Audiometrically "Normal" Conductive Hearing Losses among the Cleft Palate

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In 1964, Davis and Kranz (*3*), among others, recommended that the reference thresholds for audiometer calibration be changed from those of the American Standards Association to those adopted by the International Organization for Standardization. These authors advised that thresholds poorer than audiometric zero be expressed in decibels *Hearing Threshold Level,* instead of the former *Hearing Loss.* Normal threshold sensitivity range was assumed to be from −10 to 26 dB, Hearing Level (HL), and hearing "impairment," using the AAOO method of computing hearing disability (*6*), was assumed to begin at a speech-frequency average of 26 dB, HL. While this advice is defensible from a practical view of typical impairment, a too literal acceptance of it may lead to unwarranted complacency for hearing threshold levels less than 26 dB, HL—particularly for high-risk populations such as the cleft palate.

Prather and Kos (*9*) reviewed the prevalence of hearing loss among the cleft palate population and concluded that not only was the prevalence greater among that group than among groups without clefts, but so also was the prevalence of aural pathology. Sweitzer, Melrose, and Morris (*10*), after reviewing the air and bone conduction audiometric threshold results for 107 cleft palate patients, concluded that the air-bone gap should be included as a criterion in the identification of those within this group who have hearing losses. These latter authors expressed a need for studies comparing air and bone conduction data with otologic findings.

As part of a cleft palate team evaluating children in the State of Washington for the Department of Public Health, The University of Washington Speech and Hearing Clinic conducts audiologic evaluations on children with clefts of the lip and/or palate. A limited sampling of the results of threshold audiometric testing revealed that probably many of the children who would pass conventional hearing screening tests had significant air-bone gaps and, on subsequent otologic examination, were found to have aural pathology. Because of these observations, we became concerned about the relative number of cleft palate children with conductive hearing losses, and perhaps aural pathology, who have audiometrically "normal" hearing and who might be overlooked for treatment.

Procedure

To examine the prevalence of audiometrically "normal" cleft palate children having conductive hearing losses and aural pathology, two audiometric levels of "normal" were selected. One level was established at 25 dB, HL—following the AAOO recommendation mentioned above and the current audiometric screening practice of many school districts (*8*). The second level was set at 20 dB, HL, as recommended by Darley (*2*), Lloyd (*7*), and Anderson (*1*), among others, as the preferred level for audiometric screening.

The University of Washington Speech and Hearing Clinic files were searched for the records of those cleft palate children who were seen for audiologic evaluations at the request of the Department of Public Health between September 1, 1969, and December 31, 1970. Of the 245 cleft palate children seen during this period, the records for 93 were selected for analysis because of the completeness of audiometric data. For each of the 93 at least the following data were available: (1) air conduction thresholds for both ears for the octave test frequencies 250 through 8000 Hertz (Hz), and (2) bone conduction thresholds for the test frequencies 500 through 2000 Hz. Fifty-nine of the 93 (63 percent) were males and 34 (37 percent) were females, with an age range from four to 20 years, and a mean age of 10.3 years. Because of our insistence on complete audiometric data, the 93 cases tended to be older and more familiar with audiometric test procedures than were many of the others in the original group of 245. Thirty-five of the 93 (38 percent) had otologic examinations within plus or minus two weeks of the date of the audiologic evaluation.

The pure tone audiograms for the 93 cases were examined for the following:

1. the number of cases who had air conduction thresholds of 25 dB, HL, or less, for both ears, for the octave test frequencies 500 through 4000 Hz and who would, presumably, have passed an audiometric screening test conducted at 25 dB, HL.
2. the number of cases who had air conduction thresholds of 20 dB, HL, or less, for both ears, for the octave test frequencies 500 through 4000 Hz, and who would, presumably, have passed an audiometric screening test conducted at 20 dB, HL.
3. the number of cases having air-bone gaps of 15 dB or greater at any octave test frequency between 500 and 2000 Hz for either ear.
4. the number of cases found to be otoscopically abnormal.[1]

All audiometric tests had been conducted in a two-room, sound treated testing suite utilizing a Maico model MA-24 clinical audiometer. Under direct faculty supervision, undergraduates and graduates in audiology practicum had performed the actual testing.

[1] Definition of otoscopic abnormality was left to the examining physician. Typical explanatory comments were "classic serous otitis picture," "drum head retracted grade III; increased marginal vascularity and decreased motion with the Siegel Otoscope," and "tympanic membrane thick and retracted grade II with sluggish motion."

TABLE 1. Results of assumed screening at 25 dB, HL.

	total number	*percent*	*air-bone gap*		*otologic abnormality*		
			number	*percent of total*	*total number for whom data available*	*number with abnormal findings*	*percent of total*
total cases.....	93	100	64	69	35	20	57
pass screen.....	57	61	28	49	21	11	52
fail screen.....	36	39	36	100	14	9	64

Results and Discussion

When screening at 25 dB, HL, was assumed, it was found that 61 percent of the 93 cases would have passed, yet of that number almost half (49 percent) had air-bone gaps (Table 1). Of the 39 percent who would have failed the screening, all had air-bone gaps. Otologic data were available for 21 of the 57 who would have passed the screening, and of this number approximately half (52 percent) were otoscopically abnormal. In addition, it was determined that of those who had air conduction thresholds less than 25 dB, HL, and who also had air-bone gaps, 73 percent were otoscopically abnormal. Of the 39 percent who would have failed the screening, otoscopic data were available for 14, and of this number 64 percent were otoscopically abnormal.

When screening was assumed at 20 dB, HL, the results were similar (Table 2). At this screening level half would have passed and half would have failed, but still one-third of those who would have passed had air-bone gaps—as did all who would have failed the screening. Of those who would have passed the screen, otoscopic data were available for 14, and of this number 43 percent were otoscopically abnormal. Sixty-seven percent of those who would have failed the screening, and for whom data were available, were otoscopically abnormal.

Such a high percentage of air-bone gaps and positive otoscopic findings among children who would be classed as audiologically "normal" was not surprising. Eagles, *et al* (*4*) have described an extensive study in which

TABLE 2. Results of assumed screening at 20 dB HL.

	total number	*percent*	*air-bone gap*		*otologic abnormality*		
			number	*percent of total*	*total number for whom data available*	*number with abnormal findings*	*percent of total*
total cases.....	93	100	64	69	35	20	57
pass screen.....	46	49	17	37	14	6	43
fail screen.....	47	51	47	100	21	14	67

the hearing threshold levels for over 4000 children in Pittsburgh schools were evaluated. Six and a half percent of the "most sensitive" hearing group and 15.9 percent of the "intermediate hearing" group (or, approximately, 13.2 percent of the total study population) had one or both ears with an otoscopic abnormality. Based upon data included in Eagles, *et al*'s report, the children in both of these groups would have passed audiometric screening tests conducted at 15 dB, ASA—the standard used in the study.

As there were those with otoscopically abnormal ears found to be audiologically within normal limits, so there were those who were audiologically abnormal who were otoscopically "normal". Of the 39 percent who would have failed a screening test at 25 dB, HL, all had air-bone gaps, yet of those for whom otoscopic data were available, about one-third (36 percent) were without otoscopic abnormality. This observation is consistent also with Eagles, *et al*'s (*4*) report that 45 percent of a group of school children classified as having the poorest hearing of those surveyed, were otoscopically normal.

Eagles, *et al* observed further that among the children having the most sensitive hearing were some who were otoscopically abnormal. In the present study all cases having otoscopic abnormality had also air-bone gaps. Nevertheless, it is believed that with otoscopic data for a much larger number of cases, confirmation of Eagles, *et al*'s report would have been found.

Summary and Conclusions

Threshold audiometric data were collected for 93 school-age children with clefts of the palate. The children were examined at the request of a public supported review board, and were selected, because of the completeness of audiometric data, from a group of 245. Sixty-one percent of the 93 would have passed conventional audiometric screening tests and be classed as having "normal" hearing, yet of those who would have passed a screening, approximately one-half had conductive hearing losses and otoscopic abnormalities.

In agreement with Eagles, *et al* (*4*) otoscopic and audiometric abnormalities were observed simultaneously in some cases and independently in others. Because these abnormalities may exist independently, the adequacy of the hearing mechanism for such high-risk populations as the cleft palate must be determined on the basis of threshold air and bone conduction audiometry and otoscopy.

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