

# Audiological Status in Patients with Cleft Lip and Palate at Srinagarind Hospital

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**Objective:** To determine the audiological status in patients with cleft lip and palate.

**Study design:** A descriptive retrospective study.

**Material and Method:** Data were retrieved from hospital records of 234 patients with cleft lip and palate and cleft palate who underwent hearing assessment between June 2007 and September 2010 at Srinagarind Hospital, Khon Kaen University. Descriptive data of the audiological evaluation were presented.

**Results:** Unilateral or bilateral hearing loss at the first hearing assessment was encountered among 186 patients (79.49%). Among these, 165 (88.71%) had bilateral conductive hearing loss and 16 (8.6%) had unilateral conductive hearing loss. The degree of hearing loss was greatest to a moderate degree in 181 (50.84%) ears. Most tympanometric evaluations presented with type B (335 ears or 72.67%). The age of the patient was significantly correlated with audiological status.

**Conclusion:** The current study showed that there is a high prevalence of hearing impairment among patients with cleft lip and palate and cleft palate. Therefore, routine audiological assessment should be performed as early as possible, especially among children. Further prospective investigation of the prevalence of hearing loss in children with cleft lip and palate and cleft palate should be considered, and endorsed as a national healthcare policy priority in order to raise awareness and to prevent hearing loss among these children.

**Keywords:** Cleft lip and palate, Hearing loss

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According to birth statistics from around the world, cleft lip and cleft palate are among the most common congenital abnormalities (range, 0.3/1,000-2.65/1,000)<sup>(1-6)</sup>. Due to the incomplete closure of the lips and palate, difficulties arise with respect to: feeding, speech and language development, dentition, facial structures and therefore hearing.

Hearing impairment is one of the associated problems seen particularly in children with cleft lip and palate; over against cleft lip alone; the middle ear is the part of the ear usually affected in a child with cleft palate. In general, 100% of children with cleft lip and palate will suffer from at least one episode of otitis media/middle ear effusion by age 7<sup>(7)</sup>. Additional studies of children with cleft lip and palate reported that the middle ear effusion was often sterile, suggesting that

the middle ear disease was the result of insufficient middle ear ventilation<sup>(8-10)</sup>. The lack of ventilation is the result of changes in the movement of the Eustachian tube caused by inadequate insertion of the palate tensor and elevator muscles; thereby producing a function obstruction in the Eustachian tube and negative pressure in the middle ear, leading to otitis media. Middle ear pathology thus leads to conductive hearing loss.

Although there is general agreement among authorities that there is a higher incidence of hearing loss among the cleft lip and palate population than the non-cleft population; the incidence of hearing loss varies widely-between 30% and 93%<sup>(10-14)</sup>. Audiological problems in patients with cleft lip and/or palate may be influenced by a diverse range of factors; including sex, age and type of cleft disorder<sup>(15-21)</sup>.

The purpose of the present study was to determine the audiological status in patients with cleft lip and/or palate at Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand. The effect of sex, age and cleft type on hearing status was also studied.

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## **Material and Method**

### **Study design**

This was a descriptive study with retrospective data collection from the clinical charts of consecutive patients with cleft lip and/or palate who had undergone audiologic evaluation between June 2007 and September 2010 at Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Thailand.

### **Participants**

Patients with cleft lip and/or palate who presented at Srinagarind Hospital under the “Smart Smile and Good Speech” project.

### **Inclusion criteria**

Patients with cleft lip and palate or cleft palate.

### **Exclusion criteria**

Patients with syndromic cleft lip and palate, isolated cleft lip, other major organ system defect or no data of hearing assessment.

In all the data of 384 patients with cleft lip and/or palate were collected but after the exclusion criteria were applied, 234 patients with cleft lip and/or palate remained in the study.

Patients were classified into three categories: Group I (isolated cleft palate), Group II (unilateral cleft lip and palate) and Group III (bilateral cleft lip and palate).

### **Study procedure**

Patient charts were checked for data on patient identification (age, sex, type of cleft lip and palate) and the results of the first visit hearing assessment. The data were extracted and transferred to case record forms. Double entries and accuracy were checked. The hearing assessment was conducted by a certified audiologist at Srinagarind Hospital who routinely cares for patients with clefts.

### **Outcomes**

The main outcomes of the present study were type and degree of hearing loss, percentage of hearing loss, and type of tympanogram.

### **Hearing assessments**

Hearing assessments were conducted using standard behavioral audiometry, pure tone audiometry and low-frequency probe tone tympanometry. The frequencies for pure tone thresholds were 0.5, 1, 2 and 4 KHz. Using the pure tone average for 0.5, 1 and 2

KHz, the degree of loss was determined using the following categories<sup>(22)</sup>: normal hearing ( $\leq 25$  dBHL), mild hearing loss (26 to 40 dBHL), moderate hearing loss (41 to 55 dBHL), moderately severe hearing loss (56 to 70 dBHL), severe hearing loss (71 to 90 dBHL) and profound hearing loss ( $> 90$  dBHL).

Hearing loss was identified as conductive, sensorineural or mixed. Behavioral audiometry including distraction testing and visual reinforcement audiometry were used in young children who could not be assessed using pure tone audiometry. ABR (Auditory-Brainstem Response testing) was also performed when behavioral measures were not sufficiently reliable to provide ear-specific estimates of the type, degree and configuration of hearing loss. Low frequency probe tone tympanometry was performed on all of the subjects to detect middle ear pathology. Tympanograms were described qualitatively by three types: type A found in the normal middle ear; type B found in those with middle ear effusion; and type C tympanogram found in those with negative middle ear pressure.

### **Statistical analysis**

Descriptive statistics were used to analyze the prevalence of hearing disorders (*i.e.*, percentage). The Chi-squared test was used to determine the association of hearing loss with sex, age and cleft type ( $p \leq 0.05$ ).

## **Results**

The demographic characteristics of the patients are presented in Table 1. There were 234 patients with cleft lip and/or palate investigated for hearing (range, 4 months to 33.8 years of age; mean 3.11 years; median 1.9 and mode 1.3 years).

On review of the data, 48 patients (20.51%) had normal hearing in both ears and 186 (79.49%) already had unilateral or bilateral hearing loss at their first hearing assessment. A total of 165 patients had bilateral conductive hearing loss. Sixteen patients had unilateral conductive hearing loss (Table 2). There was a greater prevalence of conductive hearing loss in all cleft patient groups.

There was no significant difference in the proportion of males vs. females vis-a-vis hearing loss ( $p > 0.05$ ) (Table 3). The current study revealed that the hearing loss of patients  $\leq 3$  years of age was significantly greater than patients  $> 3$  years of age ( $p < 0.001$ ). No significant difference among the three cleft type categories was found for proportion of hearing

loss ( $p > 0.05$ ).

Of 468 ears, 361 had hearing loss: a moderate degree in 181 (50.84%) (Table 4). The lowest prevalence was of profound hearing loss found in 1 patient (both ears; 0.56%) with bilateral cleft lip and palate which had resulted in bilateral mixed hearing loss. Two patients had bilateral severe mixed hearing loss.

Type B tympanogram was found in 335 of the 461 ears (72.67%) while type A was found in 98 (21.26%), and type C in 28 (6.07%). The tympanometry results of 7 ears in 4 patients were lost: (i) 1 patient had bilateral ear drainage at the time of the test; (ii) 1 had tympanic membrane perforation in one ear and type A tympanogram in the other; and (iii & iv) the test was lost for two. According to cleft types, the frequency of type B tympanogram was highest and usually in persons with unilateral cleft lip and palate group ( $n = 187$  ears; 77.27%) (Table 5).

## Discussion

The current study delineates the hearing status of patients with cleft and/or palate treated at Srinagarind Hospital. The report confirms earlier reports<sup>(23)</sup> that hearing impairment is strongly associated with cleft lip and/or palate. Most other researchers found that the percentage of patients with cleft palate with hearing loss and middle ear problems varies between 30% and 93%<sup>(10-14,24-26)</sup>.

The findings of the current study, however, stand in sharp contrast with the study by Chu and McPherson<sup>(15)</sup> who studied patients with all types of clefts in Hong Kong and found that 20% of the study group (13.4% of patient ears) had failed the hearing screening. One of the main reasons for the discrepancy could be the data collection from different age groups; the authors collected data from children  $\leq 3$  years ( $n = 156$ , 66.67%) while Chu and McPherson collected the data on children  $> 7$  years ( $n = 153$ , 85%). Nearly 98% of the patients in their study had repaired cleft palate prior to the hearing screening. This would partly account for the low prevalence of hearing problems found in their study. Importantly, too, after 7 years of age, morphological changes in the Eustachian tube occur, leading to improved tubal function and, consequently, improved hearing status.

There is controversy over the relationship of cleft lip and/or palate, age and hearing status. The current study showed that gender did not significantly affect hearing status. This finding agrees with earlier studies<sup>(15,17)</sup>. In the current study, age was significantly related to hearing status; again, this finding agrees

with the earlier studies<sup>(16,17,27)</sup>. By contrast, however, other studies have found age did not affect hearing status<sup>(15,19)</sup>.

There was no evidence that cleft type had any statistically significant affect on hearing problems: this finding agrees with studies performed by others<sup>(15,17,28)</sup>. However, contrasting results have also been noted; in which some patients with an isolated palate had a higher incidence of hearing loss than those with cleft lip and palate<sup>(25)</sup>.

It is well established that the majority of individuals with cleft palate that have a hearing loss also have a bilateral conductive hearing loss<sup>(16,23)</sup>. Unilateral cleft lip and palate is more common than bilateral cleft lip and palate and isolated cleft palate, which co-relates with earlier reports<sup>(7,29,30)</sup>. There is, however, little agreement regarding the corresponding severity of cleft associated hearing loss. The literature dealing with this aspect of hearing loss in cleft palate is sparse. The degree of hearing loss in the current study ranged from mild conductive hearing loss to moderately severe conductive hearing loss. This finding agrees with previous research<sup>(16,17,31)</sup>. Handziae-Cuk et al<sup>(16)</sup> found that most types of clefts also resulted in moderate to severe conductive hearing loss. Gould and Muntz<sup>(17)</sup> reported that the hearing loss among young children with non-syndromic cleft lip and palate is mainly moderate. This severity of hearing loss can, nevertheless, result in linguistic problems because language learning is negatively affected. It has been postulated that cognitive and academic performance can also be affected because these areas are inseparably related to the psycho-socio-linguistic domains.

Although most of those in the hearing loss group in the current study had conductive hearing loss, one patient with isolated cleft palate had bilateral symmetrical moderate sensorineural hearing loss. His first visit was at 4 years of age and there was not any history on past illness. The probable cause of hearing loss in this case could therefore be due to either genetic or unknown factors. Bergstrom and Hemenway<sup>(32)</sup> found that 26% of 58 children with submucous cleft palate had sensorineural hearing loss (SNHL) and they speculated that the SNHL in twelve cases could have resulted from the diffusion of toxin products from an infected middle ear into the inner ear. Two children in their study<sup>(32)</sup> may have had hearing losses due to genetic factors or unknown causes and one because of exposure to loud noise.

Tympanometry is the test of eardrum movement, middle ear pressure and Eustachian tube

**Table. 1** Demographic characteristics of patients with cleft lip and palate

Subjects (n = 234)	No.	%
Sex		
Male	113	48.29
Female	121	51.71
Age (Years)		
0 to 3	156	66.67
3 to 6	41	17.52
6 to 9	10	4.27
9 to 12	11	4.70
12 to 15	3	1.28
15 to 18	2	0.85
18 to 21	5	2.14
21 +	6	2.56
Type of cleft lip/palate		
Group I; isolated cleft palate	50	21.37
Group II; unilateral cleft lip and palate	121	51.71
Group III; bilateral cleft lip and palate	63	26.92

**Table. 2** Types of hearing loss among the different groups of cleft patients

Cleft Type (No. of Patients) n = 234	Hearing Status										Total
	Bilateral Normal		Bilateral conductive		Unilateral conductive		Bilateral Mixed		Bilateral Sensorineural		
	No.	%	No.	%	No.	%	No.	%	No.	%	
Group I	16	32	31	62	1	2	1	2	1	2	50
Group II	18	14.88	93	76.86	10	8.26	0	0	0	0	121
Group III	14	22.22	41	65.08	5	7.94	3	4.76	0	0	63
Total	48	20.51	165	70.51	16	6.84	4	1.71	1	0.43	234

**Table. 3** Effect of sex, age and cleft type on hearing status

Subjects (n = 234)	No.	Hearing status			
		Normal hearing		Hearing loss	
		No.	%	No.	%
Sex.					
Male	113	24	21.24	89	78.76
Female	121	24	19.83	97	80.17
Age (years)					
≤ 3	156	16	10.26	140	89.74
> 3	78	32	41.03	46	58.97
Type of cleft lip and palate					
Group I	50	16	32	34	68
Group II	121	18	14.88	103	85.12
Group III	63	14	22.22	49	77.77

**Table. 4** Degree of hearing loss with different groups of cleft patients

Cleft Type (No of Ears; n = 356)	Degree of Hearing Loss									
	Mild		Moderate		Moderately severe		Severe		Profound	
	No.	%	No.	%	No.	%	No.	%	No.	%
Group I	26	38.81	34	50.75	5	7.46	2	2.98	0	0
Group II	76	38.78	97	49.49	23	11.73	0	0	0	0
Group III	28	30.11	50	53.76	11	11.83	2	2.15	2	2.15
Total	130	36.52	181	50.84	39	10.96	4	1.12	2	0.56

**Table. 5** Tympanometric findings among the different groups of cleft patients

Cleft Type (No. of Ears; n = 461)	Type of Tympanogram					
	Type A		Type B		Type C	
	No.	%	No.	%	No.	%
Group I (98)	26	26.53	64	65.31	8	8.16
Group II (242)	43	17.77	187	77.27	12	4.96
Group III (121)	29	23.97	84	69.42	8	6.61
Total	98	21.26	335	72.67	28	6.07

function. In the current study and two earlier studies<sup>(7,33)</sup>, more than half of the patients had type B tympanogram, indicative of middle ear effusion, which is more frequent in unilateral cleft lip and palate than in bilateral cleft lip and palate and isolated cleft palate. In the current study, type B tympanogram had the highest correlation with a conductive hearing loss except in the case of one 2.4 year-old female who had normal hearing with type B tympanogram in the affected ear. We explored the data and noted that the hearing sensitivity in that ear was poorer than the other but the range was within normal limits ( $\leq 25$  dBHL). We concluded that she had some degree of hearing loss from her baseline, caused by middle ear pathology.

Type A tympanogram indicates normal middle ear function. In patients with cleft lip and/or palate with conductive hearing loss, type B tympanogram is not usually found, and yet in the current study the authors encountered 4 ears in 3 patients that were type B. In routine evaluations, low frequency probe tone tympanometry is used: this represents a limitation when assessing the middle ear status of young infants. In infants from birth to seven months of age, false tympanometric findings are possible in ears with a middle ear pathology. According to one study<sup>(27)</sup>, in

such cases, type B tympanometric results-suggesting middle ear effusion-may be considered, but type A tympanometric results in young infants may be erroneous. Jacobson and Jacobson<sup>(34)</sup> suggested that when type A tympanogram is found in young infants, it should be tested with high-frequency probe-tone tympanometry or wide-band reflectance-tympanometry, to confirm or refute the earlier test result.

### Conclusion

The age of a patient has a significant relationship on audiological status. Most commonly found in the current study were (a) moderate conductive hearing loss and (b) type B tympanometric results, indicative of middle ear effusion. Most of our cases were  $\leq 3$  years of age; at this age, children begin to develop speech & language and communication skills at home. The authors encouraged parents to monitor their children's hearing carefully and urged them to have their children checked by an audiologist experienced in the assessment of the patient's with cleft lip and/or palate. Due to the high prevalence of hearing impairment in cleft lip and/or palate, routine audiological assessment is warranted. An overall hearing profile for children with cleft lip and/or palate

should be conducted as early as possible in the longitudinal treatment plan. Further prospective investigations of the prevalence of hearing loss in children with cleft lip and/or palate should be considered, and endorsed in the national healthcare policy; to heighten awareness and to prevent hearing loss among affected children.

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#### Potential conflicts of interest

None.

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## ลักษณะทางการได้ยินของผู้ป่วยปากแหว่งเพดานโหว่ในโรงพยาบาลศรีนครินทร์

พนิดา ธนาวิรัตน์านิจ, เบญจมาศ พระธานี, สงวนศักดิ์ ธนาวิรัตน์านิจ

**วัตถุประสงค์:** เพื่อศึกษาลักษณะทางการได้ยินของผู้ป่วยปากแหว่งเพดานโหว่

**วัสดุและวิธีการ:** เป็นการศึกษาแบบย้อนหลังเชิงพรรณนา นำข้อมูลจากแบบบันทึกการตรวจผู้ป่วย ปากแหว่งเพดานโหว่ของโรงพยาบาลจำนวน 234 คน ที่ได้รับการประเมินการได้ยิน ณ โรงพยาบาลศรีนครินทร์ในช่วงเดือนมิถุนายน พ.ศ. 2550 ถึง เดือนกันยายน พ.ศ. 2553 ข้อมูลทางการได้ยินจะถูกแสดงในเชิงพรรณนา

**ผลการศึกษา:** พบว่าผลตรวจการได้ยินครั้งแรกมีการได้ยินผิดปกติของหูข้างเดียวหรือหูทั้งสองข้าง จำนวน 186 ราย คิดเป็นร้อยละ 79.49 โดยพบการสูญเสียการได้ยินแบบการนำเสียงเสียทั้ง 2 ข้างมากที่สุด คิดเป็นร้อยละ 88.71 การสูญเสียการได้ยินแบบการนำเสียงเสียข้างเดียว จำนวน 16 คน คิดเป็นร้อยละ 8.6 พบการสูญเสียการได้ยินระดับปานกลางจำนวน 181 หู คิดเป็นร้อยละ 50.84 ผลการตรวจสมรรถภาพหูชั้นกลางพบมากคือ ชนิด B พบจำนวน 335 หู คิดเป็นร้อยละ 72.67 และพบว่าอายุของผู้ป่วยมีความสัมพันธ์กับลักษณะทางการได้ยิน

**สรุป:** พบว่าอุบัติการณ์ของการสูญเสียการได้ยินในผู้ป่วยปากแหว่งเพดานโหว่ในการศึกษานี้อยู่ในระดับสูง ดังนั้นการประเมินการได้ยินควรกระทำโดยเร็วที่สุดเท่าที่จะทำได้ โดยเฉพาะอย่างยิ่งในกลุ่มเด็ก ควรมีการศึกษาอุบัติการณ์ของการสูญเสียการได้ยินในเด็กปากแหว่งเพดานโหว่มากขึ้น และผลักดันให้เป็นนโยบายสุขภาพแห่งชาติในการเฝ้าระวังและป้องกันภาวะของการสูญเสียการได้ยินในเด็กกลุ่มนี้

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