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Audiological findings in cleft palate patients attending speech camp

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Background & objectives **: Hearing impairment is one of the associated problems seen particularly in children with cleft palate rather than cleft lip alone. This has received very little attention in the area of cleft care although research shows that hearing impairment affects language development The present study was carried not to find out the type and pattern of audiogram in cases attending a speech camp, average degree of hearing loss and its relation to the side of cleft, and the acoustic immittance findings and its relation to the otological evaluation. The parental awareness about the hearing problem was also assessed.**

Methods **: The study was conducted on cleft palate patients attending a speech camp. In all, there were 43 patients (19 males and 24 females) in the age range of 3-22 yr. All had undergone audiological assessment, speech and language evaluation, and otological evaluation using standard procedures.**

Results **: Hearing loss was seen in 38 (88.38%) patients. It was the first audiological assessments they ever had. The average pure tone Thresholds revealed a reverse-ski pattern with a wide air-bone gap. The degree of hearing loss ranged from 25 to 68 dB indicating that untreated otitis media resulted in moderate to moderately severe degree of hearing loss. The immittance findings supported the extent of extracranial complications identified on otoscopic examination. There were more patients with unilateral cleft of the left side with greater hearing loss in the ear alongside the cleft.**

Interpretation & conclusion **: Hearing loss is prevalent in more than three - forth of the patients attending the speech camp. There is a need for early identification and intervention of middle ear effusion for all cleft palate cases.**

Key words Audiogram - cleft palate - hearing impairment - immittance - pure - tone threshold - speech camp

Cleft lip and palate is one of the common conditions referred to a speech and hearing clinic. Cleft of the lip, palate or both has a birth prevalence rate ranging from 1/1000 to 2.69/1000 amongst different parts of the world[1]. Asians are at highest risk than Caucasians or blacks. The sex distribution shows a tendency of males being more affected than females. The ratio of unilateral primary and secondary cleft to bilateral clefts is 2:1. Among unilateral clefts, left side cleft is reported to be more common than right side cleft[1-3]. It is a congenital condition and is said to occur during the first 12 wk of gestation. Hearing impairment is one of the associated problems seen particularly in children with cleft palate rather than cleft lip alone.

The part of the ear, which is usually, affected in a child with cleft palate is the middle ear. In general, 100 per cent of the children by age seven must have suffered

from atleast one episode of otitis media/middle ear effusion[4]. Usually by age 6 or 7 yr, as anatomical development of the face takes place superior-inferiorly, the Eustachian tube assumes a diagonal shape from its horizontal shape, observed in infancy. With change in shape, infection from the throat does not have a direct access. Thus the problem of middle ear infection and blocked Eustachian tube tends to decrease with age. Cleft palate is one of the high risk factors for otitis media. The incidence in such children is as high as 100 per cent[5,6]. This condition, known as middle ear effusion continues to exist for several years if left untreated.

Common complications associated with otitis media are more insidious in nature. The complications may be extracranial/intracranial. The degree of hearing loss is directly proportional to the amount of fluid present. The average hearing loss ranges from 15 to 45 decibel hearing level (dB HL). Sensori-neural hearing loss may also result due to inflammatory toxins diffusing through the round and oval window membranes resulting in serous labyrinthitis/organ of corti damage[7].

Little attention has been paid to the implication of otologic histories in individuals with cleft palate, although hearing impairment affects the overall development of a child. We therefore undertook this study to find out or investigate the type and pattern of audiogram in cleft lip and palate subjects attending a speech camp, the average degree of hearing loss and its relation to the side of cleft and to assess the acoustic immitance findings and compare its relation to the otological evaluation. The parents were also assessed for their awareness about hearing problem in their children.

Material & Methods

Subjects: The subjects included in this study were children and adults who attended the speech camp "Cleft Palate to Clear Speech" organized at Ali Yavar Jung National Institute for the Hearing Handicapped, Southern Regional Centre (AYJNIHH, SRC), Secunderabad, in collaboration with the Department of Plastic Surgery, Nizam's Institute of Medical Sciences (NIMS), Hyderabad, and Reconstructive Surgery Foundation - Earthspeak, U.S.A. In this camp, pre- and post-operative assessment of speech, the surgical intervention and need for second surgery were decided for these subjects. The children who could benefit from speech therapy were trained using the corrective babbling approach[8] for a period of one week.

A total of 43 patients reported at the camp held from September 13-24, 2004. Of these, 19 were males and 24 were female patients. The age range for male patients was 4 to 22 yr with a mean age of 12.6 ± 5.34 yr. The female patients were between the ages 3 to 22 yr with a mean age of 10.44 ± 4.64 yr. The patients were further classified using the Nagpur classification[9]. There were in all 38 patients with group III cleft, 4 with group II cleft and one with group I cleft. All the patients had surgical treatment and correction at NIMS, Hyderabad.

Hearing assessment was done on all subjects using the following:

(i) Pure Tone Audiometer, Orbiter 922 (Madsen, Denmark) with TDH 39 earphone with MX 41/AR cushions and oticon Bone Conduction vibrator was used. The Pure tone audiometry was used to determine hearing thresholds for pure tone stimuli for each ear.

(ii) Immittance Audiometer, Amplied 750 (Amplied, Italy)- Immittance audiometer with TDH 49 earphone, 226 Hz probe tone frequency, was used to evaluate the middle ear function of each ear of the clients. It was used as a crosscheck test to confirm the provisional diagnosis made using the pure tone audiometry. It also served to compare the findings with that of the otological evaluation.

(iii) Otoscope Welch – Allyn Pocket Scope (Germany) was used.

All the audiological tests were conducted in a sound field room with ambient noise levels conforming to American National Standards Institute (ANSI)[10]. The speech & language evaluation and ear nose throat evaluation were carried out in cubicles, which were relatively quiet and free from distractions.

The instruments used for the audiological evaluation were calibrated with 2230 Sound Level Meter with, 1625 octava filter set, 4151 Artificial ear and 4930 Artificial Mastaid (Bruel & Kjaer, Denmark)

Assessment procedure :

(i) Audiological assessment: Pure tone audiometry was administered on all the subjects using the standard procedure[11]. The thresholds obtained by air conduction (AC) and bone conduction (BC) were plotted on an audiogram sheet. The pure tone average (PTA) was calculated for each ear. Next the immittance test battery comprising of tympanogram and acoustic reflex threshold were obtained in each ear separately for each patient. The results of immittance test and pure tone audiometry were used to arrive at the provisional diagnosis.

To arrive at the type and degree of hearing loss standard classification was used[12]. The immittance test results were also interpreted using standard method for classification of tympanograms[13].

(ii) Speech and language assessment: The core components of the speech and language assessment included; (a) Case history: prenatal, perinatal and postnatal history including feeding problems and motor milestones, surgical history, associated medical conditions, dentition and educational history; (b) Physical examination: oro-facial examination; (c) Perceptual evaluation: articulation, nasality, compensatory articulation such as glottalization, nasal grimaces, palatalization and pharyngeal fricatives; and (d) Rating of speech intelligibility: known/unknown context.

(iii) ENT evaluation: Otoscopic examination was done for each patient by an experienced ENT specialist.

Results

The averaged of the air conduction (AC) and bone conduction (BC) thresholds of right and left ears, obtained for the frequencies 250, 500Hz, and 1, 2, and 4KHz are shown in Fig. 1 and 2. The mean of the average pure tone thresholds showed a reverse - ski pattern for air conduction threshold with an air bone gap which is the typical audiometric pattern seen in cases with middle ear effusion. The type of hearing loss generally found in both male and female cases was conductive type of hearing loss. The PTA was 30 dBHL for right ear and 34 dBHL for the left ear in male cases. In case of the females, the PTA was 23 and 31dBHL for right and left ear respectively.

Table I shows AC and BC thresholds for right and left ears in male and female cases. The PTA range of the individual cases (N = 43) was also determined. The PTA range in the right ear was 25 to 68.03 dB and in the left ear it was 25 to 61.06 dB.

Five cases had hearing within normal limits in both ears, 10 had asymmetrical hearing loss with normal hearing in one ear and conductive hearing loss in the other, 25 cases had bilateral conductive hearing loss and 2 had asymmetrical hearing loss with conductive hearing loss in one ear and mixed hearing loss in the other. One

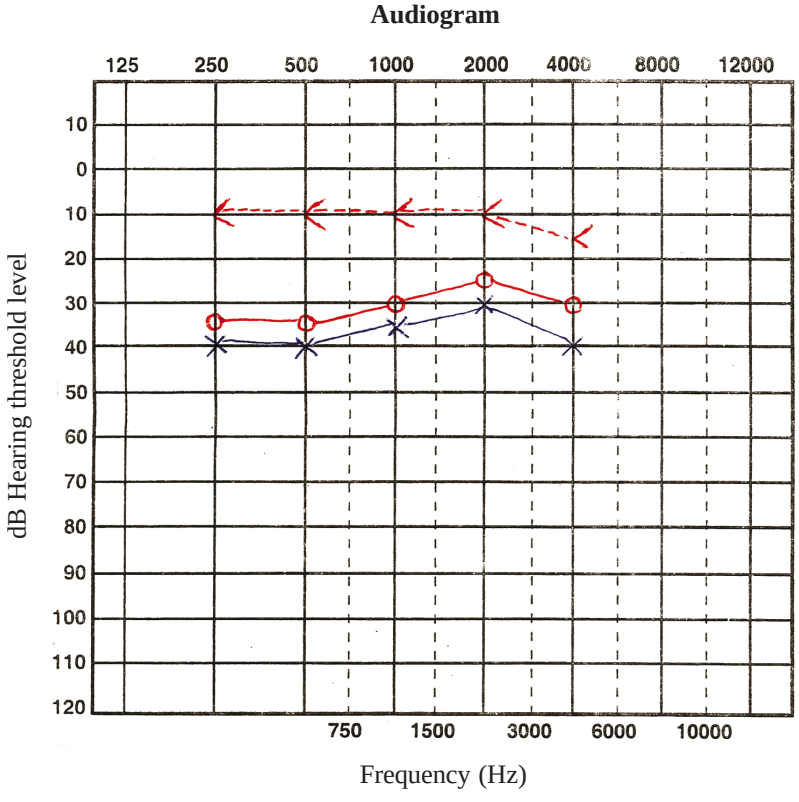

Fig. 1. Average audiometric thresholds for air and bone conduction (AC and BC) for male subjects (N=19)**. O**: Right ear air conduction thresholds; **X** : Left ear air conduction thresholds; < : Right ear unmasked bone conduction thresholds.

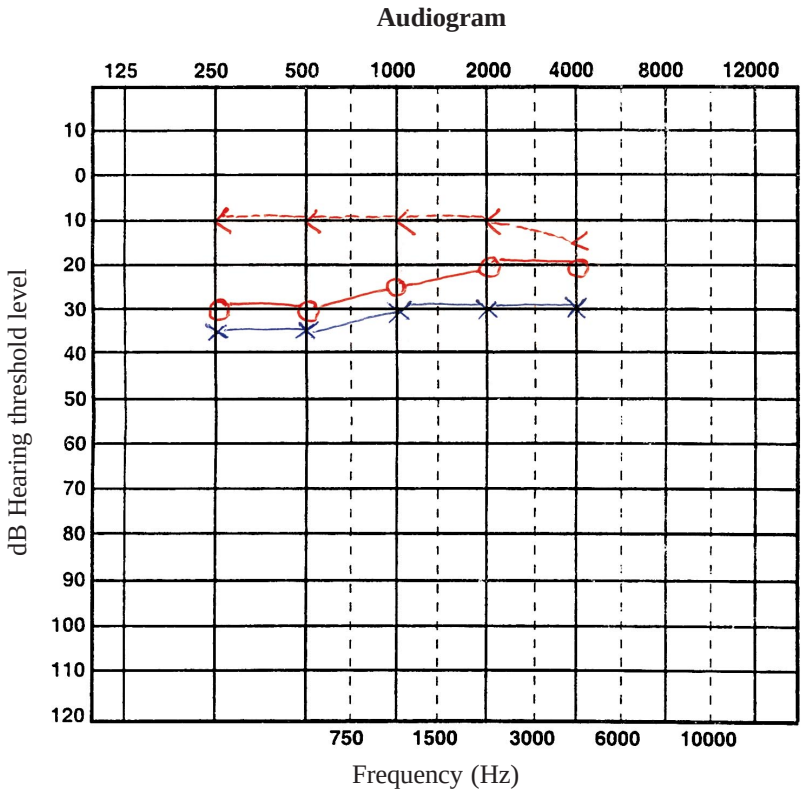

Fig. 2. Average audiometric thresholds for air and bone conduction (AC and BC) for female subjects (N=24)**. O**: Right ear air conduction thresholds; **X** : Left ear air conduction thresholds; < : Right ear unmasked bone conduction thresholds.

Table I. Means of air conduction and bone conduction (AC, BC) thresholds(dBHL) and pure tone average (PTA) obtained for male and female cases

Frequency (Hz)	Male (N =19)			Female (N=24)		
	Air conduction thresholds		Bone conduction thresholds	Air conduction thresholds		Bone conduction thresholds
	Right ear	Left ear	Common	Right ear	Left ear	Common
250	33.68	38.95	9.47	27.71	35.21	10
500	34.74	39.47	7.63	27.92	35.21	10.2
1000	30.00	33.16	9.47	22.92	30.83	8.33
2000	25.26	28.95	10.52	19.79	27.50	10.62
4000	27.63	37.89	13.68	20.21	27.92	12.5
(PTA) 0.5+1k+2k	30.00	15.84		16.31	23.42	

The audiometry was carried out after the ENT evaluation and removal of the wax

case was found having bilateral mixed hearing loss (Table II). Overall, 38 (88.4%) cases had hearing impairment.

Table III shows the tympanogram patterns seen in each ear of the cases and the probable middle ear pathology indicated by the tympanometric pattern (N = 43, number of ears =71). ENT evolution results of both the ears of cases (N=86) showed that 29 ears each had retracted tympanic membrane (TM) and impacted was respectively, 10 had Chronic Suppurative Otitis Media (CSOM), 8, 4 and 6 had ear discharge, otomycosis and NAD respectively.

Table II. Type of hearing loss seen with different groups of cleft palate patients

(N=43)

Groups of cleft palate (N)	Hearing within normal limits	Bilateral . conductive Hearing loss	Asymmetrical hearing loss		Mixed hearing loss
			Normal + conductive	Conductive+ mixed	
I (1)	-	1	-	-	-
II (4)	-	3	1	-	-
III (38)	5	21	9	2	1
Total (43)	5	25	10	2	1

Patients were divided in groups I to III based an information available in Ref. 9.

Table III. Immittance audiometric findings in cleft palate cases

Tympanograms types[14]	No. (%) of ears	Possible pathology[13]
A	14 (19.72)	No significant middle ear pathology
As	05 (7.04)	Ossicular fixation
Ad	01 (1.40)	Ossicular discontinuity
B	45 (63.38)	Middle ear effusion, ear discharge, wax
C	03 (4.23)	ET dysfunction
Cs	03 (4.23)	Ossicular fixation + ET dysfunction
Ears tested	71	
All 86 ears not tested		

Table IV. Distribution of types of cleft cases seen in both genders

Types of cleft	Gender		Total	Percentage
	Male	Female		
*Unilateral	12	14	26	60.46
Bilateral	7	10	17	39.54
Total	19	24	43	

* Unilateral cleft of palate (Right 03 cases, Left 14 cases, Information not available - 09 cases)

Of the 43 cases, 26 (60.5%) reported with unilateral clefts and 17 (39.54%) had bilateral clefts (Table IV). The mean age of the first surgery of lip and/or palatal being 2.7 yr and 5.0 yr respectively (Table V).

Discussion

The case history information of cases revealed that most of the parents/caregivers accompanying the cases were unaware of the hearing problems in their child/ward. Most/all of them attended the speech therapy for the first time during this camp.

Table V. Distribution of cleft palate cases for the first lip and palate surgery

(N = 32)

Surgeries (N)	Mean chronological age (yr)	Gender	Mean age of surgery (yr)	Mean chronological age (yr) for both sexes	Mean age of surgery (yr) for both genders
1st lip	11.42	Male	2.11	10.44	2.7
surgery (32)	9.01	Female	2.2		
1st surgery	11.02	Male	4.11	10.94	Approx.
of the palate (43)	10.87	Female	5.11		5.00

* For 11 cases the first surgery details were not available

The reasons for not attending speech therapy earlier may be attributed to lack of motivation/availability of facility and financial problems.

The audiometric findings supported the earlier reports[5,15] that hearing impairment is one of the associated problems seen in children with cleft palate. The average degree of hearing loss ranged from minimal conductive hearing loss to moderately severe conductive hearing loss. This supported the case history findings that, due to lack of parental awareness, middle ear effusion has remained untreated resulting in mild to moderately severe degree of hearing loss. Extracranial complications were also evident in the cases seen at the camp. Audiological findings and ENT diagnosis supported earlier report[7] .

In this study also unilateral cleft palate was more common than bilateral cleft palate which co-related with the earlier survey reports[1- 3] .

The PTA was higher in the left ear in both males and females *i.e.,* 34 and 31dBHL respectively when compared to the right ear, which was 30 and 24dBHL in male and female cases respectively. This showed that the hearing loss was greater in the ear alongside the cleft similar to the earlier report[2].

The type of tympanogram findings in the cases attending the speech camp revealed that 63.38 per cent had B-type tympanogram, indicative of middle ear effusion/ wax/ear discharge which supported the earlier report[14]. The otological evaluation conducted on the cases seen in the speech camp revealed that 88.38 per cent of the patients were diagnosed as having wax/CSOM/ear discharge/ retracted tympanic membrane. The observation supported the relationship between the muscles of the soft palate at the posterior end of the oral cavity and the muscles of the Eustachian tube. Because of the cleft palate these groups of muscles fail to function appropriately thereby, affecting the ventilation and drainage through the Eustachian tube, which in turn results in middle ear effusion. There is evidence indicating that the Eustachian tube function improves with surgical closure of the palate and with age[6].

There is an urgent need to document the otological and audiological findings in the Indian craniofacial anomalies Register as the effects of conductive hearing loss on the auditory comprehension skills is evident in the literature. This issue may be tackled by making audiological assessment and otological diagnosis as a pre-requisite for cases scheduled for surgery. The CLP team may have to take the initiative to make timely reference, in order to carry out early identification and early intervention of middle ear effusion in these children.

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