CLINICAL USEFULNESS OF SENSITIVITY PREDICTION BY ACOUSTIC REFLEX (SPAR) IN EVALUATING HEARING IN CHILDREN

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Assessment of hearing In children is more interesting and meaningful to-day The arrival of immittance testing and brainstem evoked response audiometry (BERA) has revolutionized the previously less exciting measurement of hearing in children. One such revolution is prediction of hearing loss using acoustic reflex.

Prediction of hearing loss using acoustic reflex is based on the concept of *noise-tone difference,* i.e., the acoustic reflex is elicited at low intensity levels by noise than tone. This difference is reduced in subjects with sensorineural hearing loss. Based on this concept several prediction methods have come into existence. And sensitivity prediction using Acoustic Reflex (SPAR) is one of them (Jerger *et al,* 1974).

SPAR's accuracy of prediction is better in children (Jerger *et al.* 1978; Norris, 1980) and such a prediction is essential for obvious reasons in early aural rehabilitation. There are only a few attempts to predict hearing loss in young children in this country. Hence this attempt.

Basically answers for three questions were looked for. They are:

1. Do children exhibit reflex thresholds for noise at lower levels than tone.
2. Can noise-tone difference be used to predict hearing thresholds in subjects with sensorineural hearing loss.
3. Can children with sensorineural hearing loss be differentiated from normal hearing children.

Method

Subjects

Thirty-six children (19 males and 17 females) in the age range 5 to 10 years Were utilized. All. of them had normal hearing ascertained by a puretone hearing evaluation. They were included in the experiment if only they met the following criteria.

1. A type tympanograms in both the ears.
2. Middle Ear Pressure within—50 mm. H_2O
3. Normal Acoustic Reflex thresholds in both the ears.
4. Negative otological history.

three subjects with sensori-neural hearing loss were also evaluated to check whether they would be distinguished from normal hearing children.

Apparatus

Immittance evaluation was performed using a commercially available electro' acoustic bridge (Madsen, ZO 73) with its associated X-Y plotter Hewlett Packard 701 OB. Contralateral reflexes were elicited using Telex 1470 earphone enclosed in MX-41/AR cushion.

A Portable Screening Audiometer Maico MA30 was used to determine the air conduction thresholds. Impedance bridge used in this study was calibrated periodically. The procedure was based on the recommendations of Jerger *et ah* (1974), Feldman and Wilber (1978) and Robinson and Brey (1978). The audiometer was calibrated periodically for earphone intensity, frequency and linearity check.

Procedure

The subjects were asked to raise their finger whenever they heard a ' pip' sound. They were told to respond even very soft tones. Children below 6 years were asked to drop a block or move bead of an abacus whenever they heard a ' pip ' sound.

Pure-tone thresholds were measured for audiometric test frequencies 250 through 8000 Hz., using Modified Hugson-Westlake procedure (Carhart and Jerger, 1959). For immittance testing, the subjects were familiarized in order to reduce fear. They were asked to sit quietly and not to swallow while testing. All ears were examined otoscopically before inserting the probe into the ear canals. A suitable ear tip was used and hermetic seal was obtained. Both the ears were evaluated. Specially the procedure included tympanometry from 200 to 400 mm H_2O, static compliance measurements and determination of contralateral acoustic reflex thresholds. Acoustic reflex thresholds were determined for pure-tone signals of 500 Hz., 1000 Hz., and 2000 Hz., and broad-band noise. The duration of the tone was for 1.5 sees, and the inter-stimulus interval was maintained at 3 seconds. Hearing loss was predicted using the method of Jerger *et ah,* (1977).

The formula was

	Average	Average	Average	Average .	
	reflex thres-	reflex thres-	reflex thres-	reflex thres-	Correction
Noise tone	hold at 500	hold at 1000	hold at 2000	hold for broad	factor
difference =	Hz. (HL) +	Hz(HL)	+ Hz(HL)	-band	+

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The. correction factor was determined biologically. The average reflex threshold, for broad band noise (BBN) was substracted from average reflex threshold for the three puretone signals, viz., 500, 1000 and 2000 Hz. for the thirty-six subjects.

Discussion and Results

The age range, mean reflex thresholds for puretones and broad-band noise and the computation of correction factor as per the guidelines of Jerger *et al.*, (1974) are illustrated in Table-1 for left and right ear respectively.

TABLE 1

Table showing age range mean reflex thresholds for pure tones and broad-band noise, difference between mean acoustic reflex threshold (ART) for pure tone and noise and the computed correction factor for the instrument used in this study, for right ear and left ear respectively.

Ear	Age Range	Mean acoustic reflex threshold for tones	Mean acoustic reflex for broad band noise	Mean difference of pure-tone acoustic reflex and broad band noise (D)	Correction factor
Left ear	5-10 years	93.27	89.94	3.33	21.67
Right ear	5-10 years	93.57	88.44	5.13	19.87

MThe Mean acoustic reflex threshold for puretone between ears is negligible •(in the order of 0.30dB). Similarly, the difference between acoustic reflex threshold for noise between the ears is negligible. The acoustic reflex threshold for broad-band noise and pure-tone when compared yield a small difference of 3.33 and 5.13dB for left and right ear respectively. However, the broad-band noise elicits acoustic reflexes at low intensity Levels than the tonal stimuli. This is in agreement with previous studies (Moller, 1962; Fisch and Schulthes, 1963; Dallos, 1964; Lilly, 1964; Djupesland *et al.*, 1967; Deutsh, 1972; Peterson and Liden, 1972; Mythili, 1976, and Hall, 1980). Also it answers the first questions of this study. That is, the children also exhibit low reflex thresholds for broad-band noise than for tonal stimuli.

The computed correction factor for the instrument used in this study (Madsen Z0 73) were 21.67 and 19.87 for left and right ear respectively. These values are higher than the ones obtained by Sudha Murthy (1980). She had obtained 13.8 in left ear and 12.16 in right ear.

The mean acoustic reflex thresholds and standard deviations for pure-tones and broad-band noise for both the ears are illustrated in Table-2. The obtained standard deviations indicate a high variability among the reflex thresholds and a similar trend runs through all the stimuli. The mean shows the concentration of reflex threshold around 95dB HL for 500 Hz., 91 dB HL for 1000 Hz. and 94 dB HL for 2000 Hz. The mean acoustic reflex threshold for broad-band noise is around 88 to 89dB. However, the acoustic reflex thresholds for broad-band noise is better than acoustic reflex threshold for tonal stimuli as expected.

TABLE 2

Table showing Mean Acoustic Reflex Thresholds with standard deviation for pure-tones 500, 1000, 2000 Hz. and broad band noise, for Left and Right ears

	500		1000		2000		Broad band noise	
	Left	Right	Left	Right	Left	Right	Left	Right
Mean	95.25	94.08	90.75	92.33	94.66	94.30	89.94	88.44
Standard Deviation	7.30	6.33	7.66	5.08	9.25	7.79	9.21	8.17

The computed product movement correlation values for test-retest reflex thresholds for all stimuli indicate high reliability.

The average acoustic reflex thresholds for pure-tones ranged from 80-116 dB HL which is comparable to that obtained by Raghunath (1977, 85 to HOdB SPL) and also to that of Niemeyer and Sesterhenn (1974) (73 to 105 dB SPL). The acoustic reflex threshold for broad-band noise varied from 70 to 105 dB SPL in the present study. This range is lightly wider than that of the earlier reports (Niemeyer and Sesterhenn 1974); Raghunath, (1977). The noise-tone difference obtained in this study was 13, in normal hearing subjects. Whereas the NTD for normal hearing subjects in 1974 SPAR is 20 with any SPL of the broad-band noise being 80dB SPL. In the 1977 SPAR, criteria for normal hearing is NTD 20 and 1000 Hz. ART at 95 dB HL, and ART for broad-band noise can be any value.

SPAR criteria for prediction of hearing loss in the present study is illustrated in Table-3. The criteria for normal prediction is NTD should be greater than or equal to 13, and the ART for 1000 Hz. should be less than 100 dB HL and the ART for broad-band noise should be less than 100 dB SPL. When the NTD is less than 13, and the ART for broad-band noise is greater than or equal to ART for 1000 Hz. tone in dBHL, then a moderate sensorineural hearing loss can be predicted. Thus, the second and third questions are answered. That is, the difference between ART for broad-band noise and tonal stimuli can be used to predict hearing threshold level of children with sensori-neural hearing loss. Also a criteria can be constructed to be used for prediction of normal hearing subjects.

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TABLS 3

SPAR criteria for prediction of hearing loss in the present Study

Noise-tone difference	Broad-band noise prediction
13 ART for 1000 Hz 100 dBHL	100 dB SPL (ART) Nortnal
13 for and acoustic reflex threshold for broad-band noise in dB SPL acoustic reflex threshold for 1000 Hz, in dB HL (ANSI, 1969).	Moderate hearing loss

The ART for pure-tones and broad-band noise and the NTD for moderate sensori-neural hearing loss subjects is sown in Table-4. Here the ART for broad-band noise is ART for pure tones. The NTD of < 13 is not applicable to all subjects. Yet the criteria of ART for broad-band noises ART for puretones helps to differentiate between normal and moderate sensori-neural hearing loss subjects.

TABLE 4

Table showing acoustic reflex thresholds for pure tones of SOOHz, 1000Hz, 2000 Hz, Acoustic reflex threshold for Broad Band Noise, and Noise-tone difference for moderate sensori-neural hearing loss subjects (N=4)

SI. No.	Ear	Acoustic reflex threshold for 5OOHz	lOOOHz	2000Hz	Acoustic reflex threshold for Broad-band noise	Noise-tone difference
1.	Left	95	100	105	100	21.67
	Right	105	100	110	105	19.87
2.	Left	95	90	95	100	15.04
	Right	90	95	100	105	9.87
3.	Left	80	85	91	94	13.00
	Right	83	100	124	103	19.14
4.	Left	105	105	105	105	21.67
	Right	105	105	115	110	18.17

From this it is concluded that sensitivity prediction using acoustic reflex is encouraging in normal population and the limited subjects with moderate sensori-neural hearing loss "used in this study. More clinical data is required.

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