A COMPARISON OF REFLEX AMPLITUDE AND DECAY TIME OF CONTRALATERAL AND IPSILATERAL STIMULATION

RAVI SHANKARA SHUKLA S*

Impedance audiometry finds its application in every phase of clinical audiology. It includes tympanometry, static compliance and stapedial reflex test. Of the three measures of impedance audiometry, the stapedial reflex thresholds are probably most useful individually (Jerger, 1970). The stapedial reflex threshold is defined as the lowest intensity at which a visible or recordable deflection of the impedance balance needle occurs consistently with stimulus presentation. Considerable variations may be found in the literature dealing with threshold of the stapedial reflex in man. Weiss et al (1962), while determining the threshold level of the human stapedius reflex found mean values of 96 to 107 dB SPL for 400 to 6400 Hz range. Hall (1977) reports that the stapedius reflex thresholds for 500 to 2000 Hz in normal ears in general varies between 70 and 100 dB HTL. However it is generally agreed that normal hearing subjects exhibit acoustic reflex threshold in the range of 85 to 95 dB HL, for puretones.

It is frequently taken for granted that the acoustically evoked stapedius reflex is bilaterally symmetrical. Moller (1961) reported that crossed reflexes are less excitable than the ipsilateral reflexes in non-anesthetized subjects. Moller (1962) reported an assymetry of the acoustic stapedius reflex with an ipsilaterally 2 to 14 dB lower threshold. Reker (1977), reported the median value of the ipsilateral reflex thresholds. They are 59 dB at 560 Hz, 62.5 dB at 1000 Hz, 67 dB at 2000 Hz and 67 dB at 4000 Hz. The difference between ipsilateral and contralateral stapedius reflex thresholds was in the range of 15 dB. Ouchi (1977) also reported that stapedial reflex thresholds for ipsilateral stimulation were lower than for contralateral stimulation.

And it has been reported by Greinsen and Rasmussen (1970) that the contralateral reflex arc is different from ipsilateral reflex arc.

These studies leave an impression that there may be differences in stapedial reflex amplitude and decay time between contralateral and ipsilateral stimulation.

The present study was conducted to study the stapedius reflex amplitude and decay time for ipsilateral and contralateral stimulation and to arrive at some general conclusions regarding the differences, if existed.

* Junior Research Fellow (ICMR) Department of Speech Pathology, All India Institute of Speech and Hearing, Mysore-6.

METHODOLOGY

Subjects

The study included 4 young adults. Two of them were males. Their ages ranged from 19 to 20 years, with a mean age of 21.5 years. Everyone in the group had bilaterally normal hearing as ascertained by a puretone audiometry (i e., 15 dB HL re. ANSI 1969) for the frequency range of 250 to 8000 Hz. All of them revealed normal tympanogram bilaterally and all of them had normal reflex thresholds. No subject reported a history of ear disease, drug use or serious medical illness and all were otoscopically normal.

Equipment

For preliminary pure-tone audiometry a commercial clinical diagnostic audiometer (Madsen OB 70) was used. The transducers (T.D.H. 30) of the audiometer were housed in cushions (MxLw/AR) and were enclosed by the associated cup enclosure devices. Ascending technique was used to establish thresholds. The experimental instrumentation was a commercial impedance audiometer (Inter acoustics AZ 7). The AZ 7 impedance audiometer is designed according to the proposed ANSI standards for the impedance audiometers and fulfils the requirement for type I instruments. Testing was performed in the sound treated rooms of All India Institute of Speech and Hearing, Mysore.

Procedure :

After establishing the pure tone thresholds, the acoustic impedance of the test ear was measured prior to the start of reflex amplitude measurement. The reflex threshold for the particular test frequency was obtained just before the start of the stapedial reflex amplitude measurement. The whole stapedial reflex amplitude measurement procedure was divided into four conditions.

Condition I In this condition the tones were presented to right ear through the ear phone, left ear was the monitoring ear.

Condition II In this condition the stimulated and monitored ear was left ear.

Condition III In this condition the tones were presented to left ear through the ear phone. Right ear was the monitoring ear.

Condition IV In this condition, stimulated and monitored ear was the right ear.

Each condition involved 4 test frequencies and each test frequency (500, 1000, 2000 and 4000 Hz) in volved 4 sensation levels : 5, 10, 15 and 20 dB SL (ref acoustic reflex threshold). Thus there were 16 conditions in each experiment. In each condition stapedial reflex amplitude was noted for 5,10,15 and 20 seconds. Thus there were 64 readings in each experiment and totally each subject yielded 256 readings. Each experiment was completed in one session, the entire testing for a subject was completed in 4 sessions.

Results

In this study stapedius reflex amplitudes for ipsilateral and contralateral stimulation were measured and analyzed. Here the reflex amplitude is defined as the magnitude of the deflection of the balance meter needle along the compliance scale of the balance meter. Tabulated results are shown in the tables A and B. Tables A and B show average reflex amplitudes of all the 4 subjects, at different levels of intensity and for the duration of 20 seconds.

TABLE 'A' Showing raw data of the subjects average for contralateral (left phone right probe) and ipsilateral (right ear probe stimulation).

Average

CONTRALATERAL RIGHT EAR PROBE							IPSILATERAL RIGHT EAR PROBE						
	REFLEX AMPLITUDE							REFLEX AMPLITUDE					
	SL	1	5	10	15	20		SL	1	5	10	15	20
500	5	5.75	5.25	6.00	5.00	5.25	500	5	7.75	7.50	7.25	7.25	7.25
	10	7.75	7.25	7.25	7.75	8 00		10	11.25	11.25	11.50	11 00	11.25
	15	9.25	9.25	9.25	9.25	9.50		15	12.75	12.75	12. 75	12.50	12.00
	20	11.00	11.25	10.75	10.25	11.25		20	14.75	14.25	14 .00	13.75	13.75
1000	5	8.25	8.25	8.00	8.00	8.00	1000	5	11.75	11.00	10.75	9.50	9.50
	10	10.75	11.00	10.50	10.50	10.50		10	14.50	14.00	13.25	12.50	12.00
	15	12.75	12.75	12 50	11.75	11,50		15	15.75	15.25	14.50	14.25	14.00
	20	14.75	14.50	13.00	11.75	11.75		20	17.25	16.00	15.25	15.00	14.50
2000	5	9.50	8.00	6.25	4.50	3.75	2000	5	14.00	11.25	8.50	5.75	5.75
	10	16 00	14.25	10.25	8.00	7.25		10	16.75	13.00	11.00	10.25	9.00
	15	18.75	16 50	14.75	13.00	12.75		15	19.25	16.75	13.50	9.00	6.50
	20	21.00	17.00	13.50	11.50	10.50		20	21.00	17.75	14.50	10.25	8.00
4000	5	6.00	3.75	3.00	2.00	1.75		5	8 00	4.75	3.00	2.00	1.50
	10	8.50	5.50	3.75	3.00	2.00		0	9.75	6.50	4.50	3.25	2.25
	15	11.25	6 25	4.50	3 00	2.00		5	11.25	6.75	4.00	2.00	2.00
	20	13.50	7.00	4 25	3.50	2.25		20	13 25	8 25	5.25	4.25	3.75

TABLE 'B' Showing raw data of the subjects average for contralateral (right phone left probe) and ipsilateral (left probe) stimulation.

Average

CONTRALATERAL LEFT EAR PROBE							IPSILATERAL LEFT EAR PROBE						
	REFLEX AMPLITUDE							REFLEX AMPLITUDE					
	SL	1	5	10	15	20		SL	1	5	10	15	20
500	5	5.50	5.25	6.00	4.75	4.50	500	5	7.50	7.25	6.75	6 75	6.50
	10	7.50	7.50	7.00	7.00	6 75		10	11.00	10.75	10.75	10.25	9.75
	15	10.50	10.25	10.00	10.00	9.75		15	13.50	13.00	13.25	12.75	11.75
	20	13.00	12.25	12.00	10.50	10. 00		20	16.00	15.50	15.00	14.50	14.00
1000	5	7.50	7.75	7.75	7.50	7.25	1000	5	11.50	11.25	11.00	10.50	9.50
	10	10.50	10.25	10.00	9.50	9.75		10	14.00	13.75	12.00	12.00	11.25
	15	13.00	12.75	12 25	12.00	12.00		15	17.75	17.25	16.00	15.50	15.00
	20	10.00	16.50	15.25	14.50	13.50		20	19.25	17.75	17.25	17.00	16.25
2000	5	7.00	5.65	4.50	3.00	2.25	2000	5	9.00	7.75	5.75	3.75	2.75
	10	13.00	11.00	6.75	5.50	5.00		10	17.00	15.00	12.50	10.25	1.75
	15	16.75	14 75	12.00	10.25	6.25		15	19.75	17.00	12.00	10.75	7.50
	20	19.00	16.00	122.5	10.75	8.75		20	22 00	18.50	15.50	11.50	9.00
4000	5	6.00	4.25	3.50	2.50	2.00	4000	5	7 25	5.25	3.75	2.75	1.75
	10	7.00	5.25	3.75	3.00	2.00		10	10.50	6.75	4.50	3.25	2.00
	15	11.25	7 75	5.25	3.50	2.25		5	12.75	8.75	5.50	4.00	3.00
	20	13.25	8.25	5 00	3.50	2.25		20	16 25	9.25	6.25	4.75	3.50

Discussion

There have been considerable attempts to study both the theoretical diagnostic aspects of the acoustic reflex in man. The current investigation was concerned with the differences in stapedial reflex amplitude for ipsilateral stimulation and contralateral stimulation.

There was increase in stapedius reflex amplitude with increase in SL for contralateral acoustic stimulation. This is in agreement with the report of earlier investigators (Anderson et al 1970. Peterson and Liden 1972). Similarly there was increase in stapedial reflex amplitude with the increase in sensation level for ipsilateral stimulation in all the conditions. This increase in stapedius reflex amplitude was not linear with increase in sensation levels in both contralateral and ipsilateral stimulation.

The results showed that 50% reflex decay was not present at low frequencies during contralateral stimulation. However at higher frequencies 50% reflex decay was observed. This finding has been reported earlier by numerous investigators (Dallos 1964: Johanson et al 1967 :

Borg 1968 ; Anderson et al 1970; and Chirerallis 1977). This phenomenon i.e, 50% decrease in reflex amplitude only for high frequencies, was true even in case of ipsilateral stimulation. There was no consistent difference in decay time for contralateral and ipsilateral stimulation.

At all the sensation levels studied (5, 10, 15 and 20 dB SL ref. threshold), and at all the frequencies tested (500, 1000, 2000 and 4000 Hz) the ipsilateral stimulation resulted in greater magnitude of reflex amplitude. This was observed even when stimulated ear was same for both ipsilateral stimulation and contralateral stimulation and also when the monitored ear was same for both the types of stimulation.

The greater magnitude of stapedial reflex amplitude for ipsilateral stimulation could be due to greater SPL of the tone because 5 dB SL through a probetip may not be equal to 5 dB SL through earphone.

However Recker (1977), by using completely unilaterally deaf individuals controlled this variable (i.e., applied a stimulus sound of high intensity to the deaf ear using a normal earphone). Even with this method he found ipsilateral reflex threshold.

The alternative explanation would be the possible difference in the ipsilateral and contralateral reflex arc.

The difference in the reflex amplitude between ipsilateral and contralateral stimulation was not same for all the sensation level.

Maximum reflex amplitude was obtained at 2 KHz for all sensation levels, both in ipsilateral stimulation and contralateral stimulation. This indicates that 2 KHz is more sensitive for reflex.

Conclusions

From the results obtained, following conclusions were made :

1 There was increase in stapedius reflex amplitude with increase in sensation levels, both in contralateral and ipsilateral stimulation.
2 Increase in stapedius reflex amplitude was not linear with increase in sensation levels in both contralateral and ipsilateral stimulation.
3 There was no 50% reflex decay in lower frequencies (500 and 1000 Hz), in both ipsilateral and contralateral stimulation.
4 There was 50% reflex decay in higher frequeneies (2000 and 4000 Hz) in both ipsilateral and contralateral stimulation.
5 There was no consistent difference in decay time for contralateral and ipsilateral stimulation.
6 Reflex amplitude were of greater magnitude, in case of ipsilateral stimulation.
7 The difference in the reflex amplitude, between ipsilateral and contralateral stimulation was not same for all the sensation levels.
8 Maximum reflex amplitude was obtained at 2 KHz for all the sensation levels, both in ipsilateral and contralateral stimulation.

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