KHON KAEN: A COMMUNITY-BASED SPEECH THERAPY MODEL FOR AN AREA LACKING IN SPEECH SERVICES FOR CLEFTS

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Abstract. Absence of speech rehabilitation services is one of the critical difficulties in care for clefts in Thailand and some other developing countries. The objective of this study was to determine the effectiveness of the "Khon Kaen Community-Based Speech Therapy Model" in decreasing the number of articulation defects in children with cleft palate and/or lip. Sixteen children with cleft palate and/or lip in 6 districts of Maha Sarakham Province were enrolled for study. A three-day intensive speech camp was held in Srinagarind Hospital and followed by an outreach program of six one-day follow-up speech camps in Maha Sarakham Hospital. Six paraprofessionals, speech assistants, provided home- or community-based speech correction every week for one year. Numbers of various articulation errors were compared pre- and post- treatment using the Wilcoxon signed-rank test. The number of articulation defects showed a statistically significant reduction (mean difference = 10; Z =-3.52; p<0.001; 95% CI: 8-13). The "Khon Kaen Community-Based Speech Therapy Model" is one of the best models for solving speech therapy problems in areas of Thailand lacking speech services and can be applied to other developing countries.

Keywords: community - based, speech therapy, cleft, speech service, Thailand

INTRODUCTION

The worldwide incidence of cleft lip/palate is between 0.30 and 2.65/1,000 live births (Chowchuen and Godfrey, 2003). In Thailand, the incidence of cleft lip/palate is between 1.10 and 2.49/1,000 live births (Chuangsuwanich *et al*, 1998), making it a major public health concern. Interestingly, most of the affected persons live in the Northeast, where the occurrence of cleft lip/palate is about 2.49/1,000 live births each year (Chowchuen and Godfrey, 2003).

Even though surgery is the first and most critical treatment to relieve social and physical abnormalities for children with cleft palate and/or lip, the needs of patients with clefts extend beyond

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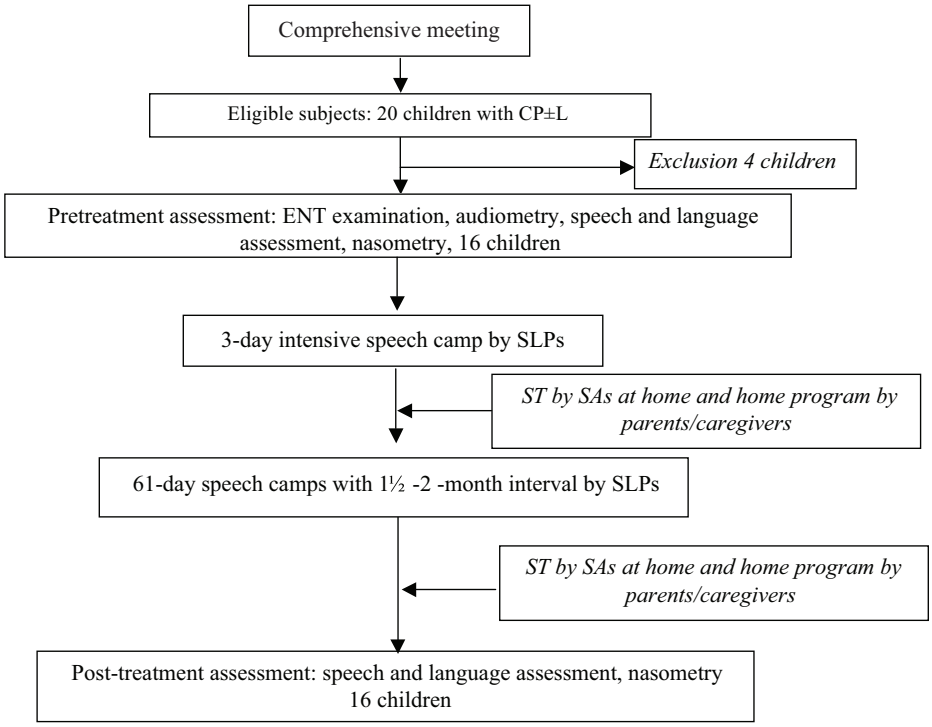
surgical repair. Once normalized in appearance from surgical remedies, such children still display secondary congenital abnormalities and require speech therapy as early as possible. Delay in providing this greatly increases the difficulty of eventual correction. A multidisciplinary approach to the care of such patients is the widely accepted standard. However, logistical and financial issues preclude this in many places, particularly in the developing world (Butler *et al*, 2011; Furr *et al,* 2011; Raposo-Amaral and Raposo-Amaral, 2012). Lack of speech and language pathologists (SLPs) and associated professionals is critical in this regard. Therefore, many alternative approaches have been established in countries such as Sri Lanka (Wirt *et al,* 1990a, b), Vietnam (Landis, 1973), Indonesia (Willcox, 1994); Mexico (Pamplona *et al*, 1999, 2005), India (D'Antonio and Nagarajan, 2003), Thailand (Prathanee *et al*, 2006; Suphawatjariyakul *et al*, 2007; Prathanee *et al*, 2011b) and Lao People's Democratic Republic (Prathanee *et al*, 2011c) have been established.

Compensatory articulation disorder (CAD) is a common behavior secondary to velopharyngeal insufficiency in cleft palate. CAD decreases intelligibility and usually requires a prolonged period of speech therapy (Pamplona and Ysunza, 2000; Pamplona *et al*, 2000; Kuehn and Henne, 2003). Reducing the effects of CAD has been a major aim of programs established in developing countries. For example, decreased articulatory defects were reported (54.32% in initial consonants; 66.57% in final consonants; and 72.31% in vowels) after a speech camp in Amnat Charoen Province, Thailand (Suphawatjariyakul *et al,* 2007). Likewise, a significant reduction in articulation errors was achieved after an initial speech camp and the follow-up session ($z = 3.11$, $p<0.01$; $z = 2.87$, $p<0.01$) in Suwannaphum District, Roi Et Province, Thailand (Prathanee *et al,* 2011b). Similar results have also been reported after speech camps in Mexico (Pamplona *et al,* 1999, 2005).

In Thailand, there are 59 qualified SLPs for cleft palate (Thai Speech and Hearing Association, 2012). Fifty-two of them are actively working, and 45 of these work in government health care units that have responsibility for an estimated 64 million people (the Thai population) (National Statistic Office Thailand, 2012). In addition to this national shortage of SLPs, the situation is particularly bad in the Northeast of Thailand, which has the highest incidence of cleft palate and only has 2 qualified SLPs, serving 21 million people. Clearly, most people with clefts cannot access speech therapy. The Community-Based Speech Therapy Model: For Children with Cleft Lip/Palate was developed by combining the principles of Community-Based Rehabilitation (CBR), Primary Health Care (PHC) and institutional medical approaches for reaching and treating speech disordered children with cleft lip and/or palate in remote areas since 2003 (Prathanee *et al,* 2006). This permitted the training of many paraprofessionals in basic knowledge related to clefts and seven speech camps from 2005-2009. These speech camps helped overcome the shortage of speech and language professionals in the short term, but longer term strategies are required, that, in Thailand, might include: 1) training of paraprofessionals to provide basic remedial speech services to individuals with clefts (Landis and Thi-Thu-Cuc, 1975; Wirt *et al,* 1990a, b); 2) encouraging engagement by parents or caregivers during speech therapy sessions, an approach known to lead to significantly better outcomes (Pamplona *et al,*



CP±L, cleft palate with or without cleft lip; ENT, ear, nose, throat; ST, Speech therapy; SAs, Speech assistants

Fig 1–Study design.

1996; Pamplona and Ysunza, 2000; Pamplona *et al*, 2001). With these approaches in mind, the "Khon Kaen Community-Based Speech Therapy Model" was established.

The aim of this study was to determine the effectiveness of the "Khon Kaen Community-Based Speech Therapy Model" in reduction of the number of articulation disorders in children with cleft palates in remote areas.

MATERIALS AND METHODS

Study design

This study was a prospective study as shown in Fig 1.

Participants

Twenty children with cleft palate with or without cleft lip (CP±L) were initially included for this study. One of them (C13) left the study because the family moved to another area, one had Treacher Collins Syndrome with deafness (C14), one had a facial cleft and global delayed development and severe delayed speech and language development (C15), and another had only a cleft lip and no articulation defects (C17). After exclusion of these four, 16 children with cleft palate and/or lip but without any other disease syndromes and aged 3½ - 8 years were included in the study (Table 1), along with their parents or caregivers. Also involved were six paraprofessionals in the role of speech assistants (SAs), one from each of the six district hospitals in the target area, Maha Sarakham Province. All children had a history of treatment in Srinargarind Hospital, Faculty of Medicine, Khon Kaen

University, Khon Kaen Thailand.

Setting

A three-day intensive speech camp was held in Srinagarind Hospital (a tertiary health care center), Khon Kaen University, Khon Kaen. Six one-day follow-up speech camps were organised in cooperation with the local provincial secondary health care center, Maha Sarakham Hospital. Speech corrections by SAs and caregivers were performed in community or home-based settings. According to the Helsinki Declaration (HE531358), the Ethics Committee of Khon Kaen University reviewed and approved (October 22, 2010) the research protocols.

There was a comprehensive meeting for health care providers in the target region and Maha Sarakham Hospital for cooperation and to find volunteers to be SAs in this study.

Children were assessed by 2 qualified SLPs (the 1st and 2nd authors) for baseline parameters including: Oral examination and facial grimace; Ear nose and throat examination, tympanogram and audiometry; Speech and language abilities with perceptual assessment of speech for cleft using the Thai Universal Parameters of Speech Outcomes for People with Cleft Palate (Prathanee *et al,* 2011a). Outcomes were summarized by consensus between the principle investigator and second author. Speech characteristics were assessed as followings: articulation; resonance; voice; intelligibility; nasal emission / turbulence; Nasometry (Nasometer II 6450, Kaypentax) was used for estimating the average nasalance scores (percentage of nasal acoustic energy/nasal + oral acoustic energy multiplied by 100) and compared to the average nasalance scores of a standard of three Thai passages including: passages entitle: 1) My house (having a mixture of oral and nasal consonants; 2) Laying Hen (devoid of nasal consonants); and 3) Winter (full of nasal consonants). The means (SD) percentage scores of these three passages in normal Thai children were 14.3 (5.8), 35.6 (5.9), and 51.1 (6.4) (Prathanee *et al,* 2003).

Language screening test (adapted Thai Early Language Milestone) (Lorwatanapongsa *et al,* 2011).

An intensive three-day speech camp was conducted at Srinagarind Hospital at the start of the study. This included lectures related to multidisciplinary approaches and speech and language therapy for cleft palate. The "Khon Kaen Community-Based Speech Therapy Model" was described. The principle investigator introduced the Manuals of: 1) Speech Correction for Children with Cleft palate: Paraprofessionals and Caregivers (Dechongkit *et al,* 2007); 2) Exercises for Articulation Correction (Pratahnee, 2010a) and; 3) Daily Home Record of Speech Correction (Prathanee, 2010b).

SAs recruited to the study included one occupational therapist, four physical therapists, and one nurse. Each took responsibility for 2-4 children, depending on geographic matching and administrative convenience. SLPs trained SAs and caregivers in methods for speech correction in individual and group intensive speech therapy (ST). SLPs observed ST by SAs and supervised the speech correction. SAs who were assigned to take care of children and caregivers attended every ST session for their assigned children. There were six stations for speech therapy by qualified SLPs and one station for relaxation, recreation and art. A nurse coordinator directed the child flow.

SLPs assigned individual home programs for SAs and caregivers. SAs visited

children's homes to assist and direct caregivers in training their children. SAs and caregivers needed to fill in the Daily Home Record of Speech Correction every time they gave speech correction assistance to their children. Researchers arranged separate meetings for SAs and caregivers for discussion of home speech therapy sessions and problems arising.

Six, one-day follow-up speech camps were run every 1½ - 2 months over a nine-month period. At these, there were four stations for ST, one station for relaxation, recreation and art, and one station for multidisciplinary team interactions. The multidisciplinary teams consisted of a nurse for providing pre- and post-operative care, a psychiatrist for developmental assessment and treatment, a dental assistant for dental care, a nurse for health education in cleft care, a nurse coordinator for giving information to support children with clefts, and a plastic surgeon for assessment and further treatment plans. Three children with cleft palates had complicated problems and were difficult to treat at home visits. The psychiatrist had additional diagnoses and suggestions for these [two boys with attention deficit hyperactivity disorders (ADHD) and a girl with selective mutism]. In addition, the principle investigator and team visited these 3 children's homes in rural areas and demonstrated how to control and provide for these children by modification of the environment.

During each one-day follow-up speech camps, the SLPs examined the Daily Home Record of Speech Correction and gave advice and feedback for both SAs and caregivers in each follow-up speech camp. Each Daily Home Record of Speech Correction was also used to select winners of an award for the best SA and for the best caregiver. These awards were presented at the last follow-up speech camp. At this time, each SA and caregiver evaluated the satisfaction of conducting the "Khon Kaen Community-Based Speech Therapy Model" by completion of a form and through group discussion. Assessments of each child's speech and language outcomes were performed 1½ months after the last speech camp.

Statistical analysis

The main outcome was the difference in the number of articulation defects calculated from pre- and post-speech camps. Oral examination 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. Perceptual assessments were also scored: resonance as normal (0), hyponasality (-1), mild hypernasality (+1), moderate hypernasality (+2), severe hypernasality (+3); nasal emission / turbulence as none, visible or audible; voice as normal and abnormal; intelligibility as intelligible, intelligible if the topic is known, unintelligible; language was scored as pass and delay, and nasometry produced a percentage of the nasalance score.

Data analyses were performed by using numbers and percentages. Wilcoxon signed-rank test was used to demonstrate the effectiveness of "Khon Kaen Community-Based Speech Therapy Model" by comparing the number of pre- and post-articulation errors in children with cleft palate.

RESULTS

Sixteen children with lip or/and palate clefts were included in the study (Table 1).

Table 1
Demographic characteristics of children with cleft lip or/and palate.

Patient No.	Age yy/mm	Gender	Cleft type	Age at chieloplasty yy/mm	Age at palatoplasty yy/mm
C 01	5/01	Female	Lt CLP	0/03	0/11
C 02	4/06	Female	CP	N/A	1/00
C 03*,a	4/01	Female	Lt CLP	0/03	0/09
C 04	4/05	Male	Bilat CLP	0/03	0/09
C 05b	5/03	Male	Lt CLP	0/03	0/09
C 06	5/09	Female	Lt CLP	N/A	N/A
C 07	5/00	Female	CP	N/A	1/00
C 08	7/01	Male	CP	N/A	2/00
C 09	7/07	Male	CP	N/A	0/09
C 10	7/08	Female	Lt CLP	0/03	0/06
C 11b	4/03	Male	Bilat CLP	0/04	1/00
C 12	4/04	Male	Lt CLP	0/03	1st time:0/09 2nd time:1/09
C 16	7/01	Male	Bilat CLP	0/03	1/01
C 18	8/00	Male	CP	N/A	1/00
C 19	6/11	Female	CP	N/A	1/00
C 20	6/01	Male	Lt CLP	0/03	2/00

*Nose/lip correction at 4/00; aSelective mutism; bAttention deficit hyperactivity disorders; Lt, Left; RT, Right; CP, Cleft lip; CPL, Cleft lip and palate; Bilat, Bilateral; N/A, not available, caregivers had no information; yy, year; mm, month.

Ear, nose, and throat examination and hearing evaluation

An ear nose and throat examination was performed by a physician. An audiologist assessed hearing using audiometry (Audiometer: acoustic analyzer 1200) (average pure tone 500-2000 Hz) and tympanometry. Sixteen children were assessed and a summary of their hearing levels is provided in Table 2. Two of them presented with an ear problem and had mild conductive hearing loss and one presented an ear with moderate hearing loss, the other ear had normal hearing. One child displayed left ear moderate conductive hearing loss and right ear mild sensory neural hearing loss. Another child presented with bilateral mild conductive hearing loss. All were referred to otorhinolaryngologists for further treatment and scheduled for follow-up. Hearing acuities are displayed in Table 2. Average hearing levels of pure tones were in the normal hearing range.

Characteristics of oral examination, speech and language, and articulation errors of children with cleft lip and/or palate are presented in Table 3. Table 4 shows average nasalance scores and nasal emission/ turbulence in the same children.

The median numbers of articulation errors between pre- and post-articulation tests were analyzed. The Wilcoxon signed-rank test was used to analyze the data.

Table 2
Hearing acuity of children with cleft lip and/or cleft palate.

Patient No.	Age yy/mm	Right hearing		Left hearing		ENT examination
		Audio (dB)	Tymp	Audio (dB)	Tymp	
C 01	5/01	17	C	17	C	Remove impacted cerumen
C 02	4/06	17	A	13	A	Remove impacted cerumen
C 03	4/01	27	B	48	B	Right and left ear drum, pressure equalization tube in place Nasal cavity: crust in vestibule Left ear: moderate conductive hearing loss Right ear: mild sensory neural hearing loss
C 04	4/05	25	B	25	A	Right ear drum, pressure equalization tube in place
C 05	5/03	30	B	22	C	Right ear mild conductive hearing loss Right and left ear drum retraction
C 06	5/09	20	B	23	B	Right ear drum, pressure equalization tube in place Left ear myringotomy, tube in place Left ear conductive hearing loss
C 07	5/00	30	B	33	B	Right and left remove impacted cerumen Nasal septum deviation Right and left mild conductive hearing loss
C 08	7/01	18	C	20	C	Remove impacted cerumen
C 09	7/07	18	A	15	A	Common cold
C 10	7/08	17	A	15	A	Left: ear remove impacted cerumen Nasal septum: deviation to right
C 11	4/03	18	B	18	B	Right and left mild conductive hearing loss
C 12	4/04	32	B	23	C	Right and left mild conductive hearing loss Right ear: remove impacted cerumen Nasal cavity, clear discharge, oronasal fistula Nasal/PNS problem, adenoid hypertrophy
C 16	7/01	47	B	15	A	Right moderate conductive hearing loss Right ear drum bulgy, suspected storage of fluid Left ear drum dull, nasal/PNS problem, oronasal fistula
C 18	8/00	20	A	17	A	Normal
C 19	6/11	20	A	12	A	Remove impacted cerumen
C 20	6/01	22	C	22	C	Right and left mild conductive hearing loss
Average		20.69		20.19		

Audio, Audiometry; Tymp, Tympanogram; yy, year; mm, month.

Table 3
Characteristics of oral examination, speech and language, and articulation errors of children with cleft lip and/or palate.

Patient No.	Oral examination	Facial grimace	Language	Intelligibility	Resonance	Voice	No. of articulation errors	
							Pre-therapy	Post-therapy
C 01	Upper lip contraction and asymmetry, left collapse Dental malocclusion	None	Pass	Intelligibility	0	Normal	15	2
C 02	Dental malocclusion	None	Pass	Intelligibility	0	Normal	16	0
C 03	Lip contraction, asymmetry and flat Nose node and flat nose tip Short soft palate and slightly movement Dental caries	None	Pass	Intelligibility	0	Normal	23	3
C 04	Lip flat Short soft palate Dental malocclusion	None	Pass	Intelligibility	0	Abnormal	19	12
C 05	Lip asymmetry and flat Nose asymmetry Bifid soft palate and active movement Dental carried and malocclusion	None	Pass	Intelligibility	+1	Normal	18	5
C 06	Lip asymmetry and flat Nose asymmetry and flat Bifid soft palate and slight movement	None	Pass	Intelligibility	0	Normal	13	1
C 07	Bifid soft palate Dental caries	None	Pass	Intelligibility	0	Normal	13	2
C 08	Bifid soft palate Dental caries Dental malocclusion	None	Delayed	Intelligibility	0	Normal	15	3
C 09	Bifid soft palate and active movement	None	Delayed	Intelligibility	0	Normal	6	0

Table 3 (Continued).

Patient No.	Oral examination	Facial grimace	Language	Intelligibility	Resonance	Voice	No. of articulation errors	
							Pre-therapy	Post-therapy
C 10	Lip asymmetry, flat, contraction Asymmetry nose Bifid soft palate and active movement Dental caries and malocclusion	1	Pass	[a]Mild unintelligibility	+2	Abnormal	19	10
C 11	Lip contraction and flat, asymmetry Nose asymmetry and flat nose tip ONE fistula Bifid soft palate and slight movement Dental malocclusion: maxi retraction	1	Delayed	Intelligibility	+1	Normal	17	1
C 12	Lip contraction and flat, asymmetry Nose asymmetry and flat nose tip Short soft palate and active movement Dental caries	None	Pass	Intelligibility	0	Normal	11	1
C 16	Lip contraction and collapse, asymmetry, limitation movement Bifid soft palate and slight movement Dental caries and malocclusion: maxillary retraction	1	Pass	[a]Mild unintelligibility	+2	Abnormal	14	5
C 18	Dental caries and malocclusion, maxillary retraction	1	Pass	Intelligibility	+1	Normal	7	1
C 19	Soft palate bifid and slightly present Dental caries	None	Pass	[a]Mild unintelligibility	+2	Abnormal	16	10
C 20	Lip contraction and flat, asymmetry Bifid soft palate and active movement Dental caries and malocclusion: maxillary retraction	None	Pass	Intelligibility	0	Normal	11	1

[a]Intelligible if topic is known

Table 4
Nasalance scores and nasal emission/ turbulence of children with cleft lip and/or palate.

Patient No.	Nasalance scores						Nasal emission/ turbulence
	My house		Winter		Laying hen		
	Pre	Post	Pre	Post	Pre	Post	
C 01	54	43	59	54	23	31	Audible
C 02	37	48	53	53	11	32	Visible
C 03	22	32	35	37	8	22	Visible
C 04	43	44	53	56	24	28	Visible
C 05	52	58	60	68	38	40	Visible
C 06	37	26	52	43	20	9	Visible
C 07	44	44	44	48	29	29	Visible
C 08	64	38	49	53	37	17	Visible
C 09	49	41	70	53	35	23	Visible
C 10	54	42	56	47	47	35	Visible
C 11	66	63	68	66	41	47	Visible
C 12	31	33	50	52	16	14	None
C 16	57	54	57	55	46	43	Visible
C 18	65	37	47	53	49	20	Visible
C 19	63	58	59	61	49	54	Visible
C 20	29	34	46	48	16	18	None
Average	47.94	43.44	53.62	49.63	30.56	31.38	-

Table 5
Descriptive data of number of pre- and post-articulation errors.

Statistic parameter	Pre	Post
Mean	14.89	4.44
Median	16.00	3.00
Std deviation	4.38	4.46
Minimum	6.00	0.00
Maximum	23.00	14.00

Results showed a significant reduction in the number of articulation errors after running the model for 9 months (Tables 5-6).

DISCUSSION

Nine of the children in this study (56.25 %) exhibited hearing loss in the range typical of cleft palate and/or lip cases (Flynn *et al,* 2009; Phua *et al*, 2009; Kwan *et al,* 2011; Gani *et al,* 2012). The results of this study agree that the younger children with cleft palate, the higher incidence of hearing loss (Handzic-Cuk *et al,* 1996). Younger kids' Eustachian tube normally is in horizontal slope more than older kids' or adults' Eustachian tubes that result in high risk for ascending infection in middle ear which is the main cause of hearing loss.

Even though children with cleft lip or/and palate had an average pure tone reception and therefore normal hearing acuity in both ears, there were two children who had moderate hearing loss (C07: Left ear = 47 dB, C16: Right ear = 47 dB),

Table 6
Comparisons pre- and post- articulation tests.

Parameter	Student's *t*-test for number of articulation defects						
	Pre	Post	*n*	Median difference	*Z*	*p*-value	95% Confident interval
Median	16	3					
Maximum	23	14	16	10	-3.52	<0.001	8-13
Minimum	6	0					

Pre, Number of articulation errors in pre-articulation test.
Post, Number of articulation errors in post-articulation test.

while the other ears showed mild loss and normal hearing, respectively (C07: Right ear = 27 dB, C16: Left ear = 15 dB). Two children had bilateral hearing loss and their best ears had mild hearing loss (C03, C07). This made it difficult for them to hear some sounds, the louder voiced sounds and they had mild speech problems (Northern and Downs, 2002). Their post-articulation errors, however, had decreased significantly. This implied that they could learn to correct articulation very well from the hearing in the better ears (Table 2).

Prevalence of malocclusion and dental caries was 62.5 % (Table 1). This agreed with previous data that dental anomalies have a high prevalence in cleft lip and/or palate populations (Tolarova and Harris, 1995; Shapira *et al*, 2000; Lourenco Ribeiro *et al*, 2003). These children indeed need dental care and further orthodontic treatment. For language abilities, three children (18.75 %) had delayed speech and language development and four had a voice abnormality. This confirmed that children with cleft are at risk for delayed speech and language development (Waldron *et al*, 2011) and voice disorders (Robison and Otteson, 2011). This prevalence varied and was similar to other prevalence data. The severity of resonance abnormality, voice disorders, and numbers of CADs reflected intelligibility (Table 3). Children who had moderate hypernasality (C10, C16, C19) with high nasalance scores (Table 4), abnormality of voice, and more numbers of CAD (C10 = 19 sounds, C16 = 14 sounds, C19 =16 sounds) seemed to be less intelligible as a consequence. Such children need a prolonged speech correction period (Pamplona *et al*, 2000; Kuehn and Henne, 2003). Two children had high nasalance scores. However, perceptual assessment could not be determined (C08 and C11). In post-treatment evaluation, one child had significant improvement of nasalance scores in all spoken passages. It is possible that it was a functional resonance abnormality and the decrease of nasalance score was significantly remedied by means of speech therapy. Another child who had high nasalance scores still had high nasalance scores after treatment: he might need further investigation and surgery.

The Wilcoxon signed-rank test demonstrated a dramatic and significant decrease in the number of articulation errors after treatment (Tables 5-6). This showed

that the "Khon Kaen Community-Based Speech Therapy Model" with long-term speech therapy by SAs was a successful remedy for the lack of speech services in Thailand. Without this intervention, children would require approximately 4 years for scheduled therapy by SLPs in the nearest speech center, the delays greatly increasing the difficulty of CAD correction. Therefore, this project should be extended to other areas in Thailand and other developing countries where there is a lack of speech services.

Internet access is rapidly expanding in rural areas worldwide and will provide a tool for service such as online consultation for speech therapy via programs such as Skype (Furr *et al*, 2011; Whitehead *et al*, 2012). The "Khon Kaen Community-Based Speech Therapy Model" was an effective way to solve problem of the lack of SLPs in Thailand and might be suitable for application in other developing countries, perhaps supported by an online presence of experts.

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