Original Article

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Comparison of Frequency Specific Hearing Thresholds Between Pure Tone Audiometry and Auditory Steady State Response

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Abstract

Hearing is one of the fundamental senses. It connects individual to the outside world, through communicate in a way that none of the other senses can achieve. Pure tone audiometry and auditory steady state response are audiological tests to evaluate hearing thresholds on an individual enabling in determination of the degree, type and configuration of hearing loss. At present, Pure tone audiometry (PTA) is the gold standard for the evaluation of hearing levels. Audiometers are used to make quantitative measurements of pure-tone air and bone conduction thresholds. However, it is not possible to obtain reliable thresholds with PTA in all patients. [1,2]

Auditory steady state response (ASSR) testing is a newly developed measurement of auditory evoked potentials it can be used to objectively for predicting frequency specific hearing thresholds. ASSR measurements also detects automatic response and that feature is attractive in that it avoids problems associated with the experience and expertise of the observer[3]

Result: Among the 51 patients we found out very strong correlation between PTA and ASSR measurements at all the four frequencies were found between Normal and SNHL groups. However, in CHL group, there was no correlation between PTA and ASSR measurements at 500 Hz and 1000 Hz.

Conclusion: ASSR was able to detect thresholds at about 5 dB higher than that of PTA in both the ears in normal hearing patients at all frequencies.We conclude that ASSR testing can be an excellent complement to other diagnostic methods to serve as a valuable tool in the determination of hearing thresholds

Keywords: PTA; ASSR; Audiological Test; Hearing Loss; SNHL; CHL.

INTRODUCTION

Communication is vital for effective execution of everyday activities and significant interaction in lack of which, it might be very tough for the human beings to share thoughts and express themselves. Being one of the five special senses, it is particularly special as it is the sense that allows the people to communicate with other.[2] Therefore, injury to hearing can disrupt communication and substantially affect a person's ability to carry out the daily activities. Hearing loss affects over 466 million individuals, causing some level of impairment. This amount equates to more than 6% of the world's population. In India, approximately 63 million people everyone has significant auditory impairment, 3 with ear wax (15.9%), chronic suppurative otitis media (5.2%), otitis media with effusion (3%), dry perforation (0.5%), congenital deafness (0.2%), and other non-infectious unknown causes (10.3%) such as presbycusis. Audiologic testing is performed for assessing the hearing thresholds throughout the spectrum of frequencies that are important for human communication.

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Auditory thresholds are usually measured for air as well as bone conducted pure tone stimuli in order to differentiate the conductive hearing loss from sensorineural hearing loss, so as to characterize the pattern of hearing impairment at various frequencies. Pure tone audiometry (PTA) is regarded the gold standard approach for evaluating hearing frequencies among the several audiometric procedures used for determining hearing thresholds.[3] On the other hand, auditory steady state response (ASSR) testing is a recently established assessment of auditory evoked potentials that may be used objectively to estimate frequency specific hearing thresholds. In ASSR, pure tone sounds are used as the stimulus. wherein it is modulated, both with respect to its amplitude and frequency. Modulation of a pure tone sound stimulus decreases the spectral splatter, thus stimulating specific, restricted and narrow area of the basilar membrane. If the rate of modulation is higher than 60 Hz, the neural activity is recorded from the brain stem. The response detection in the frequency domain assures us that the ASSRs are detected objectively. Detection is not based on subjective visual examinations of the waveforms or response patterns as in case with PTA.

It is crucial to assess both audiometric techniques in terms of their accuracy in identifying frequency thresholds in persons with hearing loss. This would improve the technique for examining a person who has complained of hearing loss in order to provide prompt assistance. With this background in mind, we want to see how pure tone audiometry and auditory steady state response compare in terms of frequency specific hearing thresholds.

SELECTION OF PATIENTS

INCLUSION CRITERIA: 1. Patients who will attend the OPD to Jawaharlal Nehru hospital and research centre, ENT & Head and Neck surgery department, with ear related complaints will be the probable subject of my study.[2] Patients who are in the age group of 12 to 60 years. (PTA & ASSR can be done in adolescents and adults, and there is increase in prevalence of hearing loss in those age group so we have included the above age group for our study.)[3] Patients who are willing to participate in the study.

EXCLUSION CRITERIA: 1. Chronic otitis media 2. Otitis media with effusion 3. Otitis externa 4. H/O operated ear 5. Patients less than 12 years and above 60 years. 6. Patients who do not give consent for study.

METHOLOGY

The 51 patients were subjected to thoroughly clinical examination and audiological examinations by PTA and ASSR. We divided the patients into 3 groups. Group 1 with normal hearing patient, group 2 with conductive hearing loss and group 3 with sensory neural hearing loss.

The PTA was done with Elkon 3N3 Multi pure tone Audiometer. For evaluation and statistical purposes, thresholds were measured at 500, 1000, 2000, and 4000 Hz. ASSR will be done with Neuro Audio (V.2010) Multi-ASSR and measurements was recorded. Participants were tested while they are awake and in a relaxed supine position. Registration electrodes were placed over both mastoid bones at the hairline and on the low forehead. Air-conducted stimuli were presented via inserted earphones. Test frequencies of 500, 1000, 2000, and 4000Hz were used as ASSR carrier stimuli. The four carrier frequencies were delivered simultaneously to both ears. These frequencies were modulated with respect to amplitude and frequency. A 100% amplitude modulation, 20% frequency modulation and 90Hz modulation rate was used. Analysis of data was done.

Criteria for hearing assessment: These patients are categorized as having conductive and Sensor ineural hearing impairment. The degree of hearing impairment is assessing by WHO classification of hearing loss.

Normal hearing–< or =25 Db

Mild = 26–40 dB

Moderate= 41– 55 dB

Moderatly Severe = 56 – 70 dB

Severe = 71–90 dB

Profund => 90 dB

RESULT

The data collection started from November 2020 till August 2021. 51 patients were analysed in our study.

- In our study, 2/3 rd patients 34 (66.6%) were from 41–60 yrs of age. 7 (13.7%) patients were less than 20 years of age and 5 patients each were from 21–30 and 31–40 years of age. The Sex distribution was 27 males and 24 females in the study. We observed that 30 (58.8%) patients were suffering from SNHL while only 4 were suffering from conductive hearing loss excluding COM, *i.e.* with intact TM. However

17 patients had Normal hearing.

- One Way Anova comparison between Types of Hearing Status on the basis of difference between ASSR and PTA at different levels frequencies in Right Ear amongst 51 patients. Mean threshold levels between both the tests were compared to each other with the same patients in their right ear at 500Hz, 1000Hz, 2000Hz, and 4000Hz (Table 14). The mean threshold levels amongst normal (n=17) individuals by PTA at 500, 1000, 2000, and 4000Hz were 4.7±2.8, 4.4±3, 3.5±4.9 and 3.8±3.3 respectively. The mean threshold levels amongst CHL (n=4) by PTA at 500, 1000, 2000, and 4000 Hz were 2.5±2.9, 5±0, 5±4.1 and 5±4.1 respectively. The mean threshold levels amongst SNHL (n=30) individuals by PTA at 500, 1000, 2000, and 4000Hz were 9±6.5, 10±6.7, 8±6.2 and 8±4.7 respectively. The three groups differ significantly in the one way anova comparison. Nevertheless, normal and CHL group were comparable to each other at all four frequencies on the basis of difference between PTA and ASSR. (p>0.05). Similarly, SNHL and CHL group were comparable to each other at all four frequencies on the basis of difference between PTA and ASSR (p>0.05). The SNHL group has higher threshold than patients with normal hearing at all the frequencies. (Table: 1)

Table 1: One Way Anova comparison between types of hearings tatuson the difference between PTA and ASSR at different levels frequencies righ tear

	Normal		CHL		SNHL		Total		F	p value	Mean difference			p value		
	Mean	S D	Mean	S D	Mean	S D	Mean	S D			A – B	A– C	B– C	A – B	A – C	B- C
Difference (PTA-ASSR) (RE) 500Hz	4.7	2.8	2.5	2.9	9	6.5	7.1	5.8	5.091	0.010	2.2	4.3	6.5	0.739	0.029	0.067
Difference (PTA-ASSR) (RE) 1000Hz	4.4	3	5	0	10	6.7	7.8	6	6.175	0.004	–0.6	5.6	5.0	0.98	0.004	0.211
Difference (PTA-ASSR) (RE) 2000Hz	3.5	4.9	5	4.1	8	6.2	6.3	6	3.427	0.041	–1.5	4.5	3.0	0.889	0.034	0.589
Difference (PTA-ASSR) (RE) 4000Hz	3.8	3.3	5	4.1	8	4.7	6.4	4.6	5.686	0.006	–1.2	4.2	3.0	0.859	0.005	0.383

- One Way Anova comparison between Types of Hearing Status on the basis of Pure tone audiometry at different levels frequencies in left Ear amongst 51 patients. Mean threshold levels between both the tests were compared to each other with the same patients in their left ear at 500Hz, 1000Hz, 2000Hz, and 4000 Hz (Table 15). The mean threshold levels amongst normal (n=17) individuals by PTA at 500, 1000, 2000, and 4000 Hz were 14.4±6.6, 15±4.7, 17.1±6.1 and 18.5±8.6 respectively. The mean threshold levels amongst CHL (n=4) by PTA at 500, 1000, 2000, and 4000 Hz were 33.8±6.3, 35±7.1, 40±8.2 and 43.8±8.2 respectively. The mean threshold levels amongst SNHL (n=30) individuals by PTA at 500, 1000, 2000, and 4000 Hz were 54.2±15.2, 59.2±13.2, 63.8±13 and 66.2±14 respectively. The three groups differ significantly in the one way anova comparison. The Normal and CHL group were significantly different from each other at all four frequencies on the basis of PTA. (Table 2)

Table 2: One way anova comparison between types of hearing statuson the basis of pure tone audiometry at different levels frequencies in left ear

	Normal		CHL		SNHL		Total		F	P Value	Mean difference			p value		
	Mean	S D	Mean	S D	Mean	SD	Mean	S D			A-B	A-C	B-C	A-B	A-C	B- C
PTA (LE) 500 Hz	14.4	6.6	33.8	6.3	54.2	15.2	39.3	22.3	55.183	<0.001	-19.3	39.8	20.4	0.021	<0.001	0.01

PTA (LE) 1000Hz	15	4.7	35	7.1	59.2	13.2	42.6	23.2	92.534	<0.001	–20.0	44.2	24.2	0.004	<0.001	<0.001
PTA (LE) 2000Hz	17.1	6.1	40	8.2	63.8	13	46.4	24.4	100.051	<0.001	–22.9	46.8	23.8	0.001	<0.001	<0.001
PTA (LE) 4000Hz	18.5	8.6	43.8	7.5	66.2	14	48.5	25.2	84.271	<0.001	–25.2	47.6	22.4	0.001	<0.001	0.003

- Relationship between pure tone audiometry and auditory steady state response assessed by linear regression at 500 Hz. At 500 Hz, the coefficient constant was calculated to be 4.709 (95% CI -8.341- -1.077). The relationship was found to be significant ($p<0.001$) Hence, the ASSR could be represent edas PTA 500=ASSR (500 Hz) × 0.925 − 4.709. (Table 3)

Table 3: Relationship between pure-tone audiometry and auditory steady state respons eassessed by linear Regression 500Hz

	Unstandardized Coefficients		Standardized Coefficients	T	p value	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	–4.709	1.807		–2.606	0.012	–8.341	–1.077
ASSR Average 500Hz	0.925	0.036	0.966	25.979	<0.001	0.854	0.997

- Relationship between pure tone audiometry and auditory steady state response assessed by linear regression at 1000Hz.At 1000Hz, the coefficient constant was calculated to be –1.923 (95% CI–4.124- -0.278). The relationship was found to be significant ($p>0.05$)Hence, the ASSR could be represented as PTA 1000 = ASSR (1000 Hz) × 0.898 – 1.923. (Table 4)

Table 4: Relationship between pure-tone audiometry assessed by linear Regression 1000 Hz and auditory steady state response

	Unstandardized Coefficients		Standardized Coefficients	T	pvalue	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	–1.923	1.095		–1.755	0.085	–4.124	0.278
ASSR Average 1000Hz	0.898	0.021	0.987	43.301	<0.001	0.856	0.939

- Relationship between pure tone audiometry and auditory steady state response assessed by line arregression at 2000Hz. At 2000Hz, the coefficient constant was calculated to be -2.506 (95% CI-4.810- -0.201). The relationship was found to be significant ($p>0.05$). Hence, the ASSR could be representedas PTA 2000 = ASSR (2000 Hz) × 0.933 – 2.506. (Table 5)

Table 5: Relationship between pure-tone audiometry assessed By linear Regression 1000 Hz and auditory steady-state response

	Unstandardized Coefficients		Standardized Coefficients	T	pvalue	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	–1.923	1.095		–1.755	0.085	–4.124	0.278
ASSR Average 1000Hz	0.898	0.021	0.987	43.301	<0.001	0.856	0.939

- Relationship between pure tone audiometry and auditory steady state response assessed by linear regression at 4000Hz. At 4000Hz, the coefficient constant was calculated to be -2.031 (95% CI-4.290- -0.227). The relationship was found to be significant ($p>0.05$). Hence, the ASSR could be representedas PTA 4000 = ASSR (4000 Hz) × 0.920 – 2.031. (Table 6)

Table 6: Relationship between pure-tone audiometry assessed Bylinear Regression 4000 Hz and auditory steady-state response

	Unstandardized Coefficients		Standardized Coefficients	T	p value	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	–2.031	1.124		–1.808	0.077	–8.341	–4.290
ASSR Average 500Hz	0.920	0.019	0.989	47.712	<0.001	0.881	0.959

- Correlation coefficient values between the PTA and ASSR results at each frequency 500, 1000, 2000, and 4000 Hz in all the three groups. We found strong correlation between PTA and ASSR measurement satall the four frequencies were 0.966,0.987, 0.988 and 0.989. ($p<0.001$). The correlation was strongest at 4000 Hz in all the groups. (Table 7)

Table 7: Pearson correlation coefficient values (r) between PTA and ASSR results at each frequency amongst all the patients

		ASSR Average 500Hz	ASSR Average 1000Hz	ASSR Average 2000Hz	ASSR Average 4000Hz
PTA Average 500Hz	Pearson Correlation	.966**	.961**	.917**	.912**
	p value	<0.001	<0.001	<0.001	<0.001
PTA Average 1000Hz	Pearson Correlation	.947**	.987**	.937**	.949**
	p value	<0.001	<0.001	<0.001	<0.001
PTA Average 2000Hz	Pearson Correlation	.942**	.962**	.988**	.958**
	p value	<0.001	<0.001	<0.001	<0.001
PTA Average 4000Hz	Pearson Correlation	.892**	.945**	.954**	.989**
	p value	<0.001	<0.001	<0.001	<0.001

- Correlation between the PTA and ASSR results at each frequency 500, 1000, 2000, and 4000 Hz in normal individuals. Very strong correlation between PTA and ASSR measurements at all the four frequencies were 0.970, 0.990, 0.981 and 0.994. ($p<0.001$). The correlation was strongest at 4000 Hz in all normal individuals. (Table 8)

Table 8: Pearson correlation coefficient values (r) between PTA and ASSR results at each frequency amongst normal study participants

		ASSR Average 500Hz	ASSR Average 1000Hz	ASSR Average 2000Hz	ASSR Average 4000Hz
PTA Average 500Hz	Pearson Correlation	.970**	.968**	.931**	.925**
	p value	<0.001	<0.001	<0.001	<0.001
PTA Average 1000Hz	Pearson Correlation	.941**	.990**	.927**	.941**
	p value	<0.001	<0.001	<0.001	<0.001
PTA Average 2000Hz	Pearson Correlation	.943**	.964**	.981**	.959**
	p value	<0.001	<0.001	<0.001	<0.001

PTA Average 4000Hz	Pearson Correlation	.883**	.951**	.962**	.994**
	p value	<0.001	<0.001	<0.001	<0.001
**.Correlation is significant at the 0.01 level (2-tailed).					
*.Correlation is significant at the 0.05 level (2-tailed).					

- Correlation between the PTA and ASSR results at each frequency 500, 1000, 2000, and 4000 Hz in CHL patients. Very strong correlation between PTA and ASSR measurements at 2000 Hz and 4000 Hz were 0.995 and 0.989. (p<0.001). Non- significant correlation between PTA and ASSR measurement sat 500Hz and 1000Hz were.0.776, 0.936 (p>0.05).

The correlation was strongest at 2000Hz in all CHL patients. (Table 9)

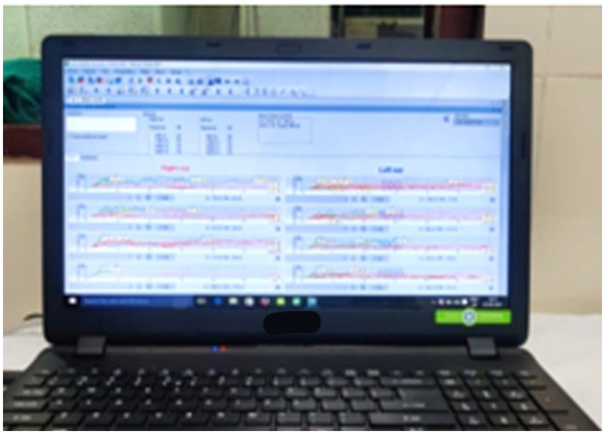
Table 9: Pearson correlation coefficient values (r) between PTA and ASSR results at each frequency amongst CHL patients

Pearson Correlation		**ASSR Average 500Hz**	**ASSR Average 1000Hz**	**ASSR Average 2000Hz**	**ASSR Average 4000Hz**
PTA Average 500Hz	Pearson Correlation	0.776	0.935	0.753	0.929
	p value	0.224	0.065	0.247	0.071
PT Average 1000Hz	Pearson Correlation	0.781	0.936	0.755	0.934
	p value	0.219	0.064	0.245	0.066
PTA Average 2000Hz	Pearson Correlation	.990**	.967*	.995**	.953*
	p value	0.010	0.033	0.005	0.047
PTA Average 4000Hz	Pearson Correlation	0.898	.987*	0.876	.989*
	p value	0.102	0.013	0.124	0.011
**.Correlationis significant at the 0.01 level (2–tailed).					
*.Correlationi ssignificant at the 0.05 level (2–tailed).					

- Correlation between the PTA and ASSR results at each frequency 500, 1000, 2000, and 4000 Hz in SNHL patients. Very strong correlation between PTA and ASSR measurements at all the four frequencies were 0.980, 0.991, 0.990 and 0.987. (p<0.001). (Table 10)

Table 10: Pearson correlation coefficient values (r) between PTA and ASSR results at each frequency amongst SNHL patients

Pearson Correlation		**ASSR Average 500Hz**	**ASSR Average 1000Hz**	**ASSR Average 2000Hz**	**ASSR Average 4000Hz**
PTA Average 500Hz	Pearson Correlation	.980**	.957**	.927**	.905**
	p value	<0.001	<0.001	<0.001	<0.001
PT Average 1000Hz	Pearson Correlation	.964**	.991**	.967**	.965**
	p value	<0.001	<0.001	<0.001	<0.001
PTA Average 2000Hz	Pearson Correlation	.933**	.962**	.990**	.961**
	pvalue	<0.001	<0.001	<0.001	<0.001
PTA Average 4000Hz	Pearson Correlation	.898**	.944**	.968**	.987**
	p value	<0.001	<0.001	<0.001	<0.001
**.Correlation is significant at the 0.01 level (2-tailed).					
*.Correlation is significant at the 0.05 level (2-tailed).					



DISCUSSION

Hearing loss leads to impaired communication, and causes psychosocial effects that leads to social isolation and reduced quality of life. Audiological testing is performed to assess hearing thresholds across range off requencies that are important for human communications. Pure tone audiometry one among them is the subjective test and auditory steady state response is the objective test to find out the hearing loss.

Types of Hearing Losson the difference between PTA and ASSR:

The difference of threshold levels between PTA and ASSR amongst normal (n=17) individual sat 500, 1000, 2000, and 4000 Hz were 4.7±2.8, 4.4±3, 3.5±4.9 and 3.8±3.3 respectively. The difference of threshold levels amongst CHL (n=4) by PTA at 500, 1000, 2000, and 4000 Hz were 2.5±2.9, 5±0, 5±4.1 and 5±4.1 respectively. Themean differenc eofthre shold level samongst SNHL (n=30) individuals by PTA at 500, 1000, 2000, and 4000 Hz were 9±6.5, 10±6.7, 8±6.2 and 8±4.7 respectively. The three groups differ significantly. The SNHL group has higher difference of threshold levels than patients with normal hearing and CHL at all the frequencies. ($p<0.05$).

Similar observations were obtain edina study done by Himanshu et al[5], except that the threshold was about 10 d Bhigherin this study. In another study done by Wadhera et al,[6] showed similar results with mean threshold of 6±5 dB. The results obtained by Komazec Z et al,[7] were similar where they observed the highest threshold difference of 7.5 dB amongst the normal hearing individuals. Never the less, in a study done by, Ozdek et al[8], Mean threshold difference values between PTA and ASSR thresholds were between 10–15 dB in normal hearing Group.

Amongst all these studies, ASSR was significantly able to detect thresholds at about 5–15 dB higher than that of PTA in either ears.

In addition to above mentioned studies We have observed that, The Normal and CHL group were comparable each other at all four frequencies on the basis of PTA and ASSR. The SNHL group has higher difference of threshold levels than patients with normal hearing based on PTA but not on ASSR.

The similar study was done by Hosseinabadi R et al[9], The difference among PTA and ASSR thresholds was similar in patients with SNHL or CHL and there was no significant difference between two types of hearing loss. Whereas, similar to present.

study, Normal hearing group differed from other two groups in frequency of 1000, 2000, and 4000 Hz and significant differences existed between normal hearing and SNHL groups.

A study by D'haenens et al[10] found that patients with moderate SNHL had lowermean threshold differences than their normal participants, but there was no significant difference between the normal participants and patients with mild SNHL. But in our study, the mean threshold differences at each frequency in our normal participants were significantly lower than those SNHL patients.

Pearson correlation between PTA and ASSR results at each frequency in the three groups.

Very strong correlation between PTA and ASSR measurements at all the four frequencies were found between Normal and SNHL groups. However, in CHL group, there was no correlation between PTA and ASSR measurements at 500 Hz and 100 Hz.

Wadhera et al,[6] showed similar results, wherein a strong correlation between PTA and ASSR values in SNHL group, with r values of 0.76, 0.82, 0.79, and

0.68 for the four frequencies.

Similar findings were observed in the study by Ozdek et al.[11] They reported that the r values between the PTA and ASSR results in their control group were 0.165, 0.352, 0.146, and 0.472 at 0.5k, 1.0k, 2.0k, and 4.0 kHz respectively.

However, in study by D'haenens et al[10] found that patients with CHL had good correlation between PTA and ASSR results in their CHL group: Their corresponding r values were 0.76, 0.89, 0.81, and 0.82 at the four frequencies.

Relationship between pure tone audiometry and auditory steady state response assessed by linear Regression at all four frequencies.

In the present study, PTA can be represent ed in terms of ASSR for each frequency by the equation derived by regression: PTA (500 Hz) = ASSR (mean 500 Hz) × 0.925 − 4.709, PTA (1000Hz) = ASSR (mean1000Hz) × 0.898 – 1.923, PTA (2000Hz) = ASSR (mean 2000 Hz) × 0.933 – 2.506, and for PTA (4000 Hz) = ASSR (mean 4000 Hz) × 0.920– 2.031.

Similar observations were obtain edina study done by Himanshu et al[5], where the regression equation were calculat edas PTA (500Hz) = ASSR (mean 500Hz) × 0.995 − 9.773, PTA (1000Hz) = ASSR (mean 1000Hz) × 1 − 9.986, PTA (2000Hz) = ASSR (mean 2000Hz) × 1.004 – 10, and for PTA (4000Hz) = ASSR (mean 4000Hz) × 0.998−9.957.

In an other study done by Ahn J et al,[12] relationships between the pure-tone threshold (PTT) and the ASSR thresholds for the frequencies tested are described by the following equations: at 0.5 kHz, PTA = 1.08 × ASSR – 10.4; at 1 kHz, PTA = 1.13 × ASSR – 9.6; at 2 kHz, PTA = 1.07 × ASSR – 5.3; and at 4 kHz, PTA = 0.99 × ASSR – 6.3.

Almost similar relationship was observed by Komazec Z, et al.[7] and calculated by the equations, at 0.5 kHz, PTA = 0.833×ASSR – 1.465; at 1 kHz, PTA = 0.995 × ASSR – 2.381; at 2 kHz, PTA = 1.06 × ASSR – 10.77; and at 4 kHz, PTA= 0.924 × ASSR – 1.415.

Therefore, all the above mentioned results reiterate the findings of the previous studies, that clinically tolerable error in hearing threshold evaluation especially when making a hearing aid plan is approximately 10 dB. These findings confirm hypothesis that the ASSR examination may predict configuration of audiometric findings with a very high level of certainity, at statistically significant levels. Very Few studies have evaluated theef fect of CHL or SNHL on ASSR thresholds. We found find a significant difference between ASSR thresholds of CHL and SNHL. Never the less, significant difference between ASSR thresholds of SNHL and normal hearing was noted. It was reported that separation of normal hearing from mild hearing loss was difficult at 500 Hz. This could be there sult of poor neural synchronization and higher ASSR threshold of 500Hz in normal hearing condition.[10] In our sudy, the ASSR could separate normal hearing SNHL and CHL, except for 500 Hz. This can be related to less neural synchrony in this frequency. The apical portions of the cochlea are responsible for detecting 500Hz in low levels.[9]

CONCLUSION

- The degree of hearing loss seems to play an important role in the correlation between PTA and ASSR thresholds.
- ASSR was able to detect thresholds at about 5 dB higher than that of PTA in both the ears in normal hearing patients at all frequencies.
- In case of CHL patients, ASSR was able to detect thresholds at about 5 dB higher than that of PTA, but it was not significant forright ear but was significant for left ear at 1000 and 4000 Hz. Hence, it can be concluded that, ASSR We assume that these findings can be attributed to low sample size of CHL patients.
- Never the less, in case of Sensor ineural Hearing loss, ASSR was consistently able to detect thresholds specifically at 8-10 d Bhigher than that of PTA ($p<0.05$).
- Weal so have observed that, SNHL patient shashi gher difference of threshold levels than patients with normal hearing based on PTA but not on ASSR.
- Very strong correlation between PTA and ASSR measurements at all the four frequencies were found between Normal and SNHL groups. However, in CHL group, there was no correlation between PTA and ASSR measurements at 500Hz and 1000Hz.
- ASSR is able to differentiate between types of hearing loss based on the type of hearing.
- ASSR has a constant relationship with PTA thresholds. ASSR can predicttrue hearing thresholds in "difficult to assess" patients.
- We conclude that ASSR testing can be an excellent complement to other diagnostic methods to serve as a valuable tool in the determination of hearing thresholds.

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