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Significance Of Objective Audiological Tests In Patients Showing InconsistentResponses On Subjective Audiological Tests.

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ABSTRACT

In numerous individuals, a functional hearing loss may be superimposed on a true organic deficit. In these persons, the functional component is referred to as a functional overlay and these cases often show inconsistent and non-reliable responses on subjective audiological tests. Hence objective audiological tests do help in assessing such cases. It was an analytical cross sectional study of 50 patients. Patients of Age between 18 – 60 years complaining of decreased hearing and showing inconsistent and non-reliable responses on subjective audiological tests were included in this study. Patients with very low IQ, psychiatric or psychological disorder or active stage of otological disease were excluded from study. Out of 50 patients (100 ears/cases) of suspected exaggerated hearing loss as per our diagnostic criteria,22 cases (22%) were found to be genuine and 78 cases /ears (78%) were of exaggerated hearing loss. Out of these 78 cases, 74 cases (74%) had functional overlay and remaining 2 cases (4%) had Pure NOHL. Electrophysiological assessment measures (like ART, ABR), when used together with behavioral observations and subjective audiological assessment (like PTA, SRT) can improve the diagnostic criterion of exaggerated hearing loss.

Keywords: Audiometry, Deafness, hearing mechanism.

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INTRODUCTION

Decreased hearing is one of the important presenting complaints in E.N.T OPD. Various audiological tests are available for evaluation of hearing of patients. Subjective audiological tests (like tuning fork tests, Pure tone audiometry, speech audiometry, etc) requires the cooperation of subject and relies upon subjective responses which may be both qualitative and quantitative & involves attention, reaction time etc. Not every patient seen for a hearing evaluation is fully cooperative. This lack of cooperation may be because the patient (a) does not understand the test procedure,(b)is poorly motivated (c)is physically or emotionally incapable of appropriate responses,(d) wishes to conceal a handicap,(e)is deliberately feigning or exaggerating a hearing loss for personal gain or exemption i.e functional overlay [1], or (f) is impelled by some unconscious motivation. The subjective assessment of hearing in these patients are often difficult and are not reliable, hence otologist /audiologist has to depend upon the objective audiological tests to get a workable knowledge about the patients hearing threshold. Objective audiological tests (Tympanometry, BERA etc) are based on physical, acoustic or electrophysiological measurement and does not depend on the cooperation or subjective responses of subject [2].

The rationale for the conduct of this study is to assess the role of objective audiological tests in patients showing inconsistent responses on subjective audiological test and for better screening of those patients that willfully exaggerate their existing organic hearing loss for social benefit i.e Functional overlay.

MATERIAL AND METHODS

It was a 2 years analytical cross sectional study conducted at out patient department of ENT at a tertiary care centre. After approval from Institutional Ethics Committee. Patients of Age between 18 – 60 years complaining of decreased hearing and showing inconsistent and non reliable responses on subjective audiological tests were included in this study. Patients with very low IQ, psychiatric or psychological disorder or active stage of otological disease were excluded from study.

Detailed clinical history and ENT examination was carried out for every patient. Hearing assessment of patient was done initially by subjective audiological tests which included tuning fork tests , Pure Tone audiometry and speech audiometry. Patients showing discrepancies among and within subjective audiological were evaluated with Objective audiological tests like Immitance audiometry and BERA to know the actual hearing level in those patients. All audiological tests were carried out in sound treated room Subjective Audiological tests-

Tuning fork tests were carried out were Rinne's Test, Weber's test and Absolute Bone Conduction test

Pure Tone audiometry was carried using clinical audiometer (Resonance 37A).

Hearing threshold was calculated by taking Pure tone average of 4 frequencies (500Hz, 1kHz,2kHz,4kHz threshold).

From the air conduction threshold levels the hearing impairment can be graded into several categories –

0–25 dB -Not significant 26–40 dB- Mild
41–55 dB -Moderate
56–70 dB -Moderately severe71–90 dB –Severe
> 90 dB- Profound [3]

Speech Audiometry was done using clinical audiometer (Resonance 37A) which included Speech Recognition threshold (SRT) and Word Recognition score (WRS).

In Speech Recognition threshold (SRT), word list is presented and patient is asked to repeat. The level is reduced in 5 dB steps until we get 50 % correct responses at one particular level, this is the speech

recognition threshold for that ear [3].

In Word Recognition score (WRS), the scores are calculated on the basis of number of correct responses given by the patient. WRS are usually expressed in percentage correct [3].

Objective audiological test

Patients showing discrepancies among and within above tests were evaluated with objective audiological tests as follows:

Immittance audiometry (Tympanogram /Acoustic Reflex Test) was carried out using Resonance 36M provided with probe tone of 220 Hz. Tymapanometry was done and patients having only 'A' type tympanogram were included in this study and those with any conductive pathology were excluded from the study. Acoustic reflexes were tested at 1000 Hz in ipsilateral ear only.

Acoustic reflex: present (suggestive of normal or mild hearing loss) Acoustic reflex : Absent (suggestive of hearing loss -moderate or more) [3]

In our study acoustic reflex test was used as an initial objective audiological tool to check pure tone threshold.

Brainstem Evoked Response Audiometry (BERA) or Auditory Brainstem

Response (ABR) was performed using IHS Junior Dual Channel ABR in patients with total relaxation and comfortable state. Patients were tested by monaurally using rarefaction/ condensation modality and click stimuli at a rate of 19.3 per second .1024 click stimuli were used with analysis time of 10 milli-seconds for ipsilateral recording only. The threshold was estimated at the lowest intensity level where peak V could be identified.

Exaggerated Hearing loss- Pure tone average and BERA threshold not correlating and difference between pure tone average and BERA threshold >12 [5].

Exaggerated Hearing loss can be further divided into

Pure NOHL(Non organic hearing loss)/Functional Hearing loss- Exaggerated hearing loss with no organic hearing loss (i.e. resolved hearing on BERA within normal limit i.e. ≤ 25 dB).

Functional Overlay- Exaggerated hearing loss superimposed on an organic hearing loss (i.e. resolved hearing on BERA >25 dB with functional component) [5].

In our study, a patients having 1 ear of pure NOHL and other ear of functional overlay or 1 ear of genuine loss and other ear of functional overlay was also considered as a patient of functional overlay.

Patient showed responses on tuning fork tests but the result on tuning fork tests was inconclusive. On PTA, hearing threshold in right ear was 70 dB and in left ear was120dB with poor response reliability and on speech audiometry, SRT was 50dB in right ear and 95 dB in left ear. So discrepancy on PTA and SRT was >12 dB in both ears with SRT better than PTA.

On acoustic reflex test, reflex was present in right ear and absent in left ear. After BERA , hearing threshold was confirmed as 40dB in right ear and 70 dB in left ear.

As discrepancy between PTA and BERA threshold was >12 dB and patient was having hearing loss of 40dB in right ear and 70 dB in left ear, so this is a case of exaggerated hearing loss in both ears , having non-organic/ functional component over pre-existing organic hearing loss, this is a case of functional overlay .

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Image 1: Pure Tone Audiogram

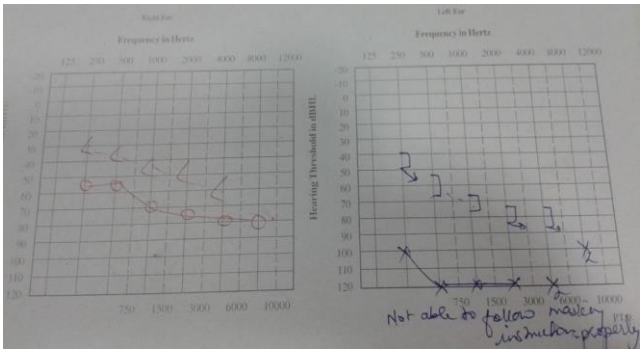
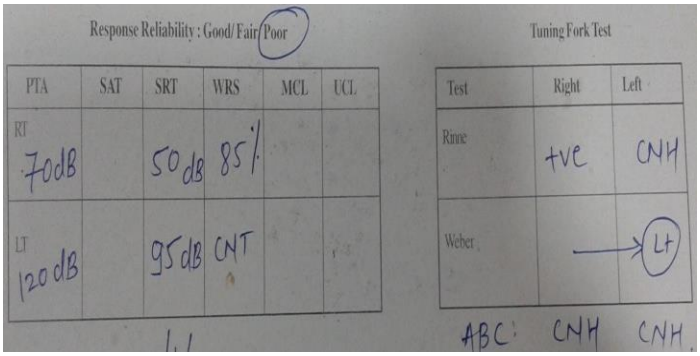


Image 2: Response reliabity assessment



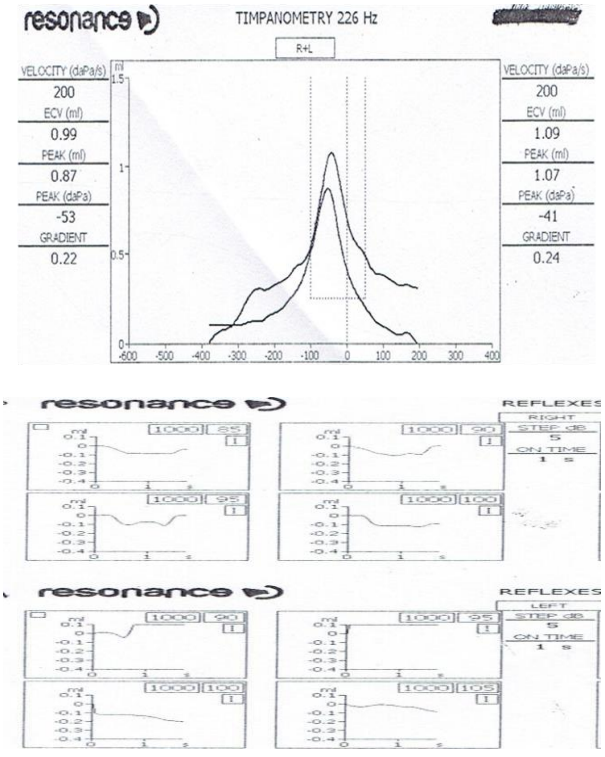


Image 3: Tympanometry

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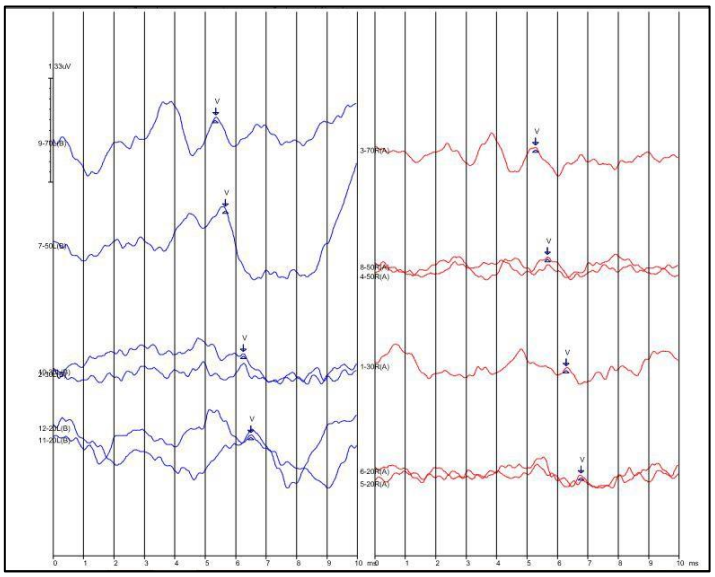
Image 4: BERA TEST



RESULTS

Study consists of 50 patients (100 ears) of which 42 (84%) cases were males while 8 (16%) cases were females. Maximum cases were in the age group of 46-60 yrs (40%) followed by 15-30 yrs (38%) and 31-45 yrs (22%.). After subjective and objective audiological tests results are as follows:- Tuning fork tests were done on all patients (100 ears) in which 36 cases did not show any response on either of the tuning fork tests (CNH i.e could not hear). Remaining 64 cases who showed responses, the found to be inconclusive and non reliable (Table 1).

Table 1

Patients response on Tuning fork tests	No. of cases(ears)	Percentage
Response Absent (CNH)	36	36%
Response Present	64	64%
Total	**100**	**100%**

Among 100 ears subjected to PTA, most common findings were profound hearing loss in 52 ears (52%), moderatelysevere hearing loss in 23 ears (23%) and mild hearing loss 1 ear(1%) as (Table 2).

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Table 2

Degree of hearing loss	Total no. of cases (RT Ear)	Total no. of cases (LT Ear)	Total no. of cases(RT+LT)
Hearing within normal limit <25 Db	2	1	3
26- 40 dB - Mild hearing loss.	1	0	1
41 to 55 dB - Moderate hearing loss.	2	3	5
56 to 70 dB – Moderately Severe Hearing loss	13	10	23
71 to 90 dB - Severe hearing loss.	9	7	16
above 90 dB - Profound hearing loss	23	29	52
Total	**50**	**50**	**100**

In our study, to find PTA-SRT Correlation, (considering difference between PTA-SRT > 12 dB as PTA-SRT disagreement and if difference is <12 is PTA-SRT agreement) we took those cases who showed response on both PTA and SRT i.e (n=83 cases). PTA –SRT disagreement was seen in 64 ears (77.11%) and only 19 ears (22.89%) showed PTA-SRT agreement (Table 3).

Table 3

PTA-SRT Correlation	Total no.	Percentage
PTA-SRT >12(disagreement)	64	77.11%
PTA-SRT<12(agreement)	19	22.89%
Total	**83**	**100%**

In 100 ears acoustic reflex threshold (1 kHz at 95dBHL) was done. Reflex was present in 40 ears (40%) and absent in 60 ears (60%) (Table 4).

Table 4

Acoustic Reflex	No. of Ears	Percentage
Present	40	40%
Absent	60	60%
Total	**100**	**100%**

BERA was done for all 100 ears and found that moderately severe hearing loss was seen in 29 ears (29%) followed by mild hearing loss in 26 ear(26%) least common was, profound hearing loss in 6 ears (6%) (Table 5).

Table 5

Degree	Total no. of pt (RT Ear)	Total no. of pt (LT Ear)	Total no. of pt (RT +LT)
Hearing within normal limit <25 dB	7	5	12
26- 40 dB - Mild hearing loss.	14	12	26
41 to 55 dB - Moderate hearing loss.	8	6	14
56 to 70 dB –Moderately Severe hearing loss.	13	16	29
71 to 90 dB - Severe hearing loss.	4	9	13
above 90 dB - Profound hearing loss	4	2	6
Total	**50**	**50**	**100**

On comparison of PTA with BERA findings (Table 6),

Table 6

PTA results/Hearing loss in dB (No. of ear)	Actual Threshold	BERA results (RT Ear)	BERA results (LT Ear)	Total no. of ears
<25 (n=3)	<25	2	1	3
	26-40	0	0	0
	41-55	0	0	0
	56-70	0	0	0
	71-90	0	0	0
	>90	0	0	0
26-40(n=1)	<25	1	0	0
	26-40	0	0	0
	41-55	0	0	0
	56-70	0	0	0
	71-90	0	0	0
	>90	0	0	0
41-55(n=5)	<25	0	1	1
	26-40	1	2	3
	41-55	1	0	1
	56-70	0	0	0
	71-90	0	0	0
	>90	0	0	0
56-70 (n=23)	<25	2	1	3
	26-40	5	4	9
	41-55	2	0	2
	56-70	4	5	9
	71-90	0	0	0
	>90	0	0	0
71-90 (n=16)	<25	1	0	1
	26-40	2	3	5
	41-55	2	1	3
	56-70	3	3	6
	71-90	1	0	1
	>90	0	0	0
>90 (n=52)	<25	1	2	3
	26-40	6	3	9
	41-55	3	5	8
	56-70	6	8	14
	71-90	3	9	12
	>90	4	2	6
Total		**50**	**50**	**100**

1. We found that 3 cases had <25 dB hearing on PTA and actual threshold on BERA was same. 1 case on PTA showed mild hearing loss (26-40dB) and after BERA the actual hearing threshold was <25 dB – i.e. hearing within normal limit.

2. 5 cases on PTA showed moderate hearing loss(41-55dB) and after BERA when their actual hearing

threshold was analyzed -only 1 case showed same degree of hearing loss and maximum cases i.e.3 ears (60%) had hearing loss between 26-40dB.

3. 23 cases on PTA showed moderately severe hearing loss (56-70dB) and after BERA when their resolved hearing threshold was analyzed - 9cases/ears(39.1%) showed same degree of hearing loss, 9 cases (39.1%) had hearing loss of 26-40dB, 2 cases had hearing loss of 41-55db and other 3 had hearing loss of <25db.

4. 16 cases on PTA showed Severe hearing loss (71-90dB) and after BERA when their resolved hearing threshold was analyzed - only 1 case/ear showed same degree of hearing loss and maximum cases i.e 6 ears (37.5%)had hearing loss of 56-70dB.52 cases on PTA showed profound hearing loss(>90dB) and after BERA when their resolved hearing threshold was analyzed only 6 cases(11.5%) showed same degree of hearing loss and maximum cases 14 cases/ears (26.92%) had hearing loss of 56-70 dB.(table 6)

5. 100 ears/cases of suspected exaggerated hearing loss as per our diagnostic criteria, 22 cases (22%) were found to be genuine and 78 cases /ears (78%) were of exaggerated hearing loss. Out of these 78 cases, 74 cases (74%) showed functional component over true organic deficit i.e. functional overlay cases and remaining 4 cases (4%) did not haveany organic pathology i.e. Pure NOHL.(Table - 7)

Table 7

Final outcome		**No. of patients (n=100 ears)**	**Percentage**
Genuine		22	22%
Exaggerated Hearing Loss	Functional Overlay	74	74%
	Pure NOHL	4	4%
Total Patients		**100**	**100%**

Table 8

Group		**n**	**Mean (in dB)**	**Std. Deviation**	**d. ErrorMean**	**t value**	**p value**
Group 1 (Genuine)	PTA	22	71.3846	27.53627	5.40031	0.635	0.528
	BERA	22	66.6923	25.73833	5.04770		
Group 2 (Exaggerated Hearing loss)	PTA	78	96.9324	23.03620	2.67790	18.638	0.000*
	BERA	78	50.1351	19.33789	2.24798		
	Total	**100**					

* Highly significant

The difference between mean of pure tone average and BERA threshold in cases with exaggerated hearing loss (Group 2) was 46.7973 dB which was significantly large and in genuine cases (Group 1) was 4.6923dB. On applying unpaired 't' test at significance level $p<0.01$

In our study, out of 64 cases of exaggerated hearing loss ,PTA-SRT discrepancy >12 correctly identified 59 (92.2%)cases of exaggerated hearing loss, however remaining 5 of exaggerated hearing loss showed PTA-SRT agreement (PTA-SRT <12) (chart 1 & Table 9).

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Table 9

	ExaggeratedHearing loss	Genuine	Total n-83
PTA-SRT >12	59	5	64
PTA-SRT<12	5	14	19
Total n-=83	64	19	83

Applying Chi Square test ,(Chi value (x) =36.01)
P value- <0.0000001* was highly significant, which indicates unexplained discrepancy between PTA-SRT showing an important indicator of functional losses

DISCUSSION

Exaggerated hearing loss describes the audiological discrepancies that exist between the real hearing threshold determined objectively and the subjective hearing threshold based on patient's response, in the absence of any anatomical or physiological lesion. Inconsistencies during audiometry should raise a degree of doubt regarding the accuracy of the subjective audiological tests. Confirmation and quantification of hearing loss is now possible by the appropriate application of a series of audiological tests, both behavioral and objective. Not much published studies are available in Index journals to determine cases of functional overlay. Those few studies which are available are discussed here.

Mahdi M S Al-Dujaily et al (2015) [6] studied 32 patients of suspected exaggerated hearing loss fit to their criteria, out of which 25% of the suspected cases were having genuine hearing loss, 59% were cases with functional overlay and rest 16% were of pure NOHL. Alexandra Holenweg et al (2010) [7] studied 18 adult cases out of which 4 cases (22%) of the non-organic hearing losses were diagnosed as psychogenic among the adults. 9 cases (50%) wereattributed to aggravation of an existing, but less pronounced, organic hearing loss and 5 (28%) were diagnosed as malingering. Our findings are consistent with above studies – Out of 100 ears/cases of suspected exaggerated hearing loss, 22 cases (22%) were found to be genuine ,74 cases (74%) were cases with Functional Overlay,4 cases (4%) were of Pure NOHL.(Table -7)

Arsian H. H. et al(2014) [8] in his study found mean difference between puretone thresholds and ABR thresholds in 28 patients of NOHL was 43.4 ± 19 dB. Seung-Deck Heo et al (2008) [9] in his study of 54 subjects divided into 2 groups malingering and control, the difference between pure tone average and ABR threshold in malingers was 33.22 dB with p value of <0.001. Our study was consistent with above studies , difference between mean of pure tone average and BERA threshold in cases with exaggerated hearing loss was 46.7973 dB ± 23 dB, with p value < 0.01. Normally, the agreement between the SRT and the appropriate pure tone average should be within ± 6 to 8 dB. If the SRT-PTA differs by as much as 12 dB or more with lower (better) SRT's, this outcome should raise the suspicion of exaggerated hearing loss. In our study, out of 64 cases of PTA-SRT disagreement, BERA correctly identified 59 cases (92.2%) of exaggerated hearing loss.

Lidija Ristovska et al (2021) [10] stated that the SRT is normally 10 dB higher than PTA at 500, 1000, and 2000 Hz of the corresponding audiogram. If the PTA and the speech thresholds do not correlate well, it is important to consider the possibility of malingering/exaggerated hearing loss. Alberti et al (1978) [11] in his study of 596 patients, PTA-SRT discrepancy was found in 88 patients in which 14% (13/88) were non-exaggerators and 85.2% (75/88) were correctly identified as exaggerators. Chaiklin & Ventry (1965) [5] in his long term study on adult males with functional hearing loss of 47 patients, discrepancy between the SRT-PTA measure correctly identified 33 of the 47 subjects (70%).

Our study demonstrate the importance of the use of physiological measures such as acoustic reflex test and Auditory brainstem response testing as a cross check for subjective audiological assessment and to quantify the approximate hearing threshold of patients. Tingting Yu et al (2022) [12] stated NOHL should be suspected in patients with discrepancies in their results on subjective hearing test; objective tests such as OAE and ABR play important roles in narrowing the differential diagnosis. Abhilash A, Saritha H

(2021) [13] which stated that BERA is useful in finding hearing thresholds in patients with inconsistent response to pure tone audiometry. Balatsouras DG et al(2003) [14] which states that ABR has been proven to be a reliable method for determining pure-tone thresholds in patients who are uncooperative in performingsubjective tests or when discrepancy exists between subjective tests. Sanders & Lazenby (1983) [15] stated auditory brain stem response measurement can be a powerful tool in the identification and quantification of nonorganic hearing loss.

CONCLUSION

From this study, we conclude that prevalence of Functional Overlay cases are increasing as governmental benefits are being available for persons with hearing impairment. Diagnosing exaggerated hearing loss requires sufficient knowledge of the disorder so that an appropriate evaluation is employed to accurately assess auditory threshold of patients. Electrophysiological assessment measures (like ART,BERA),when used together with behavioral observations and subjective audiological assessment (like PTA,SRT) can improve the diagnostic criterion of exaggerated hearing loss.

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