pre- and post-articulation tests with perceptual assessment using 1) the Myanmar Articulation Screening test which is composed of 4 connected speech and 2) Myanmar Universal Parameters of Speech Outcomes for People with Cleft Palate that were used for articulation assessment.[29] Outcomes were summarized by consensus among investigators and teams. Speech characteristics were assessed as articulation, resonance, nasal emission or turbulence, voice, speech understandability, and acceptability.
- Speech and language screening test by UTAH test of language development.[28] This test is a language screening evaluation that composed of both expressive and receptive languages based on children's age. A child who passes every item of the UTAH test was interpreted that his/her language skill was normal. If a child cannot pass any item, language skill is interpreted as delayed.

Outcomes were summarized by consensus among investigators and teams including: 1) 2 TSLPs who had >30 years' experience in investigation; 2) a Thai-Burmese linguistic, 3) a Burmese research assistant who had a literacy of both Burmese and Thai and graduated with bachelor's degree in Thai program from Mae Fah Luang University, Chiang Rai Province.

Speech therapy: the process of STV was summarized in Table 1.

Table 1. Timeline of speech therapy.

Time	Name	Duration	Activities	Note
1st month	An intensive speech camp	3 days	Day 1: introduction to speech camp, workshop of basic knowledge about Myanmar phonetics and an exercise manual for SVs and caregivers Day 2: Oral examination and assessments Day 3: 6 sessions of 45-minute of speech therapy	Each child was provided 6 sessions of 45-minute speech therapies per day.
2th, 6th, 10th months	Three site visits of speech therapy	1 day	A session of 60 minutes of speech therapy via teaching on services was provided by TSLPs with RAs for 5 children with CP±L (No. C01, C02, C03, C04, C06), who had severe articulation errors with/without complicated cases	- Severe articulation errors: ≥ 5 articulation errors - Complicated cases: less cooperation of home exercise practices, needed special help for training, a teenager with a shyness
4th, 8th, 12th months	Three follow-up speech camps	1 day	Six sessions of 45-minute speech therapy	Each child was provided 6 sessions of 45-minute speech therapies per day.

Training speech correction for SVs:

Criteria for recruited speech volunteers: People or non-paraprofessionals who have literate Burmese and lived or worked in a community or area near children with CP±L's home. They needed commitment to do the project for 1 year. Research assistants directly contacted speech volunteers or communicated via health care providers.

TSLPs taught and demonstrated speech correction of each articulation error for individuals with CP±L via demonstration, teaching on service, and training for being speech volunteers in every speech therapy session. Then, speech volunteers displayed speech correction. TSLPs gave comments and suggestions. TSLPs did a demonstration of teaching on service again until speech volunteers understood and did correct speech correction. In case of speech volunteers or caregivers could not speak or understand research assistant explained it in Burmese language. Speech volunteers had to fill in daily home records every time that they did speech correction. In case of SVs had any problems with speech correction or training, they can contact TSLPs by phone at any time.

Encouragement and commitment were provided for speech correction (SC) at children's homes or schools or primary health care units (PHC) near their home (a session of 45 minutes /week) to SVs and homework practice (5 sessions of 30 minutes/week) to caregivers. The project gave compensation for traveling SVs' expenses. Children's daily home records of speech corrections by speech volunteers and homework exercises by caregivers were tallied by RAs and selected SVs who gave the most consistent speech correction to be the best speech volunteers and the best caregivers. The winner got an award on the closing day of the project. The project provided souvenirs for every SV.

Phonological approach, traditional strategy, and specific technique for remedy cleft type characteristics (e.g., glottal substitution, nasal for oral sounds, pharyngeal fricative for oral fricatives, etc.) in speech correction were demonstrated by TSLPs via interpreters based on teaching on services (demonstration, practicing, supervision, monitoring, and checking) during 3 days of a speech camp until they could do independently.

If there was any phonological pattern, a phonological approach would be applied for speech therapy. Traditional strategy was a secondary step, then specific techniques were used if the traditional strategy was not effective. After that SVs were assigned to do speech correction in individual sound errors for 1-2 children and continually did speech correction for their children once a week for 1 year depending on geographic matching and administrative convenience. These exercises were done within the target context of the Myanmar Articulation Exercise.

Statistical Analysis

Assessment scales of speech characteristics including articulation, resonance (hypernasality, hyponasality, nasal emission, and nasal turbulence), voice, understandability, acceptability, and facial grimace were evaluated based on criteria of universal parameters for reporting speech outcomes in individuals with cleft palate.[23,24]

The main outcomes of this study were the number of pre- and post-articulation errors. Wilcoxon Signed-Rank Test was used to demonstrate the effectiveness of STV for children with CP±L by comparing the numbers of pre- and post-articulation errors in children with CP±L.

Results

Nine students with CP±L, aged range 6 years 4 months-14 years 2 months old (mean = 7.67 years; median = 8 years 3 months), were recruited to the project. No children had received previous speech therapy. Characteristics of children with CP±L were displayed in Table 2. Participants used 4 native languages or mother tongue languages (Lahu, Shan, Mandarin, Burmese),

understood Burmese (the formal language or language in the school), and received the language screening test. The average session that SVs did in the project was 1.1-2.7 sessions/week depending on the available time that they had. Speech characteristics by Myanmar Articulation, Resonation, Nasal Emission, and Nasal Turbulence Standard Test for People with Cleft Palate were shown in Table 3.

Table 2. Children with CP±L's general characteristics.

No.	Gender	Age Year; Month	Language	Diagnosis	Distance to reach child's home[$] (km)	Number of sessions of SCs[&]
C01	Male	11; 3	Shan	Bilat. CLP	2	2
C02	Male	7; 6	Shan	CP	10	2
C03	Female	14; 2	Lahu	CP	25	2.1
C04	Female	7; 1	Burmese	Lt. CLP	0	2.7
C05	Male	6; 9	Lahu	Rt. CLP	10	2.7
C06	Male	11; 6	Shan	Bilat. CLP	5	1.7
C08	Male	8; 3	Mandarin	Rt. CLP	5	1.9
C09	Female	6; 4	Burmese	Lt. CLP	5	1.1
C10	Female	10; 5	Burmese	Rt. CLP	8	1.7

Note: Bilat. CLP: Bilateral cleft lip and palate, CP: Cleft palate, Rt. CLP: Right cleft lip and palate, Lt. CLP: Left cleft lip and palate, [$]: Distance from speech volunteer' s home to child's home (kilometers), [&]: Average number of sessions of speech correction by speech volunteers per week.

Table 3. Speech characteristics by perceptual assessment in children with CP±L.

No.	Hypernasality				Audible nasal air emission /nasal turbulence				Voice**		Understandability*		Acceptability**		Facial grimace	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
C01	1	1	1	1	1	1	1	1	1	0	0	0	1	0	0	0
C02	2	2	2	2	1	3	1	3	1	0	1	0	2	0	0	1
C03	2	1	2	1	1	1	1	1	1	1	0	0	1	0	0	0
C04	3	3	3	3	2	2	3	2	3	0	2	0	3	0	0	2
C05	1	1	1	1	1	1	1	1	1	0	0	0	1	0	N/A	0
C06	1	1	1	1	1	1	1	1	N/A	0	N/A	0	N/A	0	N/A	0
C08	1	1	1	1	1	1	1	1	1	0	0	0	1	0	2	0
C09	1	2	1	2	2	1	2	2	2	0	0	0	2	0	1	0
C10	1	2	1	2	1	1	1	1	1	0	0	0	1	0	0	2

*Note: *assessment from conversational speech,** assessment from whole speech sample, N/A: not available, Hypernasality: 1=normal, 2=mild, 3=moderate, 4=severe, Audible nasal air emission/nasal: 1=within normal limits/None, 2=intermittent or variable, 3=frequent or pervasive, Voice: 0=normal, 1=abnormal, Understandability: 0=speech is always easy to understand, 1=speech is occasionally hard to understand, 2=speech is often hard to understand, 3=speech is hard to understand most or all of the time, Acceptability: 0=within normal limits: Speech is normal; 1=speech deviates from normal to a mild degree, 2=speech deviates from normal to a moderate degree, 3=speech deviates from normal to a severe, Facial Grimace: 0=none, 1=Ala, 2=nasal bridge, 3=forehead.*

Individual pre- and post-articulation patterns were quantified and presented in Table 4. Table 5 displayed the overall percentage of pre- and post-articulation patterns. Pre- and post-articulation numbers of all children with CP±L were shown in Table 6.

Table 4. Individual pre- and post- articulation pattern.

No.	Words		Sentences		Screening	
	Pre-	Post-	Pre-	Post-	Pre-	Post-
C01	/p/ for /b/, /s/ for /z/, /m/ for /hm/, n/ for /hn/, /ŋ/ for /hŋ/, /w/ for /hw/, /l/ for /hl/, /j/ for /hj/	-	/p/ for /b/, /s/ for /z/, /m/ for /hm/, /n/ for /hn/, /ŋ/ for /hŋ/, /w/ for /hw/, /l/ for /hl/, /j/ for /hj/	-	/s/ for /z/	-
C02	/p/ for /b/, /t/ for /θ/, /t/ for /d/, /c/ for /j/, /k/ for /g/, /s/ for /sh/, /s/ for /z/, /m/ for /hm/, /n/ for /hn/, /ŋ/ for /hŋ/, /ŋ/ for /hj/, /w/ for /hw/, /l/ for /hl/,	NAE(z)	/p/ for /b/, /t/ for /d/, /c/ for /j/, /k/ for /g/, /s/ for /ch/, /s/ for /sh/, /s/ for /z/, /m/ for /hm/, /n/ for /hn/, /ŋ/ for /hŋ/, /l/ for /hl/, /j/ for /hj/, /-yo/ for /ɛ/,	NAE(z,s,hs	/k/ for /g/, /c/ for /j/, /s/ for /ch/, /s/ for /sh/, /s/ for /z/, /m/ for /hm/, /n/ for /hn/, /ŋ/ for /hŋ/, /l/ for /hl/,	/s/ for /sh/, /s/ for /ch/, NAE(z)(2)
C03	/m/ for /hm/, /n/ for /hn/, /ŋ/ for /hŋ/, /w/ for /hw/, /l/ for /hl/,	-	/m/ for /hm/, /n/ for /hn/, /ŋ/ for /hŋ/, /w/ for /hw/, /l/ for /hl/,	-	/n/ for /hn/, /ŋ/ for /hŋ/, /ɲ/ for /hɲ/, /l/ for /hl/	-
C04	/p/ for /b/, /t/ for /s/, /ʔ/ for /th/, /ʔd/ for /d/, /ʔNE/ for /kh/, /ʔ/ for /hs/, /n/ for /hl/, /n/ for /l/, /ŋ/ for /k/, /ŋ/ for /g/, /j/ for /c/, /j/ for /ch/, /j/ for /sh/, /jNE/ for /j/, /jNE/ for /z/, NE for /ph/	/c/ for /j/, /kʔ/ for /g/	/t, /ʔc/ for /s/, /t/, /ʔNE/ for /th/, /c/, /ʔ/ for /ch/, /ʔ/ for /hs/, /ʔt/ for /θ/, /ʔd/ for /d/, /ʔc, /j/ for /sh/, /ʔw/ for /hw/, /n/ for /hl/, /n/ for /l/, /ŋ/ for /k/, /ŋ/ for /kh/, /ŋ/ for /g/, /j/ for /c/, /j/ for /z/, NE for /ph/	/c/ for /j/, Dental lisping, N(h), /kʔ/ for /g/	dental lisplisping, /t/ for /sh/, /ʔ/ for /t/, /ʔ/ for /d/, /ʔ/ for /n/, /ʔt/ for /s/, /h/ for /th/, /m/ for /hm/, /n/for /d/, /n/ for /hl/, /ŋ/ for /d/, /ŋ/ for /k/, /ɲ/ for /z/, /ɲ/ for /sh/, /ɲ/ for /c/, /ɲ/ for /ch/, /y/ for /d/, /y/ for /ch/,	WPC(c,th), N(c), /s/ for /z/, (1)
C05	/ʔg/ for /g/, /l/ for /hl/	-	/ʔg/ for /g/, /ch/ for /hs/, /s/ for /sh/, /m/ for /hm/, /ŋ/ for /hŋ/, /l/ for /hl/	-	/t/ for /θ/, /chs/ for /s/, /s/ for /z/, /m/ for /hm/, /mɣ/ for /ɲ/, /n/ for /hn/, /ŋ/ for /hŋ/, /ɲ/ for /hɲ/, /l/ for /y/, /l/ for /hl/,	-

Table 4. Individual pre- and post- articulation pattern (continued).

No.	Words		Sentences		Screening	
	Pre-	Post-	Pre-	Post-	Pre-	Post-
C06	/t/ for /θ/, /t/ for /d/, /c/ for /j/, /ch/ for /sh/, /s/ for /hs/, /s/ for /z/, /m/ for /hm/, /n/ for /hn/, /ŋ/ for /hŋ/, /ŋ/ for /hj/, /w/ for /hw/, /l/ for /hl/	-	/th/ for /d/, /c/ for /j/, /ch/ for /sh/, /k/ for /g/, /s/ for /z/, /m/ for /hm/, /n/ for /hn/, /ŋ/ for /hŋ/, /ŋ/ for /hj/, /w/ for /hw/, /l/ for /hl/	/ch/ for /sh/	/k/ for /g/, /m/ for /hm/, /n/ for /hn/, /ŋ/ for /hŋ/, /ɲ/ for /hɲ/, /l/ for /hl/, /y/ for /ɲ/	-
C08	/p/ for /b/, /t/ for /d/, /t/ for /θ/, /n/ for /hn/, /w/ for /hw/, /l/ for /hl/	-	/p/ for /b/, /t/ for /d/, /t/ for /θ/, /s/ for /z/, /m/ for /hm/, /ŋ/ for /hŋ/, /w/ for /hw/,	-	/s/ for /z/, /n/ for /hn/	-
C09	/p/ for /b/, /t/ for /θ/, /t/ for /d/, /l/ for /hl/, NT for /hs/, NT for /z/	-	/p/ for /b/, /t/ for /θ/, /t/ for /d/, /ch/ for /sh/, /s/, NT for /z/, /n/ for /hn/, /ŋ/ for /hŋ/, /l/ for /hl/, NT for /s/, NT for /hs/	NAE(hs)	/s/ for /z/, /m/ for /hm/, /n/ for /hn/, /ŋ/ for /hŋ/, /l/ for /hl/,	NAE(z)
C10	/t/ for /θ/, /L/ for /ch/, /L/ for /hs/	-	/t/ for /θ/, L for /ch/, L for /hs/	N(c)	/sh/ for /ch/	-

Note: NAE: nasal air emission, N: nasalization, NT: nasal turbulence.

Table 5. Overall percentage of pre- and post-articulation patterns*

Pattern		Word level				Sentence level				Screening/connected speech			
		Pre		Post		Pre		Post		Pre		Post	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Normal		-	-	8	88.9	-	-	**7**	**77.**8	-	-	**7**	**77.**8
Pharyngeal		1	2.1	-	-	-	-	-	-	-	-	-	-
Glottal		1	2.1	-	-	1	2.1	-	-	1	2.1	-	-
Mid-dorsum palatal		1	2.1	-	-	2	22.2	-	-	-	-	-	-
Nasalization		-	-	-	-	-		2	22.2	-	-	1	2.1
Nasal consonant for oral pressure consonant		1	2.1	-	-	1	2.1			-	-	1	2.1
Phonological error	V/VL	8	88.9	-	-	8	88.89			6	66.67	-	-
	VL/V	5	55.6			6	66.7			2	22.2	1	2.1
Functional/other oral misarticulation		8	88.9	1	2.1	9	100	1	2.1	4	44.4	2	22.2
Dental lisping		2	22.2	-	-	2	22.2	1	2.1	-	-	-	-
Coarticulation		2	22.2	1	2.1	2	22.2	1	2.1	2	22.2	-	-
Lateralization		1	2.1	-	-	1	2.1	-	-	-	-	-	-
Weak pressure consonant		-	-	-	-	-	-	-	-	-	-	1	2.1

*Note: V/VL: voice substitute voiceless, *: overall articulation pattern in all participants.*

Table 6. Number of pre- and post-articulation errors.

No.	Word		Sentence		Screening	
	Pre	Post	Pre	Post	Pre	Post
C01	8	0	8	0	1	0
C02	13	0	13	0	9	2
C03	5	0	5	0	4	0
C04	15	2	17	2	24	1
C05	2	0	6	0	10	0
C06	12	0	11	1	7	0
C08	6	0	7	0	2	0
C09	3	0	8	0	5	0
C10	3	0	3	0	1	0

** Number of articulation errors in each child*

In this study, common articulation substitution was voiceless substituted for voice such as /p/ for /b/, /t/ for /d/. C04, C02, and C6 had orderly the most severe articulation errors at the pre-articulation period.

Phonological errors and functional articulation errors were common the pattern in children with CP±L in this study at both pre-articulation and post-articulation tests.

C01, C03, C05, C08. C09 and C10 had normal articulation at all levels of tests (word, sentence, and screening or connected speech level) at the end of a project.

The medians of numbers of articulation errors between pre- and post-articulation tests were analyzed by the Wilcoxon signed-rank test. Results showed significant reductions in the number of articulation errors after running the model for 1 year (Table 7).

Table 7 Median difference of pre- and post-articulation disorders.

(N=9)	Median		Min, Max		Median difference	95% CI	*p* value
	Pre	Post	Pre	Post			
Screening/connected speech	6	0	1-24	0-2	6	5.2-9.2	<0.001
Word	8	0	2-15	0-2	8	6.4-10.8	<0.001
Sentence	5	0	3-17	0-2	5	4.2-8.3	<0.001

Note: 95% CI: 95 % Confident interval, # : comparison of the number pre- and post- articulation errors

Discussion

Rates of speech defects in Table 3 support the prevalence of speech disorders.[5-7, 9, 20] After 1 year of treatment, these speech characteristics had significant improvement (Table 3-6) except hypernasality and audible nasal emission because this project focused on speech correction for CAD.

The most error patterns of articulation were nasal voice substitution for voicelessness (e.g., /m/for /hm/, /n/ for /hn/, /ŋ/ for /hŋ/) and these were very common in Burmese articulation patterns because most sounds of Burmese are nasalized, and it wasn't a common cleft speech characteristic. Correct placement and articulation resulted in a reduction of nasal resonance in some children; this was a similar result to a previous study that provided 6 hours of individualized speech therapy in 3 or 4 days and resulted in progression of nasalance values and/or articulation.[30] Some children had more severe hypernasality (C09 and C10) after speech therapy while they had significant improvement in the number of articulation errors or some children had no residual articulation defects in all of the standard tests in word, sentence levels, and screening/ connected speech tests. Regarding more hypernasality, it is possible that speech therapy focuses on placement correction that changes the articulation valve and proportion of acoustic energy of the oral and nasal cavity such as when corrected /ʔ/ to /b/, placement changed from vocal cord to bilabial that makes high-pressure acoustic energy from vocal cord passed velopharyngeal valve to be a bilabial valve. It has more opportunity to leak into the nasal cavity resulting in more hypernasality.

Regarding articulation patterns, the summation of articulation patterns in each child and displayed as percentages. Articulation patterns presented that phonological errors were the most common patterns (Table 5). Similar to previous studies found that phonological error was one of the common patterns in children with CP±L[31] because they had delayed phonological development. On the other hand, the errors of retraction/backing of alveolar target consonants to a velar place of articulation occurred frequently, these were supported by previous studies.[5,20,32,33] Phonological and traditional approaches including placement and manner of articulation techniques might solve these errors in this study. After applying STV for children with CP±L, 77.78-88.88% had normal articulation patterns (Table 5). Only 1 or 2 children still had 1-2 error patterns in phonological errors and functional articulation disorders. Table 4 indicated that they had more severe articulation errors (C02, C04, C06) and might need a longer period of speech training. Patterns of articulation errors had improved. Pharyngeal (e.g., /h/ for /tʰ/; /h/ for /n/), glottal (e.g., /ʔ/ for /tʰ/; /ʔ/

for /n/), mid-dorsum palatal (e.g., /j/ for /c/ ;/j/ for /hŋ/) substitutions, nasalization, nasal consonant for oral reassure consonant (e.g., /ɲ/ for /c/; /ɲ/ for /sh,z/), and phonological errors were reduced. Most glottal and coarticulation with glottal substitution, (e.g., /ʔ/ for /tʰ/, /ʔd/ for /d/, /ʤ/ for /c/, /ʔt// for /θ/, /t,ʔ for /tʰ/), were corrected to be the right placement in oral sounds (e.g., /t/, /d/, /c/, /θ/) after 1-year of speech therapy. However, Table 3 presented that there was increasing of nasalization in sentence level from post-tests of standard and screening tests. This indicated that after correction placement, it might affect to manner of articulation from coarticulation of speech organs (combination of articulators below velopharyngeal valve and oral sounds) to be oral or correct sounds (e.g., correction of /ʔd/ to be /d/ and /ʔc/ to be /c/), it could be higher oral pressure and easier leak to nasal cavity to be nasalization. Because the sound pressure of placement below the velopharyngeal valve (/ʔ/) disappeared from the correction placement of /d/ and /c/. It made acoustic energy of /d/ and /c/ directly flow to the oral via the VP valve and leak from the nasal cavity to the oral cavity. Therefore, it was possible to have increasing of the more nasalization and hypernasality after therapy.

The number of articulation errors decreased in most of the speech characteristics (Table 3-6). Comparison of the numbers of pre-and post-articulation errors by the Wilcoxon Signed-Rank Test that presented medians of the post-articulation numbers significantly less than pre-articulation numbers (Table 7). Similar to previous models,[10,14,18,21,34,35] these findings supported that there were several models or methods of solving problems about limitations of SLPs and speech services.

STV is similar to the speech therapy model for patients with cleft palate in Lao People's Democratic Republic: lack of speech services but speech volunteers were not health care providers and performed speech correction at home or primary health care unit.[16] This STV presented that local non-healthcare providers or speech volunteers could facilitate speech correction under the monitoring of SLPs. In summary, STV presented the speech intervention via facilitation from speech volunteers and local non-government organization (NGO) networking and support as an effective way to improve speech defects in children with CP±L in Myanmar, a developing country lacking speech service.

Limitations of study

A limitation of the study was the small sample size. This study recruited all children with CP±L in Tachileik and the surrounding area who received lip and/or palate repair. The result was a primary study in which future research should enroll more participants for generalization.

Conclusion

The STV significantly decreased the number of articulation errors or CAD and improved other speech defects in Myanmar children with CP±L, who lack speech therapy service.

Conflict of interest

There are no potential conflicts of interest to declare.

Ethic approval

According to the Helsinki Declaration (HE601372), the Ethics Committee for Human Research, Khon Kaen University reviewed and approved (Oct 24, 2018) the protocols.

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