

# Audiological Findings in Cleft Lip and Palate Children Attending Speech Camp

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**Objective:** To determine the audiological status in children with cleft lip and palate attending at speech camp.

**Material and Method:** The present study was performed in children with cleft lip and palate attending speech camp. 14 children with cleft lip and/or palate registered in the speech camp for 4 days. All subjects had undergone otoscopic examination, hearing evaluation and speech and language assessment.

**Results:** Only 12 children performed the complete hearing evaluation. 16 of 23 ears had very slight hearing loss and most of them were found in children with unilateral cleft lip and palate. The air conduction thresholds ranged from 16.36 to 25.91 dB across the frequencies on the right ear and 10 to 23.18 dB on the left ear. The average pure tone thresholds showed a rising slope configuration of audiogram.

**Conclusion:** The minimal hearing loss probably impacted on speech and language problems. Children with cleft lip and palate need early detection and intervention of hearing impairment.

**Keywords:** Cleft lip and/or palate, Degree of hearing loss, Configuration of audiogram

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Cleft lip and/or palate may be associated with other alterations. Among the alterations found associated with clefts, we emphasize hearing problems. In children with cleft lip and/or palate the most common hearing-related alteration is otitis media with effusion, caused by anatomical and/or functional malformations in the Eustachian tube and in the velopharyngeal sphincter region. The oscillating characteristic trait of otitis media with effusion causes lack of auditory stimulation consistency and distortions in the received message-impairing hearing, speech and language development. It has also been postulated that cognitive and academic performance can be also affected because these areas are inseparably related to the psycho-socio-linguistic perspective<sup>(1,2)</sup>. The problems of middle ear pathology and Eustachian tube dysfunction tend to decrease with age<sup>(3,4)</sup>.

Hearing problems in children with cleft lip and/or palate have consistently been reported and considered to be at greater risk of conductive hearing disorders<sup>(5,6)</sup>. Sensorineural hearing loss may also be

reported in some patients, which could have resulted from inflammatory toxins products from middle ear into the inner ear<sup>(5,7)</sup>. The degree of hearing loss is directly proportionate to the fluid level. The average hearing level ranged from minimal to moderately severe hearing loss<sup>(8-10)</sup>. Speech and language deficits in children with cleft lip and/or palate varies, and is directly dependent on hearing status. The early detection and management may reduce the impact of the hearing impairment, which can have consequences regarding the child's speech and language development.

The purpose of the current study was to determine the audiological status in children with cleft lip and palate attending the speech camp.

## Material and Method

### Subjects

The subjects included in this study were children with cleft lip and/or palate who attended the speech camp conducted at Suwanaphum Hospital, Suwanaphum district, Roi Et Province, Northeast region, Thailand. Fourteen children and their parents or caregivers registered in the speech camp for four days. These participants lived in Suwanaphum district and were included for speech camp by purposive sampling. The present study was approved by the Khon Kaen University Ethics Committees for Human Research

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(HE510134).

### Study procedure

All subjects were assessed by the following procedure on the first day. This was the first time of hearing assessment for this group.

1. Otoloscopic evaluation was done for each subject before doing the hearing test.

2. Hearing assessments were conducted on all subjects using the following:

- Pure tone audiometry was performed using a Voyager 522 (Madsen, Denmark) audiometer with TDH 39 phones fitted with noise-excluding headset ME 70 and bone conductor B-71 with headband, calibrated to American National Standards Institute (ANSI) S3.6-1996 standards (American National Standards Institute, 1996). The pure tone audiometry findings for air conduction were obtained for each ear at 250, 500, 1,000, 2,000, 4,000 and 8,000 Hz with standard procedure. The thresholds were plotted on an audiogram sheet. Pure tone average (PTA) at 500, 1,000 and 2,000 Hz was calculated for each ear. Hearing threshold were classified, and normal hearing threshold was defined as  $\leq 15$  dB (Table 1). Hearing loss was defined as  $> 15$  dB<sup>(11)</sup>.

- Tympanometry was conducted using a OTO flex 100 (Madsen, Denmark) tympanometer with a 226 Hz probe tone frequency and was performed to evaluate the middle ear function for each ear, calibrated to ANSI standards (American National Standards Institute, 1987). The subjects' tympanometric results were described qualitatively by three types; type A tympanograms were classified as normal, and type B and C tympanograms were classified as abnormal.

All the audiological tests were performed in a room, which was relatively quiet and free from distractions. The average ambient noise in this room was lower than 40 dB A, which was measured by the standard sound level meter.

3. Speech and language assessments were

completed by five speech and language pathologists. The core components of the speech and language assessment included; physical examination: oro-facial examination, language assessment, intelligibility evaluation, articulation test, resonance and voice quality. All evaluation was carried out in separated cubicles, which were free from distractions.

The main outcome of the current study was the degree of hearing loss and configuration of audiogram in children with cleft lip and/or palate attending the speech camp.

### Results

13 in 14 children with cleft lip and/or palate enrolled in the speech camp for four days. One boy was excluded from the project because he had bilateral severe hearing loss. He had never worn a hearing aid. We referred him to Srinagarind Hospital, which is the tertiary hospital, for further investigation and proper management. 12 in 13 children with cleft lip and/or palate performed the complete hearing evaluation except one 11 year old girl, missed the hearing evaluation. The demographic characteristics of the patients are presented in Table 2. There were 12 children with cleft lip and/or palate. Of these, 8 were male and 4 were female children. The age range of the children was from 4 to 12 years old (mean age 8.9 years). One boy, who was the youngest in this group, could not have the complete hearing test performed.

Of 23 ears, the degree of hearing loss was greatest to a very slight degree in 16 ears. An 8 year old boy had unilateral severe sensorineural hearing loss on right ear. The degree of hearing loss with different groups of cleft patients is shown in Table 3.

The average of pure tone air-conduction threshold obtained for the frequencies 250, 500, 1,000, 2,000, 4,000 and 8,000 Hz are shown in Fig. 1. The mean of the average air conduction pure tone threshold shows a reverse-slope configuration. The pure tone average (PTA) was 23 dBHL on the right ear and 17 dBHL on the left ear. The mean of pure tone threshold at each frequency on right and left ear are shown in Table 4.

### Discussion

The previous research suggests that children with cleft lip and/or palate were at very high risk of middle ear disorder and greater risk of hearing loss, especially conductive hearing loss<sup>(5,6,8,9,12-14)</sup>. Most of them found 50% or more of children with cleft lip and/or palate had hearing loss. By contrast, however, the

**Table 1.** Classification of hearing loss

dB	Degree of the hearing loss
0-15 dB HL	Normal
16-25 dB HL	Very slight
26-40 dB HL	Mild
41-55 dB HL	Moderate
56-70 dB HL	Moderate to severe
71-90 dB HL	Severe
91+ dB HL	Profound

**Table 2.** Demographic characteristics and audiological profile of children with cleft lip and palate

Subject number	Age	Sex	Cleft type	Otoscopic examination		Tympanogram		PTA	
				Rt	Lt	Rt	Lt	Rt	Lt
1	7	M	Gr.3	N	N	A	A	18	18
2	10	M	Gr.4	wax	wax	CNT	CNT	22	17
3	12	F	Gr.4	N	N	A	A	13	15
4	10	M	Gr.3	N	N	A	A	17	22
5	10	F	Gr.2	wax	wax	CNT	CNT	10	18
6	11	F	Gr.3	N	N	A	A	13	17
7	12	M	Gr.3	N	N	A	A	23	23
8	6	M	Gr.1	N	N	A	A	18	17
9	8	M	Gr.3	N	N	A	A	75	15
10	4	M	Gr.3	N	N	A	A	CNT	22
11	7	F	Gr.2	N	N	A	A	20	17
12	10	M	Gr.4	N	N	C	C	17	13

Gr.1 = isolated cleft lip; Gr.2 = isolated cleft palate; Gr.3 = unilateral cleft lip and palate; Gr.4 = bilateral cleft lip and palate; N = normal; CNT = could not test; M = male; F = female; Rt = right ear; Lt = left ear; PTA = pure tone average

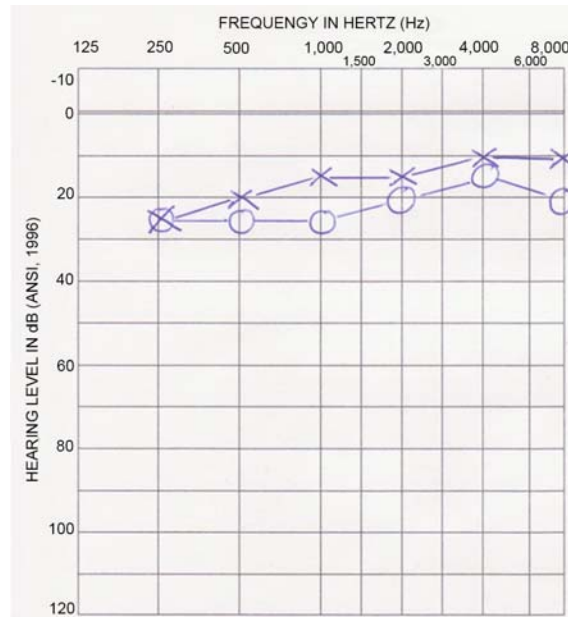
**Table 3.** Degree of hearing loss with different groups of cleft patients

Cleft type (No. of ears)	Pure tone average at 500-2,000 Hz		
	Normal (0-15 dB)	Very slight (16-25 dB)	Severe (70-90 dB)
Group 1 (n = 2)	-	2	-
Group 2 (n = 4)	1	3	-
Group 3 (n = 11)	2	8	1
Group 4 (n = 6)	3	3	-
Total (n = 23)	6	16	1

**Table 4.** Means of air conduction threshold

Frequency (Hz)	Subject (n = 12)	
	Air conduction threshold	
	Right ear	Left ear
250	25.91	23.18
500	24.55	22.5
1,000	24.55	17.08
2,000	18.18	13.75
4,000	16.36	12.27
8,000	22.27	10
PTA at 500-2,000 Hz	21.97	16.46

current study has found the degree of hearing threshold for the group of children with cleft lip and/or palate



**Fig. 1** Average pure tone threshold from 250 to 8,000 Hz on right and left ear.

O: represented right ear air conduction threshold, X: represented left ear air conduction threshold

was at a very slight level and no evidence of conductive hearing loss, except a boy who had unilateral sensorinueral hearing loss. One of the main reasons for the discrepancy could be the data collection from different age groups; most of the children with cleft lip and/or palate in this group were school age (more than

6 years), except subject number 10, while most other researchers collected the data on pre-school age children. This finding was in agreement with the study performed by Chu and McPherson<sup>(15)</sup> which found that 20% of the study group (13.4% of patient ears) had failed the hearing screening and most of them were under 7 years old. Regarding the age factor, a number of studies have showed the audiological problems of patients with cleft palate improved with age<sup>(8,10)</sup>. However, Lau et al<sup>(16)</sup> found patient's audiological problems did not diminish, or even increase, with age. The reduced prevalence of audiological problems noted in older children was due to differences in the dimensions and angle of the bony Eustachian tube, which produced a more efficient Eustachian tube in older children.

The greatest degree of hearing impairment found in the current study was only very slight. This finding agrees with two earlier studies<sup>(8,10)</sup> noted that hearing loss in young children was mainly moderate to severe but in the older children, teenage and adult age groups reduced to a slight to mild deficit. The very slight degree of hearing loss may result in language delays. This effect is dependent on the age of onset, if it is present at birth or develops within the first few months of life, and it will have more severe linguistic deficit than after he or she has acquired language<sup>(17)</sup>. The reasons lie in the nature of speech sounds; the unvoiced consonants contain so little speech energy that they often fall below even normal hearing thresholds in average rapid conversation. Children who have learned speech and language normally can automatically use learned strategies for understanding speech in context. However, infants, toddlers and young children who are just learning speech relationships need to hear all the sounds clearly to implant the perceptions solidly.

The configuration of an audiogram will tell which sound is best heard. Pitches are particularly important for speech. Most vowels are low-pitched sounds, whereas consonants such as "s", "f" and "sh" are high-pitched sounds. All other consonants have middle ranged frequencies. In the current study, the authors found the rising-sloped audiogram which means high pitched sounds can be better heard than low pitched sounds. This finding is same as study of D'Mello et al<sup>(3)</sup>. Importantly, this configuration affects the auditory perception to vowels sound area and nasal area and is the typical audiometric pattern seen in cases with middle ear effusion<sup>(18)</sup>.

The other factors that may influence

audiological problems in patients with cleft lip and/or palate are: gender, cleft types or age of repair. Several researchers have also reported that the repair status of clefts may influence the prevalence of audiological problems in children with cleft lip and/or palate and early closure of cleft palate could significantly reduce the prevalence of audiological problems<sup>(16,19-23)</sup>. They concluded that with earlier age of repair came improved Eustachian tube functioning, and consequently audiological problems were reduced. On the other hand, some investigators have suggested that surgical closure time does not affect the ultimate audiometric condition of the patient. They noted that improvement is not exclusively a result of the surgery performed but is more likely caused by a combination of surgical correction, developmental factors, and treatment of middle ear pathology<sup>(24,25)</sup>.

The gender distribution shows a tendency of males being more affected than females; also unilateral cleft palate was more common than bilateral cleft palate which co-related with the earlier survey reports<sup>(3,26)</sup>. Due to the current study being conducted in small sample sizes, even though the authors found the same result, it has not been concluded the same as previous reported. The result of several studies<sup>(1,10,15)</sup> reported that gender and cleft type of a subject were not related to hearing status. However, study by Jocelyn LJ et al<sup>(9)</sup> have found patients with isolated palate had a higher incidence of hearing loss than those with cleft lip and palate.

### **Conclusion**

Due to hearing problems in cleft children sometimes being ignored by parents because facial malformations are the major symptom and concern and given the fact of fluctuating hearing loss and the subsequent long-term impact on communication and education development, it is important that early detection, management, and follow-up be provided to parents of children with cleft lip and/or palate.

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### **Potential conflicts of interest**

None.

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## ลักษณะทางการได้ยินที่พบในเด็กปากแหว่งเพดานโหว่ที่เข้าค่ายฝึกพูด

พนิดา ธนาวิรัตน์านิจ, เบญจมาศ พระธานี

**วัตถุประสงค์:** เพื่อศึกษาลักษณะทางการได้ยินในเด็กปากแหว่งเพดานโหว่ที่เข้าค่ายฝึกพูด

**วัสดุและวิธีการ:** ศึกษาในเด็กปากแหว่งเพดานโหว่จำนวน 14 ราย ที่เข้าค่ายฝึกพูดระยะเวลา 4 วัน เด็กปากแหว่งเพดานโหว่ทั้งหมดจะได้รับการตรวจหู การตรวจประเมินการได้ยิน และการประเมินภาษาและการพูด

**ผลการศึกษา:** มีเด็กปากแหว่งเพดานโหว่จำนวน 12 ราย ที่ได้รับการตรวจประเมินการได้ยินอย่างสมบูรณ์จาก 23 หู พบ 16 หู มีระดับการสูญเสียการได้ยินระดับเล็กน้อยและส่วนใหญ่พบในเด็กที่มีปากแหว่งเพดานโหว่ 1 ข้าง ระดับการได้ยินเสียงที่เบาที่สุดผ่านการนำเสียงทางอากาศทุกความถี่อยู่ในช่วง 16.36 ถึง 25.91 เดซิเบลในหูขวา และ 10 ถึง 23.18 เดซิเบลในหูซ้าย ลักษณะของกราฟการได้ยินแสดงในรูปค่าเฉลี่ยของระดับการได้ยินเสียงเบาที่สุดที่ความถี่สูงจะดีกว่าที่ความถี่ต่ำ

**สรุป:** การสูญเสียการได้ยินระดับเพียงเล็กน้อยสามารถก่อให้เกิดปัญหาทางการพูดและภาษาได้ เด็กปากแหว่งเพดานโหว่ต้องได้รับการตรวจการได้ยินและการรักษาโดยเร็ว

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