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Speech therapy model for patients with cleft palate in Lao People's Democratic Republic: Lack of speech services

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ABSTRACT

Background: A majority of children with cleft lip and palate (CLP) have persistent speech and language problems after repair. Speech services are critically needed for these children in some developing countries where there is a lack of or no speech services. This includes the Lao People's Democratic Republic (LPDR) where accessibility to speech therapy is not an attainable medical specialty.

Objective: To establish and determine the effectiveness of speech therapy model in reduction of the number of articulation errors for children with CLP in LPDR where these services are lacking.

Methods: Speech therapy for children with CLP in LPDR by using the adapted Khon Kaen University Speech Therapy Model based on combining the principles of Community-Based Rehabilitation (CBR), Primary Health Care (PHC) and institutional medical approaches was provided for children with CLP in Bokeo, LPDR. Twelve children with CLP (3.6–16 years) were recruited for this study. Demonstration and teaching services for both speech assistants (SAs), who were local health care providers, and caregivers were performed in 3-day intensive speech camps. Three 1-day follow-up speech camps and 3 site visits were conducted by Thai speech and language pathologists (TSLPs) and their teams. SAs provided speech correction at local health care units based on TSLPs' individual monitoring and supervision. Caregivers practiced assigned exercises at home. Speech Therapy Model in LPDR was undertaken for 1 year.

Results: The Speech Therapy Model in LPDR was one of the effective models and significantly reduced number of articulatory errors (mean difference = 6.42; 95% confidence interval = 3.01, 9.83).

1. Introduction

Cleft palate with or without lip defects (CLP) affects approximately 1 in 750 live births around the world [1]. The prevalence varies according to race/ethnicity, sex, and cleft type. A similar incidence rate of CLP in Arab populations found a prevalence that was 1.39/1000 live births in Jordan [2] and 1.50/1000 live births in Oman [3]. Prevalence, however, was high in some developing countries such as 2.19/1000 live births in Saudi Arabia [4] and ranged from 0.58 to 2.49/1000 live births, particularly in northeastern, Thailand [5–7]. Most recent studies have shown the highest prevalence of CLP, compared with cleft palate only [2,3,8]. The prevalence rates presented a racial variation with a low prevalence among blacks and a higher prevalence among Asians, whereas the caucasian prevalence was between 0.58 and 2.49/1000 live births. Cleft palate had a higher prevalence in girls, while cleft lip and

palate mainly affected boys [2].

Surgery is the first line for management of CLP. There are 3 main outcomes of treatments including good or normal configuration, speech, and quality of life (QoL). Previous studies found that after configuration treatment, however, the prevalence of speech abnormalities including compensatory articulation disorders (CAD), resonance disorders, voice disorders, hearing loss, and intelligibility were residual defects. CAD was at a very high rate that ranged from 74 to 88.56% [9,10]. Speech remediation is critically necessary for children with CLP. Most of these children in the LPDR had no access to speech services due to a lack of a speech and language pathologist (SLP) or a limitation of speech services in this and other developing countries. This has a negative impact on communication in daily life and QoL. There have been several models and strategies developed to face these critical problems that have been provided by both local and international government services and

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non-governmental organizations in some developing countries including, Sri Lanka [11,12], Vietnam [13], Indonesia [14], Mexico [15, 16] and India [17].

Even though, prevalence of CLP in LPDR was not high, around 0.02/1000 live births [18], there were no speech services to remedy the social stigma from speech abnormalities or CAD. Therefore, it was of critical concern to provide speech therapy for children in LPDR. There was no speech service due to lacking professionals in LPDR. Challenges in the delivery of speech therapy model in LPDR and correction speech characteristics for children with CLP should critically be focused. Therefore, establishment of speech therapy model in LPDR, adapted from the Khon Kaen Community-Based Speech Therapy Model [19,20], was planned to process [21]. The aims of this study were to: 1) delivery the Speech Therapy Model; and 2) investigate the effectiveness of the speech therapy model on reduction of the number of articulation errors for patients with CLP in LPDR, where a lack of speech services existed.

2. Materials and methods

According to the Helsinki Declaration (HE571181), the Ethics Committee for Human Research of Khon Kaen University reviewed and approved the research protocols (June 17, 2014).

2.1. Establishing the model

A Speech Therapy Model for Patients with Cleft Palate in LPDR was established based on an area context and adapted from the original model, the Khon Kaen University Speech Therapy Model, which combined the principles of Community-Based Rehabilitation (CBR), Primary Health Care (PHC) and institutional medical approaches [19–21]. The local primary health care unit in the nearest areas to children with CLP's home was the local speech service for individual speech correction (SC), the Bokeo Provincial Hospital provided hospitality for an intensive speech camp and follow-up speech camps. Local health care administrators accepted and supported the model.

Investigation of the effectiveness of the speech therapy model.

2.2. Participants

Inclusion criteria: Children with CLP who lived in Bokeo or the near area, who had CLP repaired in the Overbrook Hospital, Chaing Rai, Thailand. All children were of a poor economic status and had an arrangement within the Northern Woman's Development Foundation's organization.

Exclusion criteria: Children with CLP who other mobility issues, e.g. global delay development, cerebral palsy, autism or could not attend all speech camps.

Twenty children with CLP, ages 3.6–16 years, were enrolled in this study. After a pre-articulation test, the LPDR Universal Parameters of Speech Outcomes for People with Cleft Palate, which was developed under guidelines of Thai Universal Parameters of Speech Outcomes for People with Cleft Palate [22] and based on the guidelines for establishment of speech outcomes for individuals with CLP was administered [23]. Eight children were excluded from this study because 7 children with CLP had no articulation errors and 1 child was of a minority and showed selective mutism with no cooperation. The remaining 12 children with CLP, along with their parents or caregivers were registered in this project. All participants were enrolled in this study with written consent.

Ten Laotian nurses, who worked in local health care units and lived near the children with CLP, were recruited as speech assistants (SAs) in this study. Two SAs withdrew from this study because of moving to work in other cities and were then not available to take care of selected children. Eight SAs were rearranged in order to provide SC for children with CLP.

Setting: A three-day intensive speech camp and 3, 1-day follow-up

speech camps were organized in cooperation with Bokeo Hospital, LPDR, opposite Chaing Rai, Thailand. Three site visits for monitoring SC by Thai speech and language pathologists (TSLPs) and teams were done at local health care units, near the homes of children with CLP.

All children were assessed by 2 qualified TSLPs (1st and 4th authors) and co-evaluators included a native Laotian health care provider, caregiver and SAs for baseline parameters and post articulation tests. Consensus among evaluators was determined for the final report. Examinations and assessments included;

- Oral examination and facial grimace
- Standard LPDR Universal Parameters of Speech Outcomes for People with Cleft Palate were used for eliciting articulation errors in children with CLP. Laotian and Northeast Thai languages are quite the same. This test was adapted from the same concept as the Thai Speech Parameters for Patients with Cleft Palate in a Universal Reporting System (The percentage of agreement among evaluators ranged from 43.75 to 100. Thirty percent of the proportion of positives ranged from 0.70 to 1. Thirteen percent of proportion of negatives ranged from 0.70 to 1). There are 21 initial consonants and 6 final sounds in the Lao language that are the same as in the Northeast Thai language There were 2 senior Thai SLP assessors who had experience with CLP for more than 30 years. One assessor came from the original Northeast Thai language area and understood Lao language very well. The articulation errors were in agreement of these assessors and native Laotian co-evaluators for consensus. Speech characteristics were assessed as follows:
 - Intelligibility
 - Articulation
 - Resonance
 - Nasal emission/nasal turbulence
 - Voice

For language screening tests, the Adapted Early Language Milestones [24] test was performed with CLP children ages ≤ 4 years and the UTAH language test for children with CLP, age > 4 years [25].

For the first day of intensive speech camp, investigators gave active lectures providing basic knowledge for SC in CLP to SAs, caregivers and support teams. A Pre-test and Post-knowledge test (post-test 1) were provided for SAs after lectures. The process of Speech Therapy Model in LPDR and manuals of documents were introduced and included for participants and support teams:

- 1) Laotian manual of speech and language therapy for Children with Cleft palate [26].
- 2) Laotian Exercises for Articulation Correction [27].
- 3) Daily Home Record of Speech Correction [28].

These documents were translated and endorsed by the Lao Information Center of the Cultural Center of Khon Kaen University and information about Thai-Laos relationships.

2.3. Intensive speech camp

After assessment session, children were provided with speech therapy. Six 45-min sessions/day with 15-min breaks for snacks for individuals or groups of children with CLP in each 5 stations of speech therapy by TSLPs. TSLPs performed teaching services for SAs and caregivers in each session. Even though all of participants could understand Thai very well, there were SAs who understood Thai very well who facilitated teaching in speech therapy (Lao people watch Thai television every day). Two or three children with CLP attended each speech therapy station. Children who did not attend speech therapy sessions, stayed and enjoyed activities for recreation and art.

2.4. Follow-up speech camps

Three 1-day follow-up speech camps were run every 4 months with site visits over a one year period. Similar to the intensive speech camps, children were provided speech therapy. Six 45-min sessions/day with 15-min breaks for snacks for individuals or groups of children with CLP in each 5 stations of speech therapy by TSLPs.

Post-articulation tests for children with CLP and post-knowledge tests (post-test 2) for SAs were done for both SAs and caregivers at the end of the 1-year project.

SC by SAs and caregivers performed in community or home-based settings. Each of the SAs was assigned 1–2 children with CLP for SC, depending on geographic matching and convenience of children's accessibilities. SLPs trained SAs and caregivers for SC. SAs and caregivers had to attend speech therapy sessions for their children and were assigned home exercises. SAs and caregivers needed to fill in the Daily Home Record of Speech Correction when they gave SC or exercises.

During each 1-day follow-up speech camps and site visits, separate meetings for SAs and caregivers were held for discussions and problem solving about home speech therapy. The Daily Home Records of Speech Correction were checked for monitoring SCs and providing transportation compensation for SAs. Each Daily Home Record of Speech Correction was quantified and used for feedback as well as for monitoring SC. The post articulation tests were performed for numbers of articulation errors. Satisfaction questionnaires were filled out by SAs and caregivers at the end of the project. Scores were rated using a scale: 1 = the least; 2 = less; 3 = fair; 4 = good; 5 = excellent on issues of transportation, food provision, hospitality, cooperation, process of the project, and summary of the project.

2.5. Statistical analysis

The main outcome was the number of articulation defects calculated from pre- and post-speech camps. Language ability was scored as pass and delayed. Perceptual assessments were scored parameters of speech outcomes including:

A) Resonance: normal (0), hyponasality (–1), mild hypernasality (1), moderate hypernasality (2), severe hypernasality (3);

B) Speech Understandability from conversational speech within normal limits: speech is always easy to understand (0), speech is occasionally hard to understand (1); speech is often hard to understand (2); speech is hard to understand most or all of the time (3).

C) Speech acceptability. Whole speech samples: within normal limits: speech is normal (0); speech deviates from normal to a mild degree (1); speech deviates from normal to a moderate degree (2); speech deviates from normal to a severe degree (3).

D) Voice assessment: normal (0), abnormal (1). Scores were ranged from mild (1), moderate (2), or severe (3) based on 6 parameters of grading, instability, roughness, breathiness, asthenia, and strained vocalization (total score of 6 parameters 0 = normal voice; ≥ 1 = abnormal voice).

Oral examinations described characteristics of oronasal configurations: facial grimace was scored as 1: a wrinkle in the floor of the nose ala; 2: a wrinkle in the bridge of the nose; and 3: a frown and wrinkle in the forehead.

Descriptive data analyses were performed. Wilcoxon Signed-Rank Test was used to demonstrate the effectiveness of Speech Therapy Model for children with CLP in LPDR by comparing the number of pre- and post-articulation errors in children with CLP.

3. Results

Speech Therapy Model in LPDR was established by cooperation among Laotian local paraprofessionals, the local hospital, professionals from the lead institution (TSLPs), and a non-profit organization, the Northern Woman's Development Foundation. A 4-day intensive speech

camp and 3 follow-up speech camps were provided for SC by SAs and caregivers in community or home-based settings. This model was carried out for 1 year.

General characteristics are displayed in Table 1. Fifty percent of participants were females. Five participants used non-Laotian or minority languages for daily life communication. Five of them had heredity of CLP. One child had another abnormality (left eye squint). Seven children with CLP had no formal education.

Most caregivers were parents but 1 caregiver was the grandmother. Half of caregivers' occupations were agriculture, 2 of them were employees, and 2 were housekeepers. Fifty percent of families had income <5000 Baht/month or approximately US\$ 166/month. Two of them had an income of 5000–10,000 Baht/month.

Perceptual speech and language assessments by LPDR Universal Parameters of Speech Outcomes for People with Cleft Palate are displayed in Table 2.

According to the articulation test at a word level, the numbers of pre- and post-articulation errors are presented as Table 3. To determine the effectiveness of speech therapy model in LPDR, the Wilcoxon Sign Rank Test was performed to statistically detect significant median differences between pre- and post-articulation numbers (Table 4).

For articulation types, Table 5 displays improvement of articulation patterns from articulation placement of backing oral (e.g. velar sounds) or beyond oral placement (e.g. pharyngeal or glottal sounds) to be more a type of normal oral placement.

Information about SC that SAs and caregivers acquired during 1 year using knowledge scores with pre- and post-tests are displayed in Table 6.

Regarding rating scores of satisfaction on topics of transportation, food provision, hospitality, cooperation, process of the project, and summary of the project, most SAs (75–100%) scored satisfaction for speech therapy model for children with CLP as 4–5 (good-excellent). A majority of caregivers (91–100%) also scored satisfaction on these topics for speech therapy model for children with CLP as 4–5 (good-excellent).

4. Discussion

The delivery of the speech therapy model for children with CLP in LPDR was processed. This model was applied under organization of 5 local health care units (primary health care units), 1 provincial hospital in LPDR, and Institutions in Thailand. SAs, health care providers or paraprofessionals from primary health care units, facilitators from provincial hospital in LPDR, and TSLPs from tertiary health care unit in Thailand involved speech therapy model within Non-profit organization's arrangement (Northern Women's Development Foundation). Twelve children with CLP (6 males and 6 females) were participants. Eight of them were left CLP, 3 bilateral CLP, and 1 Cleft palate. Most children with CLP used official Laotian language for daily life communication. Laotian is very similar to Thai and all caregivers and SAs could understand Thai language very well because they daily learned from and watched Thai television. One principle investigator could speak the northeast Thai language that is very similar to Laotian. There were also local Laotian volunteers who were health care providers. SAs could perfectly speak both Laotian and Thai. There were 3 families who used Hmong, and 2 used Khmu in daily life communication. These children were provided speech therapy using official Laotian. Local Laotian volunteers or health care providers, SAs and caregivers helped in cases when they had difficulty in understanding Thai language which TSLPs used for teaching services for SAs and caregivers. On the other hand, SAs and caregivers could practice SC in Laotian and Thai SLPs could understand Laotian very well.

Resolving the challenges in the speech therapy model in LPDR, was based on many factors e.g., illiteracy (7 of 12 children had no formal education), dialects of Hmong, and Khmu, long distances to access local care units, where SAs worked and provided SC; some children took 4–6 h to visit the local health care unit. This was in addition to limitations of time of SAs' service because all SAs had a responsibility to their main

Table 1
General characteristics of children with CLP.

Code	Gender	Age (Year; Month)		Cleft Type	Other Abnormal.	Family history	Native language	Education
		Pre-	Post					
L002	Female	4; 8	5; 7	Left Cleft lip and palate	No	No	Laotian	Kindergarten
L003	Male	5; 3	6; 3	Left Cleft lip and palate	No	No	Hmong	No formal education
L004	Female	3; 6	4; 6	Bilateral Cleft lip and palate	No	Yes (mother)	Laotian	No formal education
L007	Male	16; 0	17; 0	Left Cleft lip and palate	Left eye squint	No	Hmong	Secondary school
L009	Female	6; 10	7; 9	Left Cleft lip and palate	No	Yes (cousin)	Laotian	Primary school
L012	Female	3; 7	4; 6	Left Cleft lip and palate	No	No	Laotian	Primary school
L013	Male	3; 6	4; 5	Left Cleft lip and palate	No	No	Laotian	No formal education
L014	Female	15; 3	16; 3	Bilateral Cleft lip and palate	No	Yes (Mother and brother)	Laotian	No formal education
L015	Male	7; 4	8; 4	Left Cleft lip and palate	No	No	Hmong	No formal education
L016	Male	4; 1	5; 1	Bilateral Cleft lip and palate	No	Yes (grandmother)	Khmu	No formal education
L020	Female	4.1	5; 1	Left Cleft lip and palate	No	Yes (uncle)	Khmu	No formal education
L024	Male	9; 9	10; 9	Cleft Palate	No	No	Laotian	Primary school

Table 2
Perceptual assessment for some characteristics of speech and language.

Code	Language ^a		Resonance ^b		Understandability ^c		Acceptability ^d		Voice ^e		Facial Grimace ^f	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
L002	1	0	0	0	0	0	0	0	0	0	0	0
L003	0	1	0	0	0	1	1	1	0	0	0	0
L004	1	0	0	0	1	0	1	0	0	0	0	0
L007	1	1	3	3	3	2	3	2	0	0	1	2
L009	0	1	0	0	1	1	1	1	0	0	0	0
L012	0	0	0	0	0	0	1	0	0	0	0	0
L013	0	0	0	-1	0	0	1	1	0	0	0	0
L014	0	1	0	0	1	0	1	1	0	0	0	0
L015	1	1	2	3	2	2	2	3	0	0	2	2
L016	1	1	2	2	2	3	2	3	1	1	1	0
L020	1	N/A	3	N/A	3	N/A	3	N/A	0	N/A	1	N/A
L024	1	1	2	0	2	0	2	0	1	0	3	0

Pre: Pre-test; Post: Post-test; N/A: not available.

^a 1 = normal; 0 = delayed speech and language development.

^b -1 = hyponasality, 0 = normal, 1 = mild hypernasality, 2 moderate hypernasality, severe hypernasality.

^c 0 = within normal limits: 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.

^d 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 degree.

^e 0 = normal voice; ≥1 = abnormal voice. 1: a wrinkle in the floor of the nose ala; 2: a wrinkle on the bridge of the nose; and 3: a frown and wrinkle on the forehead

Table 3
Number of pre- and post-articulation errors.

Code	Number of pre-articulation errors	Number of post-articulation errors	Number of articulation error reduction
L002	2	1	1
L003	10	6	4
L004	4	1	3
L007	15	8	7
L009	5	4	1
L012	14	2	12
L013	14	2	12
L014	4	2	2
L015	18	2	16
L016	21	18	3
L020	15	2	13
L024	3	0	3

Table 4
Numbers of pre- and post-articulation errors at a word level.

(n = 12)	Mean	Min, Max	SD	Mean difference	95%CI	p-value
Pre-test	10.42	2, 21	6.57	6.42	3.01,	0.002
Post-Test	4	0, 18	4.95		9.83	

Table 5
Type of pre- and post-articulation errors.

Type of articulation	Pre-articulation test		Post-articulation test	
	Word level		Word level	
	n	%	n	%
1. Within Normal limits//None	1	2.22	4	13.79
2. Pharyngeal	5	11.11	0	0
3. Glottal	4	8.89	2	6.9
4. Mid-dorsum palatal	7	15.57	0	0
5. Velar	6	13.33	3	10.34
6. Phoneme specific	0	0	0	0
7. Not phoneme specific	0	0	0	0
8. Nasal consonant for oral pressure consonants	3	6.67	1	3.45
9. Nasalized voiced pressure consonants	2	4.44	3	10.34
10. Weak oral pressures	0	0	0	0
11. Developmental articulation error	1	2.22	10	34.48
12. Phonological error	0	0	0	0
13. Functional/Other Oral misarticulation	10	22.22	4	13.80
14. Dental lisping	4	8.89	2	6.9
15. Organic articulation disorders	2	4.44	0	0
Total	45	100	29	100

Table 6
Speech assistant and caregiver pre- and post-test knowledge scores.

Speech assistants						
Time	N	Mean	SD	Mean difference	95%CI	p-value
Pre-test	8	7.13	1.64	Pre & Post-test 1	2.50 1.87, 3.13	0.00 0.15
Post-test 1	8	9.63	1.69	Post-test 2 & Pre-test	3.13 1.81, 6.19	0.00
Post-test 2	8	11.13	2.03	Post-test 2 & Post-test1	1.50 -0.69, 3.69	
Caregivers						
Pre-test	20	5.50	1.43	3.0	2.29,	<0.001
Post-test	20	8.50	1.64		3.71	

duties as nurses that might have affected results for speech outcomes of speech therapy model for children with CLP in LPDR. Strategies therefore depended on problem-based solving from meeting a consensus that involved personnel who were in a process: the health care providers in Bokeo, health care providers in local units, SLPs, volunteers, SAs, caregivers, and the support team of the Northern Women's Development Foundation as well as regional personnel. For example, when caregivers had no available time to take children to get SC at local health care units, SAs visited them at home on holiday with transportation and compensation supported by the project. For a child who could not reach SC at local health care units due to long distance, transportation compensation was not enough for round-trip motor cycle expenses, therefore, the child's families needed to visit SCs once a month instead of twice a month. The project needed to provide more compensation for reaching the goal of SC twice a week etc. These strategies of problem solving were adapted for proper management in individual cases and in the regional context. This information as to how to manage and solve problems in speech therapy model to resolve the challenges was not simple. This experience and suggestions might help to facilitate successful speech correction by SAs and caregivers elsewhere, too. The Speech therapy Model was one of the ways that solved problems of lacking speech services which had particularly strategies to remedy based on contexts of local situation in LPDR. This model might be adapted for any country, where has similar condition. The strategies for processing the model should be applied and provided based on background, culture and contexts.

In a comparison of speech and language outcomes (Table 2), 7 children with CLP language skills had delayed both pre- and post-language tests. This included 58.33% or 7 of 12 children who had delayed speech and language development. This prevalence was in range of prevalence in delayed speech and language development in previous studies that ranged from 8.33 to 92% [10,19,29] and 49% needed speech and language therapy [29]. Children who had delayed speech and language skills were not the same ones in pre- and post-assessments. These might be language tests for pre- and post-language skills (Adapted Early Language Milestone and UTAH) that were different in each age level test. The language skill assessment was not the aim to be corrected in this article, however, language skills were investigated for prevalence of delayed language and language development and findings revealed that this problem remained for children with CLP at the end of project and the need the further intervention.

Prevalence of resonance disorders was 41.67% (5/12 children) and was in the range of resonance disorders in previous studies (range 20–43%) [10,19,30–32]. Two (L020, L024) had resolved hypernasality by the end of the project (Table 2). SC could remedy CAD, abnormal placement in response to abnormal structure that was the cause of VPI; correct placements resulted in decreased nasal resonance as well as solving air flow or too much acoustic energy that resonated in the nasal cavity [33]. This appeared that articulation therapy also provided positive results in a VPI solution in some cases in CLP who had placement

and manner errors.

For understandability and acceptability, rating scores for individual participants revealed that some children had improved, and for some there were negative effects. For improvement of acceptability in children with CLP, articulation errors decreased by SC resulting in understandability and acceptability. On the other hand, some children with CLP had more negative effects of understandability and acceptability in post-speech therapy. This might be reflected in children who had obligatory speech distortion. When correction of articulation placement was performed, it caused distortion of speech sounds due to structural interference and resulted in adverse outcomes in acceptability [33]. On the other hand, remedied CAD also reduced hypernasality by correct placement and decreased nasal resonance. Two of 12 children with CLP (16.67%) had hoarseness; this prevalence agreed with previous studies (5.5–19.13%) [10,19,34]. A child could get rid of voice disorders from vocal hygiene programs that provided treatment.

The main outcome of this research was the reduction of the number of post-articulation errors, Tables 3 and 4 present outcomes of model showing that speech therapy in LPDR using an adaptation of the Khon Kaen University Speech Therapy Model, and by combining the principles of Community-Based Rehabilitation (CBR), Primary Health Care (PHC) and institutional medical approaches that could significantly reduce articulation errors in children with CLP. Articulation types or patterns were changed and improved from backing to oral or beyond oral to be oral placement (Table 5), particularly by increasing normal patterns and getting rid of pharyngeal, mid-dorsal palatal, velar and nasal consonant replaced by oral pressure consonants. For reduction of articulation errors, Table 6 presented the significant reduction of the articulation errors in the end of the project. Possible factors that might effect on speech outcomes were children's ages that varied from 3 ½ –16 years. The highest number of reduction of articulation errors were found in younger children with CLP [children number L012 (3 years 7 months); L013 (3 and a half years); L015 (7 years 4 months); and L020 (4 years 1 month) (Tables 1 and 3) who had the number of articulation errors as 12, 12, 16, and 13 sounds, respectively. These might be possible that younger children with CLP acquired to correct target sounds earlier than older ones. However, there were many factors that were possible to effect on speech outcomes including the number of speech correction by SAs or home exercises by caregivers; environment during training at home; as well as children's attention span. Problem solving of these factors was planned and provided strategy based on local context as mentioned above. Even though there were many factors effect on the results, study revealed the good results for solving articulation errors, both number of articulation errors and types of articulation errors in children with CLP in an area where a lack of professionals prevailed. Speech therapy model could significantly change in the speech characteristics of the children with CLP to better outcome and give positive results on quality of life and communication.

SAs and caregivers' knowledge scores also significantly improved after implementation of the model (Table 6). It could then be implied that this model was an effective way to remedy articulation errors in any region, but particularly in developing countries where a lack or limitation of speech services exists. These outcomes supported previous studies that provided speech therapy based on CBR in some areas in Thailand [19,35] and therefore might be applied to other developing countries.

Both SAs and caregivers were satisfied with the project arrangements in transportation, food, hospitality, location for speech camps and the speech camp process was rated as good to excellent. This information is useful for providing developing further projects.

5. Conclusion

A speech therapy model in LPDR based upon the existing healthcare system and regional management was an effective way to solve the lack of speech services for children with CLP and can be applied to other

areas in LPDR and developing countries where there is a paucity of speech services.

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