

CALIBRATION

Purpose

Pure-tone audiometric results have significant influence on the medical, legal, educational, occupational, social, and psychological outcomes, it is critical that procedures be standardized and consistent among test providers.

Scope

The guidelines presented in this document are limited to diagnostic pure tone audiometry. The current forum does not intend to imply that only one method is correct. Variations in procedure may be demanded by special clinical problems or regulatory demands. For example, special populations—such as very young children, those who are uncooperative, and persons with severe developmental delays, severe hearing impairment, or neurological disorders—may require modifications of the guideline procedures if the audiologist is to develop sufficient information for case management. Additionally, occupational, forensic, and financial compensation determinations, (e.g. disability, worker's compensation), may also require modifications to standard procedures to obtain true and accurate results. When variations in procedure are necessary, they should be noted in a manner that allows other testers to understand how thresholds were obtained and to replicate the findings if necessary. However, one cannot assume, however, that calibrated equipment ensures that valid measurements are always obtained.

Equipment and Test Environment

It is essential that audiometric equipment be calibrated, be functioning properly, and be used in an acceptable test environment to assure accurate test results.

Audiometer and calibration

Air- and bone-conduction audiometry shall be accomplished with an audiometer and transducers that meet the applicable specifications of ANSI S3.6-2004 (American National Standards Institute, 2004b) and are appropriate to the test technique being used. Exhaustive electroacoustic calibrations should be performed annually using instrumentation traceable to the National Institute of Standards and Technology (previously known as the National Bureau of Standards prior to 1988). Functional inspection, performance checks, and bio-acoustic measurements should be conducted daily to verify the equipment performance before use.

Transducers. Transducers are matched to the audiometer and should not be interchanged without recalibration. Supra-aural and insert earphones are appropriate for air-conduction threshold measurements from 125 Hz through 8000 Hz, while circumaural earphones are used for extended high-frequency measurements within their respective frequency and intensity response ranges. Bone vibrators are used for bone-conducted threshold measurements for frequencies within their

respected frequency response range and must meet the specification of *Mechanical Coupler for Measurement of Bone Vibrators* (ANSI S3.13-1987; American National Standards Institute, 2002).

Test environment

The test environment shall meet at all times the specifications detailed in *Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms* (ANSI S3.1-1999; American National Standards Institute, 2003). Confirmation of an acceptable test environment shall be documented at least annually.

The test room and audiologist work area should provide for proper control of temperature, air exchange, and humidity. In the interest of safety, sound-isolated areas must be provided with either or both visual and auditory warning systems.

To conclude, the ambient noise should be as per ANSI (1999) specification and in any case should not exceed 35 dB(A as recommended by BSA (2011). If it is higher than this then it is recommended that audiometry should not proceed.

BIOLOGIC CALIBRATION

Purpose: To obtain consistent responses in the clinic over a period of time

To ensure appropriate diagnosis

Subject: normal hearing without any ontological problems

Frequency (no of times) of calibration:

- Once daily when the first switch is on
- If the patient load is more than 20 patients during the morning and afternoon session, biologic calibration in each session
- When transducer falls down
- When inconsistent responses noted between patients, and or not correlating with results

Frequency considered for calibration:

- 500-4000 Hz

Placement of BC:

- Mastoid placement (follow standard placement and method)

Reference:

- Average value obtained on 5 normal hearing subjects without other otological symptoms. This reference value to be checked every 6 months
- $> \pm 5\text{dB}$ with reference (need to add correction factor)

- If > 20dB, should be sent for objective calibration

OBJECTIVE EVALUATION

Purpose: same purpose as biologic calibration

When to perform: > 20 dB between three successive subjective calibration

Instruments: artificial mastoid, SLM, cables/transducers

Standards: ANSI (1996) (1989)

Personnel involved in calibration:

- Biomedical engineers
- Audiologists

Frequency (no of times) calibration:

- Annual
- If patient load is > 100 more than month bi-annually
- Interchange/ new transducers

SOUNDFIELD CALIBRATION

Procedure:

1. Switch of audiometer
2. Select sound field
3. Prepare SLM, place it middle of 2 speakers at a distance of 1 meter, at 45 °
4. SLM at ear level mounted on tripod
5. Mic: free-field microphone
6. Continuous/interrupt – “on”, lowest frequency at 70 dBHL
7. Match the SPL value on SLM
8. Same procedures for all the equipment

Guidelines for routine audiometric procedures

Preamble: With the emergence of various academic training institutes across the country and many young professionals willing to take up private practice as an option of carrier choice, there is need for coming up with common guidelines that are practiced in doing basic audiometric procedures. This will enable us to address and handle many legal, ethical issues that are practiced in India. India, being multicultural, different social demands from western countries and with wide socio economic groups, there is need to develop guidelines that are apt for our country. In making this possible, a workshop was conducted at Department of Speech and Hearing, Manipal University, Manipal on 4-7 December, 2015. 30 professionals participated from academic and clinical institutions. The professionals deliberated using focus group discussion methodology and came out with the consensus of the following guidelines that would be apt for our country. The expressed guidelines are limited to the experience and knowledge of the participants. However, to have wider acceptability, your input on this can further facilitate in modifying the document to get wider acceptability and implemented across India.

1.1 Standard audiometric procedure to carryout

1.2 Preparation of subject

Prior to doing hearing evaluation, following steps are recommended to be followed and findings/observations of these need to be recorded in the clinical records.

1.2.1 Ear examination

Prior to hearing evaluation, audiologist has to perform the ear examination. In case of referral cases information given by the concerned medical doctor can be considered, but should do ear examination to confirm the findings.

1.2.1.1 Otoscopic examination (video/direct) should be performed on each patient

1.2.1.2 Any wax/foreign body which can affect test results, refer to ENT/Medical professionals for otologic management

1.2.1.3 Comment of findings need to reflect in the report/case file.

1.2.1.4 External ear anomalies can be subjected for evaluations with appropriate modifications in transducers/placement of transducer based on the extent of anomalies.

1.2.2 Instruction

After the ear examination and case history taken, the audiologist should give appropriate instructions to elicit good and reliable results. In medico-legal cases it is recommended to take informed consent that he/she has understood the instructions and is informed about the test procedure. Attached template (annexure 1) can be used. This informed consent should be filed in the case file.

1.2.2.1 Language/culture specific instructions

1.2.2.2 References of ASHA can be taken and translated

1.2.2.3 Instructions to be given prior to testing

- 1.2.2.4 Written instruction can complement verbal instruction
- 1.2.2.5 Patient should be clearly instructed on safety, outcome of the procedure
- 1.2.2.6 s routine signature can be obtained on understanding of instructions mandated in medico-legal cases
- 1.2.2.7 Modify instruction in difficult to test population and pediatric population

1.2.3 Threshold determination method

In the literature there are many threshold estimation method are described. Following threshold estimation method is recommended.

1.2.3.1 First five trials for familiarization at anticipated supra-threshold level

1.2.3.2 Preferably use ascending/descending method

1.2.3.3 Initial presentation level – normal (30dB), Hearing loss (50 dB)

Test frequency – octave (250-8kHz), Mid octaves will be tested if threshold difference exceeds more than 20 between two octaves.

1.2.3.4

1.2.3.5 Sequence of testing: Usually 1kHz, 2kHz, 4kHz, 8kHz,500 Hz,250 Hz (cross check at 1kHz, if the difference is more than 10dB recheck all the frequencies

1.2.3.6 Pediatric: session should be divided from (500-4kHz, <5 years of age) and all the frequencies for children >5 years of age. Overall Begin at 500Hz, if no response, shift to 250 Hz. In many children with congenital hearing loss, very low frequencies may be better preserved.

1.2.3.7

1.2.3.8 Response: conditioned responses

1.2.3.9 Stimulus used: tinnitus – pulse; Pediatric – warble/FM; Adult – pure tone

1.2.4 Plotting of Audiogram

Recommended symbols used for plotting audiogram are given in Annexure 2a and recommended audiogram is given in Annexure 2b. Universal code of red for right ear and blue for left ear is adopted. Plotting audiogram in these colours is not essential. Right ear, Rt Ear, RE or the recommended representation/abbreviations to be used for right ear and Left Ear, Lt Ear, LE for the left ear.

1.2.4.1 Care should be taken to mark appropriately. For example, the BC plot should be done next to the line and not on the line.

1.2.4.2

1.2.5 Audiogram interpretation

1.2.5.1 Pure Tone Average: Four-frequency average value of hearing loss (500, 1000, 2000 and 4000 Hz (Ministry of Social Justice and Empowerment, 2001).

1.2.5.2 If at any frequency no response is obtained due to the severity of the loss, this reading shall be given a value of maximum audiometric limit at that particular frequency.

1.2.5.3 Any hearing threshold level lower (better) than 0 dB HL shall be given the value 0 dB HL.

1.2.5.4 Averages do not imply any particular configuration of hearing loss and do not exclude additional terms (e.g. high-frequency hearing loss) being used.

1.2.5.5 To be reported as: Average hearing threshold levels (....dB HL) inEar.

1.2.5.6 Classification of degree of hearing loss: Normal Hearing: till 15 dB HL; Slight/Minimal loss: 16-25 dB HL; Mild hearing loss 26-40 dB HL; Moderate hearing loss 41-55 dB HL; Moderately Severe loss 56-70 dB HL; Severe hearing loss 71-90 dB HL; Profound hearing loss In excess of 90 dB HL.

1.2.6 Sample Audiogram report

A sample audiogram report is given if you are using single audiogram in Annexure 3a and two audiograms in Annexure 3b.

SPEECH AUDIOMETRY

Purpose of Guidelines

Scope

Purpose of Speech Audiometry

Set - Up

- *Test environment*
- *Test room*
- *Test equipment*
- *Mode of presentation*
- *Basic Instruction*

Tests to be performed in adults

- *Speech Recognition Threshold (SRT)*
- *Word Recognition Score (WRS)*
- *Speech Detection Threshold (SDT)*
- *MCL for speech*
- *UCL for speech*
- *Dynamic Range*

Speech Assessment in Difficult to Test Population

Purpose of Guideline

The purpose of this guideline is to recommend a simple and rapid procedure for speech audiometry, to define common terminology and its usability in a variety of clinical circumstances for adults. However,

certain individuals such as mentally disabled, uncooperative, or neurologically disabled individuals may require modification of the procedure.

Scope

Speech audiometry is the procedure used in the assessment of an individual's threshold of hearing for speech.

Purpose of Speech Audiometry

The basic purpose is to measure the patient's ability to recognize speech stimuli, to validate the Pure Tone Audiometry (PTA) results, to compliment differential diagnosis (retro-cochlear pathology), and to evaluate in difficult to test populations such as non-organic hearing loss, neurological related cases such as stroke or dysarthric patients etc. The purpose is also to give a reasonable estimate in planning rehabilitation, especially in Hearing Aid (HA) evaluations.

Set-up

- **Test environment:** The test environment shall meet the criteria for background noise in audiometric rooms as specified by the ANSI criteria for Maximum Permissible Ambient Noise during Audiometric Test Rooms (ANSI S3.1-1999).
- **Test room:** All the testing shall be conducted in the double or single sound treated room satisfying ANSI standards.
- **Test equipment:** A duly calibrated clinical diagnostic audiometer satisfying ANSI S3.6-1969[B1973] is to be used. The transducers used can be a TDH 39 or equivalent / Loudspeakers. If the mode of presentation is through recorded speech, then a CD/DVD Player/PC/Laptop is required.
- **Mode of Presentation:** Either a recorded or monitored live voice technique can be used. Each mode has its own advantages and disadvantages.
 - *Monitored live voice without lip reading* – is the preferred choice as it offers flexibility while testing. The examiner can control his/her voice intensity and to have the speech balanced at 0 dB on VU (volume unit) meter. The disadvantage is that it is impossible to present each spondaic word in the same manner to every client. Though it is more flexible but lip reading may occur.
 - *Recorded material* can be used if double room setting is not available to conduct speech audiometry. It is an ideal method (more accurate, better control of the intensity of the test items). However, the use of recorded test materials may limit flexibility of the test procedure in terms of selection of test words, rate of presentation and is restricted to clinical setting only.

- **Basic Instruction:** The specific wording of the instructions must be phrased in the language appropriate to the client.
 - Instruct regarding the nature of the test and specify the clients' mode of response (repeating orally / for those with speech difficulties, the mode of response can be through picture pointing or writing).
 - Instruct to respond even when the stimuli is soft and encourage him/her to guess.
 - Make appropriate changes in the audiometer prior to testing, ensuring that the VU meter is at zero, when spondaic word is presented.
 - Start the testing in the better ear first.

Test Protocol for Adults

The test that could be performed for adults include Speech Recognition Threshold (SRT), Word Recognition Score (WRS), Uncomfortable Level (UCL) for Speech, Most Comfortable Level for speech* and the Speech Detection Threshold (SDT)*. Some of the tests are mandatory and others are optional* / need based*.

Speech Recognition Threshold (SRT)

- *Definition:* The SRT is the minimum hearing level for speech (ANSI S3.6-1988) at which an individual can recognize 50% of the speech material.
- *Purpose:* The purpose of SRT is:
 - To validate the thresholds obtained through PTA
 - To serve as a reference point for supra-threshold tests
 - To ascertain the need for aural (re)-habilitation and monitor its progress
 - To determine hearing sensitivity in difficult to test population
- *Material:*
 - Spondaic words are the usual and recommended test material for the SRT test. They are 2-syllable words that have equal stress on both syllables.
 - Word familiarization can be done prior to the start of test. This ensures that the client is familiar with the test vocabulary, and the client's responses can be accurately interpreted by the clinician. Care to be taken to eliminate the visual cues during familiarization.

- Based on the circumstances or individuals (age, language facility, physical condition), the standard word list can be modified; however, that the use of speech stimuli with less homogeneity than spondaic words may compromise the reliability of this measure.
- The test material used should be noted in reporting of the results.
- *Response Format / Mode:* The usual response mode for obtaining the SRT is repetition of the stimulus item. For many patients it is not possible to obtain verbal responses, necessitating the use of alternative response modes such as writing down the responses or closed set of choices such as picture pointing, signing, or visual scanning etc. If picture pointing mode is to be used, then the clinician should be cautious in choosing the number of response items (e.g., between 6 and 12 words usually is appropriate).
- *Procedure:* There are different methods to obtain SRT - ascending or descending method. Generally, descending method (ASHA, 1988) is preferred and is described below.
 - Obtain pure tone average (PTA).
 - Starting level for SRT: 30-40dB above anticipated SRT or 20 dBSL (with reference to PTA).
 - Present one spondee at a time at this level. Decrease in 10 dB decrements, whenever the client response is correct. The 10 dB decrement continues until one word is missed/ until the client responds incorrectly.
 - Now present a second spondaic word at the same level that the client responded incorrectly.
 - If the second word is correctly identified by the client, the level is attenuated by 10 dB and two spondees are presented. This process is continued until two spondees are incorrectly identified at one level. This is the preliminary phase and the actual test phase begins, which can be performed in 5 dB step (Martin & Sides, 1985).
 - If you get response for at least one spondee, reduce the intensity by 5 dB and present 03 spondees at that level.
 - Continue the same procedure, until “no response” for all the 03 spondees obtained.
 - Increase by 5 dB and continue it by presenting 03 spondees at each level till you get 2/3 spondees (>50%). That level can be considered as SRT.
- *Interpretation*
 - The SRT shall be recorded in dB HL. The results should be recorded for each ear on the same form that contains the client's results for pure tone audiometry. Additional space

should be available to report other pertinent information that describes the test situation, such as alternative materials or response modes

- TheSRT & PTA correlation are usually within 6 – 12dB.
- If there is disagreement, it could indicate one of the possibilities: misunderstanding of the instructions, functional hearing loss (non-organic), instrumentation malfunction, pathology along CANS including VIII nerve, cognitive and language difficulties etc. For e.g. the SRT can be poorer than PTA in elderly and auditory processing disorders; whereas the SRT can be better than PTA in cases of malingerers/functional hearing loss.
- *SRT Masking:*
 - Masking should be applied to the non-test ear, when the obtained SRT in one ear exceeds the apparent SRT or a pure tone BC threshold at 500, 1000, 2000 or 4000 Hz in the contralateral ear by 40 dB or more.
 - The masker used should have a wide band spectrum (white, pink or speech noise) to effectively mask the speech stimuli.
 - The level of effective masking used should be sufficient to eliminate reception by the non-test ear without causing over masking and should be recorded on the same form as that used to record audiometric results.

Word Recognition Scores (WRS)

- *Definition:* The word recognition score is the percentage of words correctly identified, when presented at a constant suprathreshold level.
- *Purpose:* To assess the individual's auditory system's capability to identify the speech stimuli.
- *Materials:* Monosyllabic words that are presented in an open set format. These monosyllabic should be *Phonetically balance PB* words (sets of words that contain speech sounds with the same frequency of occurrence as in everyday conversation).
- *Procedure:*
 - Instruct the client to repeat each test word.
 - Adjust attenuator to desired presentation level, i.e. at MCL (\sim SRT + 40dB).
 - Present 20 monosyllabic words to each ear. When a 20 words list is used, give 5% for each correct response.
 - Repeat the procedure for the other ear
- *Interpretation:*

- Record the percent correct score at the presentation level. As stated, when a 20 words list is used, 5% for each correct response is given.
- Normal: 90 to 100%; Conductive hearing loss: 80-or 60 to 100%; Cochlear pathology: >60%; Retro-cochlear pathology: < 70% (however, the scores vary depending on the etiology and degree of loss).

Speech Detection Threshold (SDT)

- *Definition:* The SDT is the minimum hearing level for speech at which an individual can just discern the presence of a speech material 50% of the time.
- *Purpose:* To assess the awareness of the presence of sound and to confirm the client's thresholds. This test is to be performed only when we can't perform SRT, for individuals who are not able to repeat words such as non-cooperative patient, testing in their second / foreign language and the stroke victims etc.
- *Material:* The type of speech material is not as critical because it reflects detection and not recognition. Some common materials are speech babble, running speech, or familiar words. Running speech and sentences are more preferable. Nevertheless, specification of the type of material helps to ensure test-retest reliability and may be useful information for future hearing evaluations.
- *Procedure:*
 - Determination of the SDT involves a detection task that is similar to the one used in pure tone threshold audiometry.
 - Stimulus familiarization is unnecessary.
 - No specific steps (ascending - ascending "10 dB up & 5 dB down or descending method - "10 dB down & 5 dB up").
 - The test can be conducted through head phone or speakers.
 - *Response mode:* A number of response modes can be used to convey signal detection even without repeating it correctly by verbal, hand signal, or push the buttons. Usually, these response modes are nonverbal.
- *Interpretation:*
 - The SDT shall be recorded in dB HL. The results should be recorded for each ear on the same form that contains the client's results for pure tone audiometry.
 - TheSDT will be 10-12 less than SRT. Generally, the recognition or understanding of the speech stimuli does not occur until about 7-9 dB above the level of detection.

Most Comfortable Level (MCL)

- *Definition:* It is the hearing level at which the patient experiences speech material to be most comfortable and he/she prefers to listen to speech material.
- *Purpose:* To determine the limit of amplification suitable for the candidate for the HA fitting. It is about 40-50/55 dB above SRT for normal hearing.
- *Stimulus Used:* cold running speech- sentences or 3 spondees.
- *Instruction:* You are going to hear words/sentences at decent loudness levels. When you hear these words/sentences clearly and comfortably, then you indicate to us.
- *Procedure:*
 - Running speech is presented at 10 dB above SRT.
 - A 10 dB increment is provided till the patient hears the words/sentences at comfortable level.
 - Several trials are usually completed because MCL is typically a range, not a specific level or a single value.
- *Interpretation:*
 - People sometimes want sounds a little louder or a little softer, so the range is a more appropriate term for this than MCL.
 - The value/ range and the material used should be recorded on the audiogram.

***Uncomfortable Loudness Level (UCL)**

Definition: It is the hearing level at which the patient considers speech material to be uncomfortably loud

Purpose: To assess the individual's maximum tolerance threshold for speech stimuli. It also represents the maximum amplification that the patient can accept with H.A

Procedures>> see the attached document (Speech Tests Procedures)

Dynamic Range (DR)

Definition: The range in decibels between the patient's SRT and UCL. It is the patient's usable listening range

Purpose: This important point for HA fitting and will be problem in HA use.

Estimation of DR: DR=UCL-SRT

Interpretation:

- For normal hearing person: 100 dB or more
- Similar Conductive hearing loss
- Can be much smaller in SNHL due to recruitment

Hearing Assessment In Difficult To Test Population

Category 1: Patients who cannot give verbal response but written response mode (e.g. Dysarthria, Apraxia)

Measures:

- SRT (bracketing method)
- WRS- in quiet (Full list)
- WRS – in noise (WRTN)
- UCL (rating on a 3-point rating scale -“Uncomfortable”, “Comfortable”, “Very comfortable”)

Category 2: Patients those who cannot give verbal or written response (e.g. Aphasia with hemiplegia)

Measures:

- SDT
- UCL
- SRT

- WRS in quiet and in noise
 - Picture pointing- can be used for those with good motor control
 - For one stimulus – 3 foils, percentage guessing
 - Location of target/correct stimulus maybe rawed for each stimulus
 - Stimulus: minimal pair/rhyming words

(the highlighted ones were written before, did not understand what it meant)

Mode of response and alternative materials used should be specified in the report

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Hearing Screening – General

Purpose of hearing screening:

The purpose of hearing screening is limited to check for the presence or absence of hearing loss.

Who can carry out hearing screening procedure?

Practise of hearing screening should be limited to:

- A. An RCI certified Audiologist.
- B. Any other RCI recognized personnel in hearing assessment.

Test Environment:-

A reverberation free quiet room without sound reflections and with an ambient noise level less than 45-50 dB SPL. Ambient noise level can be measured with a sound level meter

Levels of hearing screening:

- 1. Level 1: Screening: Questions / Screening checklist**
 - a. Do you have difficulty in hearing: Yes/No
 - b. Does your work / learning / life events / communication get affected

- 2. Level 2 Screening: Audiometry**

Frequencies tested

- a. All frequencies(250 Hz, 500Hz, 1000 Hz,2000 Hz,4000 Hz and 8000 Hz)
- b. Testing Intensity level: 40 dBHL
40dB criteria chosen as per the WHO definition of hearing loss for adults in the better ear (WHO, 2015, www.who.int/mediacentre/factsheets/fs300/en)
- c. Test population: Adult(above 18 years of age. Though we recommend the criteria for age above 14 years).

Pass / Fail criteria

A subject is considered Failed in the screening when he / she is unable to hear

- At 40 dB (even unilaterally)
- A minimum of two consecutive frequencies in the same ears /same frequencies in both ears / even in one frequency
- Failure in answering any one of the questions

Reporting format Draft

Date:

Hearing screening report

This is to inform that in the hearing screening conducted on Mr/Ms. _____, has passed / failed and has been advised to consult for diagnostic testing / report after 1 year for rescreening.

Signature

Hearing Screening - Industrial screening

Frequencies to be tested

Screening – PTA (500Hz, 1kHz, 2kHz, 3kHz,4kHz, 6kHz) at 20 dBHL

Equipment to be used – Diagnostic Audiometer + High frequency Audiometry,

Frequency of testing: 6 months / 1 year

Pass/Failed criteria:

Fail if there is no response in the consecutive 2 frequencies in any ear.

Testing should be carried out 15 hrs prior to the noise exposure

Who can carry out hearing screening procedure?

RCI certificated audiologist

Test Environment

Sound treated room/booth is must or biological calibration should be done prior to the testing

Special Tests

Purpose of Guideline

The purpose of this guideline is to recommend a simple procedure for special tests. However, certain individuals such as mentally disabled, uncooperative, or neurologically disabled individuals may require modification of the procedure.

Purpose of special test

Special tests are used to identify the site of lesion and also it helps in differential diagnosis. This further helps in appropriate management

Set-up

- ***Test environment:*** The test environment shall meet the criteria for background noise in audiometric rooms as specified by the ANSI criteria for Maximum Permissible Ambient Noise during Audiometric Test Rooms (ANSI S3.1-1999).
- ***Test room:*** All the testing shall be conducted in the double or single sound treated room satisfying ANSI standards.
- ***Test equipment:*** A duly calibrated clinical diagnostic audiometer satisfying ANSI S3.6-1969[B1973] is to be used. The transducers used can be a TDH 39 or equivalent / Loudspeakers and also CD/DVD Player/PC/Laptop is required. To measure OAE calibrated instrument should be used.

TESTS FOR COCHLEAR PATHOLOGY

SISI: Short Increment Sensitivity Index

Procedure:

- The subject is presented with continuous pure tone at 20 dB SL with 1 dB increment presented every 5 seconds.
- The subject has to be instructed to respond to the increments when detected. To familiarize the subject to the test trials can be given with increment of 5 dB is presented.
- Catch trials can be included to make sure the subject doesn't give false responses (with 5 dB increment or no increment)
- The SISI score in percentage can be calculated by multiplying the number of 1 dB increments correctly detected by 5.
- The tests is usually done at frequencies 1 kHz, 2kHz and 4 kHz

Interpretation:

- Scores between 0 – 70% are negative for cochlear pathology
- Scores above 75% are positive for cochlear pathology

OTO ACOUSTIC EMISSIONS

TEOAE

Procedure:

- Insert a probe with a soft flexible tip in the ear canal to obtain a seal.
- The stimulus used to obtain TEOAE is clicks of 80 to 85-dB SPL stimuli are used clinically with frequency ranging from 500 Hz -4 kHz
- TEOAEs are generally recorded in the time domain over approximately 20 milliseconds Multiple responses are averaged.
- All OAEs are analyzed relative to the noise floor; therefore, reduction of physiologic and acoustic ambient noise is critical for good recordings.
- To consider TEOAE to be present the criteria is $SNR \geq 6$ dB with reproducibility $\geq 80\%$

Interpretation:

Presence of a TEOAE in a particular frequency band suggests that cochlear sensitivity in that region. Absence of TEOAE suggests cochlear pathology (Outer hair cell dysfunction)

DPOAE

- Insert a probe with a soft flexible tip in the ear canal to obtain a seal.
- Stimuli consist of 2 pure tones at 2 frequencies (ie, f_1 , f_2 [$f_2 > f_1$]) and 2 intensity levels (ie, L_1 , L_2).
- The frequency range should be from 500 Hz – 12 kHz with intensity 65/55 dB SPL
- Artifact-free averaging should be conducted for 20 seconds to allow the noise at each frequency to reach sufficiently low levels.

- To consider DPOAE to be present the criteria is $SNR \geq 6$ dB

Interpretation:

Presence of a DPOAE in a particular frequency band suggests that cochlear sensitivity in that region. Absence of DPOAE suggests cochlear pathology (Outer hair cell dysfunction)

SCAP - A : Screening checklist for auditory processing – Adults

- The checklist consists of twelve questions that tap auditory separation/closure, memory and attention.
- Two checklists, one to be answered by the individual themselves and the other to be answered by a family member
- A 2-point rating scale (‘present’ and ‘absent’) is used to obtain responses for both checklists adults who obtain more than the 50% score (a score ≥ 6) are considered at risk for auditory processing deficits

.. . Screening Checklist for Auditory Processing in Adults (SCAP-A) – Modified 2-point rating scale^a
(Report by Self)

Name: _____ Date: _____
 Age: _____
 Gender: Male/Female
 Please tick (✓) the most appropriate option

No.	Questions	Score	
		Present	Absent
1	Do you require frequent repetitions while listening to someone who does not have a speech problem?	1	0

2	Can you pay attention to someone speaking continuously for more than 10 minutes? E.g. Listening to a conversation.	0	1
3	Do you find it difficult to attend to speech in the presence of background noise? E.g. Television at normal volume/fan at high speed.	1	0
4	Do you have trouble recalling what was said in the correct order? E.g. 5 different (non-routine) things in the order you have done them	1	0
5	Do you forget what was told to you within a short span of time (within a minute)? E.g. To buy a particular item from a shop	1	0
6	Do you have difficulty in understanding speech in the presence of background noise (when the television/fan at full speed)?	1	0
7	Can you recall the names of 5 of your school/ college friends, who you have not met after you left school/college?	0	1
8	Have you been told that you take longer than others to respond when your friends or family talk to you?	1	0
9	Do you have difficulty in responding to two people talking at the same time? E.g. In a group, when two people answer/ask a question at the same time.	1	0
10	Do you feel it is difficult to understand someone's speech when you cannot see his or her face? E.g. When the person's face is turned away from you.	1	0
11	Do you have difficulty in remembering numbers, especially telephone/vehicle/door numbers, bus numbers, account numbers?	1	0
12	Do others report that you do not attend to them when they suddenly start talking to you?	1	0

Thank you for the careful completion of this questionnaire

Screening Checklist for Auditory Processing in Adults (SCAP-A) - Modified 2-point rating scale^a
(Report by Family)

Name:

Date:

Age:

Family member of:

Relationship:

No.	Questions	Score	
		Present	Absent
1	Does she/he require frequent repetitions while listening to you or someone who speaks clearly?	1	0
2	Can she/he attend to someone speaking continuously for more than 10 minutes?	0	1
3	Does she/he find it difficult to attend to speech in the presence of background noise?	1	0
4	Does she/he have trouble recalling what was said in the correct order? E.g. 5 different (non-routine) things in the correct order	1	0
5	Does she/he forget what was told very quickly within a short span of time (within a minute)? E.g. To buy a particular item from a shop	1	0
6	Does she/he have difficulty in understanding in the presence of background noise (when the television/fan at full speed)?	1	0
7	Can she/he recollect the names of 5 friends whom they have not met over 30 years?	0	1
8	Does she/he take much longer (almost double the time) to respond to what was said compared to others in the family/friends?	1	0
9	Does she/he have difficulty in responding to two people talking almost at the same time?	1	0
10	Does she/he have difficulty in understanding speech when the face of the speaker cannot be seen?	1	0
11	Does she/he have difficulty in recalling digits, especially telephone/vehicle/door numbers, bus numbers, account numbers?	1	0
12	Does she/he not attend to you or others when you or others suddenly start talking to her/him?	1	0

Thank you for the careful completion of this questionnaire

Quick Speech In Noise (English) -

Procedure:

- Connect a CD player to the speech circuit of a standard audiometer.
- Present the test with earphones or in a sound field, with the attenuator dial set to 70 dB HL.
- For subjects with PTA hearing losses greater than 45 dB HL, set the attenuator dial to a level that is “loud but OK.”
- Instruct the patient to repeat the sentences spoken by the target (female) talker.
- A list of six sentences with five key words per sentence is presented in four-talker babble noise.
- The sentences are presented at pre-recorded signal-to-noise ratios which decrease in 5-dB steps from 25 (very easy) to 0 (extremely difficult).

- The SNRs used are: 25, 20, 15, 10, 5 and 0, encompassing normal to severely impaired performance in noise.

Scoring:

- In each list there are 6 sentences, and in each sentence there will be 5 key words.
- Score the client on how many of these key words the client correctly repeats back to you.
- Add the number of words repeated correctly, totalled across all 6 sentences.
- Subtract the total correct from 25.5 to obtain SNR loss

Interpretation:

- The SNR loss is the difference in the patient's performance in noise compared to normal hearing persons' performance in noise.
- The SNR Loss is the score used to **quantify** the client's difficulties and used to report the loss in **dB**
- This score can be used to categorise the client's degree of SNR Loss and the expected improvements with directional mics

SNR LOSS	DEGREE OF SNR LOSS	EXPECTED IMPROVEMENT WITH DIRECTIONAL MIC
0-3 dB	Normal/near normal	May hear better than normals hear in noise
3-7 dB	Mild SNR loss	May hear almost as well as normals hear in noise
7-15 dB	Moderate SNR loss	Directional microphones help. Consider array mic
>15 dB	Severe SNR loss	Maximum SNR improvement is needed. Consider FM system

Hearing Disability Certificate

Guidelines for Issue of Hearing Disability Certificate (for Centers recognised by appropriate authority)

Hearing disability certificate is issued as per the definition of hearing disability published in Persons with Disability Act. (PWD) 1995 which says that the hearing disabled person is one who has the hearing loss of 60 dB HL or more in the better ear for conversational range of frequencies.

For implementation of PWD Act 1995, Government of India published a Gazette in 2001. This Gazette has provided the guidelines for issue of Disability Certificate. These guidelines are as follows:

1. **Definition of Hearing:** A persons with hearing impairment having difficulty of various degrees in hearing sounds is an impaired person.
2. Categories of Hearing Impairment

Information about the various types of impairment				
Category	Type of Impairment	dB Level	Word Recognition Score(Speech discrimination)	Percentage(%) of Impairment
I	Mild hearing impairment	26 – 40 dBHL in better ear	80 to 100% % in better ear	Less than 40%
II a)	Moderate hearing impairment	41 to 60 dB in better ear	50 to 80% in better ear	40% to 50%
II b)	Severe hearing impairment	61 to 70 dB in better	40 to 50 % in better ear	71 % to 100%
III	a) Profound hearing Impairment	71 to 90 dB	Less than 40% in better ear	100%
	c) Total deafness	91 dB and above in better ear	Very poor discrimination	

Tests to be used for certification

- PTA (diagnostic) + BERA (threshold tracking)
- Speech audiometry (SRT, WRS)
- Auditory neuropathy – WRS and also ABR, OAE, CM

Steps for calculation of percentage of disability

1. Estimate PTA of 500, 1K, 2K, 4K shall be 60dB or more in the better ear
2. Word Recognition Score shall be 50% or less
3. PTA of Better Ear minus 25 (Low fence) and multiply by 1.5 and again by 5
4. PTA of Poorer Ear minus 25 (Low fence) and multiply by 1.5
5. Divide sum of 3 and 4 by 6 to get the binaural percentage of disability

It is advised to do the following as a matter of precaution, as to safeguard us from the malingerers and attempts of impersonation

- a. Do ABR for all clients
- b. Take left thumb impression of the testee for our records
- c. Take photograph of the testee for records

Issuing of disability certificate

1. Threshold:

- a. **PTA:** PTA of 60 dB in better ear of permanent and progressive in nature
- b. In confirmed Auditory Neuropathy with no benefit from amplification with speech scores to be taken as well

2. Document requested:

- a. Valid photo and ID proof
- b. Witness with address
- c. Form copy to be requested and record to be maintained
- d. Record maintenance for minimum duration as per legal requirement

References:

AYJNIHH guidelines for hearing disability