

# Types of Articulation Errors in Individuals with Cleft Lip and Palate

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**Objective:** To identify types of articulation errors in speech camp.

**Material and Method:** Sixteen children with cleft palate with or without lip and articulatory defects in Maharakham Province and surrounding area enrolled for 3-day intensive speech camp that was held in Srinagarind Hospital. Assessments of speech and language problems: articulation, resonance, nasal emission/turbulence, voice, and intelligibility were performed. Type of articulation errors were grouped based on standard guidelines.

**Results:** Velar production was the most common types, both at word (75%) and sentence levels (93%) followed by glottal and pharyngeal productions at word level testing (43.75% and 43.75%) and at sentence level (37.5% and 18.75%), respectively.

**Conclusion:** Abnormal backing of oral targets was the most common speech type. Further study and early prevention for articulation disorders are needed.

**Keywords:** Cleft speech type, Cleft speech characteristics, Speech disorders

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The worldwide incidence of cleft lip/palate is between 0.30 and 2.65/1,000 live births<sup>(1)</sup>. Cleft lip/palate is indeed a major public health concern in Thailand, where the incidence of cleft lip/palate is between 1.10 and 2.49/1,000 live births<sup>(2)</sup>. Prevalence of cleft lip/palate by the numbers on the birth certificate and the registry were 0.11 vs. 0.71; 0.30 vs. 0.51; 0.35 vs. 0.66, respectively<sup>(3-5)</sup>. Interestingly, most of the affected persons live in the Northeast, where the annual occurrence of cleft lip/palate is about one in 745 live births each year<sup>(1)</sup>.

Surgery is the first and most critical treatment to relieve social and physical abnormalities for children with cleft palate; however, the needs of patients with clefts extend beyond surgical repair including corrections of speech and language disorders, malocclusion, hearing abnormalities etc. Articulation errors are very common in cleft speech defect. Articulation disorders in cleft are included either functional or phonological articulation disorders or adaptive oral misarticulation<sup>(6,7)</sup>. The prevalence of articulation errors, particularly compensatory articulation disorders

(CAD) is 44-63%<sup>(8-10)</sup> and is higher one in (Not clear, needs revision) recent study (88.56%; 95% CI = 84.47-92.65)<sup>(11)</sup>.

CAD is known as a common behavior secondary to velopharyngeal insufficiency (VPI) or articulator defects in cleft palate which include dysfunction not only of the velopharyngeal sphincter, but of the entire vocal tract<sup>(12)</sup> such as plosive sounds e.g./t/or/p/ might be attempted by substituting a glottal stop or pharyngeal stop. Articulation patterns are usually referred to compensatory articulation disorders or cleft speech types. CAD usually decreases intelligibility. The longer the time passes the age of articulation development, the more difficulty it is to correct and the longer period of speech therapy is required<sup>(13,14)</sup>.

Phonetic disorders in cleft occur when the movements of the articulators, such as the lips, tongue, palate or resonating cavities deviate from normal articulations. Compensations such as a glottal stop, velar, pharyngeal production would be considered phonetic, as the child attempts to produce the sound in an alternative manner to compensate for the inability to establish oral pressure because of inadequate velopharyngeal function. Because the glottal, pharyngeal and velar productions reflect an obvious and productive compensation, these have been viewed as phonetic and articulation which becomes the main

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topic in intervention. Most children with cleft continue to produce CAD despite the early and effective repair. There might be some other factors other than the inability to establish sufficient oral air pressure is contributing to the development and maintenance of these articulatory patterns<sup>(12,15)</sup>. CAD is a phonological disorder rather than phonetic, the same types of phonological process errors as with younger, typically developing children<sup>(16)</sup>. CAD is considered as a phonological disorder, that is linguistically based and more related to higher levels of linguistic organization (rule level) rather than phonetic (cognitive peripheral level)<sup>(14)</sup>. The phonological rules resulted in faster learning of the target productions and more rapid incorporation into the language rules and thus more immediate carry over into conversational speech<sup>(17)</sup>. Therefore, recent study focused on speech therapy based on the linguistic system of each child, and considered the speech sound production as an integral component of higher levels of language organization for intervention. The result indicated that it was a valid and efficient method for providing speech therapy in cleft palate children with compensatory articulation disorder<sup>(18)</sup>.

In Thailand, where pathologists (SLPs) in speech and language is lacking and speech services is one of the critical areas of cleft care<sup>(19-22)</sup>. Speech camp was modified for providing speech services for children with cleft, particularly in the northeast where the high prevalence of cleft in Thailand exists. 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 was a model that had been launched in 2011-2012<sup>(23)</sup>.

The aim of the present study was to identify types of articulation errors in speech camp, one part of the “Khon Kaen Community-Based Speech Therapy Model”.

## **Material and Method**

### **Study design**

This study was a cross-sectional study.

### **Participants**

Twenty children aged 3½-8 years with cleft palate and or without cleft lip (CP ± L) in target areas of the “Khon Kaen Community-Based Speech Therapy Model” (districts of Borabue, Chiengyuen,

Kantharawichai, Wapiprathum, Mueng, Kosumphisai) were included. Four of them were excluded from the study because of migration and could not participate in the project (Patient No. C13); complicated physical problems (Patient No. C14, C15) and another had only a cleft lip and no articulation defects (C17). Sixteen children with CP ± L were in the present study.

### **Setting**

Assessments of speech and language problems were performed in a Speech clinic, Srinagarind Hospital, Khon Kaen University, Khon Kaen. According to the Helsinki Declaration (HE531358), the Ethics Committee of Khon Kaen University reviewed and approved (October 22, 2010) the research protocols. Children were assessed for baseline parameters at the intensive 3-day speech camp including.

Ear, nose throat examination was performed by an ENT physician; tympanogram and audiometry (Audiometer: acoustic analyzer 1,200) by an audiologist.

Oral examination and speech and language abilities with perceptual assessment of speech for cleft using the Thai Universal Parameters of Speech Outcomes for People with Cleft Palate were investigate by a SLP. Outcomes were summarized by 2 speech and language pathologists’ consensus. Speech characteristics were assessed as follows: articulation, resonance, nasal emission/turbulence, voice, and intelligibility. Articulation patterns were classified by following standard universal guidelines<sup>(24)</sup>. These included both single word and sentence levels as follows:

- 1) Abnormal backing of oral targets to post-uvular place (pharyngeal & glottal sounds);
- 2) Abnormal backing of oral targets, but place remains oral (mid-dorsum palatal & velar);
- 3) Nasal fricative (phoneme specific & not phoneme specific);
- 4) Nasal consonant for oral pressure consonant;
- 5) Nasalized voiced pressure consonants;
- 6) Weak oral pressures;
- 7) Other oral misarticulations;
- 8) Developmental articulation
- 9) Phonological errors

Nasometry (Nasometer II 6450, Kaypentax) was used for assessing the average nasalance scores and compared to the average nasalance scores of a standard of 3 Thai passages<sup>(25)</sup>.

Language screening test (adapted to Thai Early Language Milestone)<sup>(26)</sup>.

### Analysis

The main outcome was the pattern of articulation errors from pre-articulation test (the Thai Universal Parameters of Speech Outcomes for People with Cleft Palate)<sup>(27)</sup> in speech camps. Oral examination described characteristics of oronasal configurations: facial grimace was scored as 1: a wrinkle in the floor of the nose alar; 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, audible; voice as normal and abnormal; intelligibility as intelligibility, intelligibility if the topic is known; unintelligibility; language was scored as pass and delay, and nasometry gave a percentage of the nasalance score.

Descriptive data were applied by using numbers and percentages.

### Results

Sixteen children with cleft lip or/and palate clefts in Mahasarakham Province were included in this study. Cleft type proportion of left unilateral cleft lip and palate: cleft palate: bilateral cleft lip and palate was 7: 6: 3. Demographic characteristics of these children are shown in Table 1.

Characteristics of speech and language

disorders of children with cleft lip and/or palate are presented in Table 2. Prevalence of language delay was 18.75%; a resonance disorder (hypernasality from velopharyngeal insufficiency) was 37.50%; voice abnormality was 25%.

The percentages and numbers of articulation errors of individuals with cleft at word level were displayed in Table 3. The overall percentages and numbers of articulation patterns at sentence level were showed as Table 4. The common patterns of articulation errors (with exception developmental errors that often found in typically children) in individual with cleft were other oral misarticulation, velar, and pharyngeal productions, respectively.

Prevalence of each articulation patterns for all children (16 participants) with cleft was presented in Table 5. With exception and other oral misarticulations, the high prevalence of cleft articulation patterns, both word and sentence level, were orderly velar, pharyngeal productions, and nasalized voice pressure consonants, respectively.

### Discussion

Most participants in this study were in pre-school age ( $\leq 7$  years old) (Table 1). There were 5 children at school age ( $> 7$  years old) that were beyond normal articulation development following Thai articulation norms<sup>(28)</sup>. This would be more difficult and

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

Patient number	Age (year: month)	Gender	Cleft type
C01	5: 1	Female	Lt. CLP
C02	4: 6	Female	CP
C03 <sup>†</sup>	4: 1	Female*	Lt. CLP
C04	4: 5	Male	Bilat. CLP
C05	5: 3	Male**	Lt. CLP
C06	5: 9	Female	Lt. CLP
C07	5: 0	Female	CP
C08	7: 1	Male	CP
C09	7: 7	Male	CP
C10	7: 8	Female	Lt. CLP
C11	4: 3	Male**	Bilat. CLP
C12	4: 4	Male	Lt. CLP
C16	7: 1	Male	Bilat. CLP
C18	8: 0	Male	CP
C19	6: 11	Female	CP
C20	6: 1	Male	Lt. CLP

<sup>†</sup>Nose/lip correction at 4:0; \* Selective mutism; \*\* Attention deficit hyperactivity disorders; Lt. = Left; Rt. = Right; CP = Cleft palate; CLP = Cleft lip and palate; Bilat. = Bilateral; N/A = not available, caregivers had no information

**Table 2.** Characteristics of oral examination, speech and language of children with CP ± L

Patient No.	Facial grimace	Language	Intelligibility	Resonance	Voice
C01	None	Pass	Intelligibility	0	Normal
C02	None	Pass	Intelligibility	0	Normal
C03	None	pass	Intelligibility	0	Normal
C04	None	Pass	Intelligibility	0	Abnormal
C05	None	Pass	Intelligibility	+1	Normal
C06	None	Pass	Intelligibility	0	Normal
C07	None	Pass	Intelligibility	0	Normal
C08	None	Delayed	Intelligibility	0	Normal
C09	None	Delayed	Intelligibility	0	Normal
C10	1	Pass	*Mild unintelligibility	+2	Abnormal
C11	1	Delayed	Intelligibility	+1	Normal
C12	None	Pass	Intelligibility	0	Normal
C16	1	Pass	*Mild unintelligibility	+2	Abnormal
C18	1	Pass	Intelligibility	+1	Normal
C19	None	Pass	*Mild unintelligibility	+2	Abnormal
C20	None	Pass	Intelligibility	0	Normal

\* = Speech had intelligibility if assessor knew the topic of conversation or question that asked child

take a longer duration for articulatory correction<sup>(13,14)</sup>, particularly child No. C10 who had the most number of articulatory errors (Table 3). Intensive speech correction should be applied in a short-term period before he/she passes longer complete articulation development. Results of this study indicated that children with cleft and articulation defects or CAD were at risk for delayed speech and language development (18.75% or 3 in 16 children), voice disorders (25% or 4 in 16 children), resonance disorders (37.5% or 5 in 16 children). These supported the previous studies but lower in prevalence of language delay<sup>(9,29-32)</sup>. Prevalence of voice disorders and resonance disorders (hypernasality) were in range of previous results (5.5-20.8%)<sup>(33-35)</sup> and 20-40%<sup>(6,36-41)</sup>, respectively. These, particularly in cases of more severe resonance disorders (moderate or +2 levels in C10, C16 and C19), resulted in mild unintelligibility (Table 2).

Prevalence from the present study was from children with cleft and CAD or articulatory defects, which could not be inferred from general population with cleft. For treatment implication, it would be implied and planned for speech therapy of communication disorders in target populations. For example C10 had the most number of articulatory defects and severe resonance disorders (+2) (Table 2) which might have resulted from maladaptive learning behavior in CAD. Speech and language pathologist should try to modify or correct CAD and follow-up speech problems (resonance disorders) after short-term therapy (e.g., 6-

12 months). If CAD is corrected, resonance disorder resulting from maladaptive learning behavior will disappear<sup>(6,7)</sup>.

According to articulation patterns in clefts, developmental errors (68.75% at word level and 62.5% at sentence level) and other oral misarticulation (100% at both levels) were the highest prevalence (Table 5). Developmental errors will be spontaneously acquired with growth. For other oral misarticulation, 8.6-12% of normal kindergarteners had articulatory defects<sup>(42,43)</sup>. From results of the present study, prevalence of other oral misarticulation or function articulation disorders in clefts was higher than children in the general population. It presented that children with cleft population were at higher risk for other oral misarticulation than the general population. With the exception of developmental errors and other oral misarticulation types, abnormal backing of oral targets but place remains oral (velar production) was the most common type, both at word (75%) and sentence levels (93%), followed by abnormal backing of oral targets to post-uvular place, glottal and pharyngeal productions. These confirmed that abnormal backing was the most common speech pattern in clefts and support previous ones<sup>(6,7,13,44)</sup>. A phonological error (12.5%) was found in clefts and agreed with a previous study and indicates that it should be correct early with an effective program in speech intervention<sup>(18)</sup>. However, study of cleft speech types is not available in Thailand. These results

**Table 3.** Overall percentages (numbers) of articulation patterns of cleft speech: word level

No.	Oral targets to post-uvular place*		Oral targets, but place remains oral <sup>†</sup> **	Nasalized voiced pressure consonants	Other oral misarticulations	Developmental articulations	Phonological errors	Total
	Pharyngeal	Glottal						
C01			78.78 (7)		11.11 (1)	11.11 (1)		100 (9)
C02			47.05 (8)		41.17 (7)	11.76 (2)		100 (17)
C03	23.53 (4)	11.76 (2)	23.53 (4)		23.53 (4)	17.65 (3)		100 (17)
C04		25.92 (7)	29.63 (8)		33.33 (9)	11.11 (3)		100 (27)
C05		3.70 (1)	22.22 (6)	7.41 (2)	51.85 (14)	7.41 (2)	7.41 (2)	100 (27)
C06			25.00 (5)		70.00 (14)	5.00 (1)		100 (20)
C07		5.88 (1)	11.76 (2)		64.70 (11)	17.65 (3)		100 (17)
C08		11.76 (2)	17.65 (3)		70.59 (12)			100 (17)
C09					100.00 (3)			100 (3)
C10	6.89 (2)	34.48 (10)		10.34 (3)	37.93 (11)		10.34 (3)	100 (29)
C11	5.26 (1)		36.84 (7)	10.53 (2)	31.58 (6)	15.79 (3)		100 (19)
C12	6.25 (1)		37.50 (6)		31.25 (5)	25.00 (4)		100 (16)
C16	9.09 (1)	9.09 (1)		18.18 (2)	63.63 (7)			100 (11)
C18					100.00 (3)			100 (3)
C19	7.14 (1)		35.71 (5)	7.14 (1)	42.85 (6)	7.14 (1)		100 (14)
C20	10.00 (1)		20.00 (2)		60.00 (6)	10.00 (1)		100 (10)

\* = Abnormal backing of oral targets to post-uvular place; \*\* = Abnormal backing of oral targets, but place remains oral; <sup>†</sup> = Nasalized voiced pressure consonants; ## = Phonological errors

**Table 4.** Overall percentages (numbers) of articulation patterns of cleft speech: sentence level

No.	Oral targets to post-uvular place*		Oral targets, but place remains oral**	Nasalized voiced pressure consonants	Other articulations	Developmental articulations	Phonological errors	Total
	Pharyngeal	Glottal						
C01			50.00 (5)		40.00 (4)	10.00 (1)		100 (10)
C02			28.57 (4)	7.14 (1)	35.71 (5)	28.57 (4)		100 (14)
C03		15.78 (3)	21.05 (4)		47.37 (9)	15.79 (3)		100 (19)
C04	4.51 (1)	18.18 (4)	50.00 (11)		22.72 (5)	4.54 (1)		100 (22)
C05			57.89 (11)		26.32 (5)		15.79 (3)	100 (19)
C06			12.50 (1)		75.00 (6)	12.50 (1)		100 (8)
C07		6.25 (1)	12.50 (2)		75.00 (12)	6.25 (1)		100 (16)
C08					100.00 (9)			100 (9)
C09			33.33 (2)		66.67 (4)			100 (6)
C10	4.76 (1)	47.62 (10)	14.29 (3)	19.05 (4)	14.29 (3)			100 (21)
C11			70.00 (14)		20.00 (4)			100 (20)
C12			28.57 (2)		14.28 (1)	10.00 (2)		100 (7)
C16		15.38 (2)	7.69 (1)	15.38 (2)	61.54 (8)	57.14 (4)		100 (13)
C18			33.33 (2)		66.66 (4)			100 (6)
C19	4.54 (1)	22.72 (5)	36.36 (8)	4.54 (1)	22.72 (5)	9.09 (2)		100 (22)
C20					57.14 (4)	14.29 (1)	28.57 (2)	100 (7)

\* = Abnormal backing of oral targets to post-uvular place; \*\* = Abnormal backing of oral targets, but place remains oral

**Table 5.** Overall articulation patterns of cleft speech (n = 16)

Articulation patterns	Number (Total 16 patients)	Percentage
Words		
1. Abnormal backing of oral targets to post-uvular place		
1.1 Pharyngeal	7	43.75
1.2 Glottal	7	43.75
2. Abnormal backing of oral targets, but place remains oral		
2.1 Mid-dorsum palatal		
2.2 Velar	12	75.00
5. Nasalized voiced pressure consonants	5	31.25
7. Other oral misarticulations	16	100.00
8. Developmental articulations	11	68.75
9. Phonological errors	2	12.50
Sentences		
1. Abnormal backing of oral targets to post-uvular place		
1.1 Pharyngeal	3	18.75
1.2 Glottal	6	37.50
2. Abnormal backing of oral targets, but place remains oral		
2.1 Mid-dorsum palatal		
2.2 Velar	15	93.75
5. Nasalized voiced pressure consonants	4	25.00
7. Other oral misarticulations	16	100.00
8. Developmental articulations	10	62.50
9. Phonological errors	2	12.50

might be the primary report and can show need for further study and planning for speech therapy in children with clefts.

### Conclusion

Children with clefts were at risk for other oral misarticulation more than the general population. Abnormal backing of oral targets but place remains oral (velar production) and abnormal backing of oral targets to post-uvular place were the common types of clefts. Further study and planning for speech correction are needed.

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### Potential conflicts of interest

None.

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## ประเภทของการพูดไม่ชัดในผู้ป่วยปากแหว่งเพดานโหว่

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**วัตถุประสงค์:** เพื่อศึกษารูปแบบการพูดไม่ชัดในผู้ป่วยปากแหว่งเพดานโหว่

**วัสดุและวิธีการ:** เด็กเพดานโหว่อย่างเดี่ยวหรือที่มีปากแหว่งร่วมด้วยและมีปัญหาการพูดไม่ชัดจำนวน 16 ราย ในจังหวัดมหาสารคามและพื้นที่ใกล้เคียงเข้าค่ายแบบเข้มข้นฝึกพูด 3 วัน ที่โรงพยาบาลศรีนครินทร์ ทำการประเมินความผิดปกติของการแปรเสียง ความก้องของเสียง ลมรั่วหรือเสียงเสียดสีทางจมูกเสียงและการฟังคำพูดรู้เรื่อง และจัดประเภทของการพูดไม่ชัดตามแนวทางมาตรฐาน

**ผลการศึกษา:** การพูดไม่ชัดที่ใช้เพดานอ่อนในการออกเสียงข้างหลังแต่ยังอยู่ในปากเป็นรูปแบบที่พบมากที่สุด ทั้งการทดสอบในระดับคำ (ร้อยละ 75) และระดับประโยค (ร้อยละ 93) ตามด้วยการพูดไม่ชัดที่ใช้สายเสียงและคอหอย ทั้งในการทดสอบระดับคำ (ร้อยละ 43.75 และ ร้อยละ 43.75) และระดับประโยค (ร้อยละ 37.5 และ ร้อยละ 18.75) ตามลำดับ

**สรุป:** การพูดไม่ชัดโดยการออกเสียงที่ใช้ฐานกรณข้างหลังเป็นรูปแบบที่พบมากที่สุด การศึกษาในอนาคตและการป้องกันการพูดไม่ชัดแต่เนิ่นๆ เป็นสิ่งจำเป็น

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