

Audiologic Evaluation Protocol Ear & Hearing | Center for Neurosciences

COMPREHENSIVE ADULT AUDIOLOGIC EVALUATION

30 MINS

Otoscopy

Tympanometry

Acoustic Reflexes

Pure-tone thresholds for air and bone conduction, 125-8000 Hz

Speech reception thresholds

Word recognition scores

Additional tests, performed as needed:

Reflex decay, DPOAEs, Quick-SIN, Tinnitus evaluation, Ultra-high frequency audiometry

OTOSCOPY

Visual inspection of the external auditory canal via otoscope to assess:

Cerumen accumulation/impaction

Tympanic membrane status

Middle ear status/fluid accumulation

Health of the skin in the external auditory canals

Shape and size of the external auditory canals

TYMPANOMETRY

Tympanometry is the dynamic measure of acoustic immittance of the tympanic membrane as a function of changes in air pressure in the ear canal to assess static compliance/admittance, ear canal volume, and middle ear pressure.

	Adult norms	Child norms
Static compliance/admittance	0.3 to 1.4 ml	0.3 to 0.9 ml
Ear Canal Volume	0.6 to 1.5 cc	0.3 to 0.9 cc
Middle ear pressure	-110 to 150 daPa	-150 to 150 daPa

ACOUSTIC REFLEXES

Acoustic reflex testing involves the measurement of the threshold at which the stapedial muscle contracts. The 8th nerve carries the stimulus to the brainstem and if the stimulus is intense enough, it will elicit a response that the 7th nerve carries which commands the stapedius muscle to contract. A detectable admittance change with 226 Hz is 0.02 ml or greater.

Acoustic reflexes assess:

Degree of hearing loss

Auditory neuropathy

Hyperacusis

Patients with auditory or brainstem tumors

Patients with neurologic diseases

PURE TONE THRESHOLDS

This test obtains the softest sounds a patient can hear at individual frequencies (125-8000 Hz) in order to determine the degree, type, and configuration of hearing loss. Pure-tone thresholds are obtained for air conduction and bone conduction.

Degree of Hearing	
Normal Hearing	≥ 25 dB HL
Mild Hearing Loss	30-40 dB HL
Moderate Hearing loss	45-55 dB HL
Moderately Severe Hearing Loss	55-65 dB HL
Severe Hearing Loss	70-85 dB HL
Profound Hearing Loss	≤ 90 dB HL

SPEECH RECEPTION THRESHOLD

Evaluating the softest level at which a patient can repeat a word with 50% accuracy, this allows us to cross-check the reliability of pure-tone thresholds. Recorded spondee speech is utilized as the stimulus unless use of Monitored Live Voice is indicated.

WORD RECOGNITION SCORES

Evaluation of the accuracy at which a patient can repeat words at a supra-threshold level to determine if they may be a candidate for hearing aid(s) or if they need further evaluation to determine if they are a candidate for implantable solutions. Our method is as follows:

Degree of Hearing	Word List	Presentation level	# of words
Normal	CNC	50 dB HL	50
Mild to Profound	CNC	UCL-5 dB HL*	50

*Uncomfortable Loudness Level (UCL)

Testing at UCL-5dBHL allows for determination of roll-over and if word recognition testing needs to be completed at lower intensity levels. Additionally, if a patient is fit with hearing aids, WRS at UCL-5dBHL allows for validation of hearing aid performance.

Degrees of word recognition performance	
Excellent	90-100%
Good	78-88%
Fair	66-76%
Poor	54-64%
Very Poor	≤ 52%

Criteria for further testing:

- If a patient scores ≤ 60%, they will be referred for cochlear implant candidacy evaluation
- If positive rollover of word recognition scores is present, calculated by:

$$(PB_{max} - PB_{min}) / (PB_{max}) = \text{Rollover index (RI)}$$
 An RI of ≤ 0.45 is positive for rollover
- If an asymmetry is present, the patient will be referred to neurotology for medical evaluation. An asymmetry in word recognition is defined in our clinic as a difference of 12% or more between ears.

ADDITIONAL TESTS, PERFORMED AS NEEDED:

Acoustic Reflex Decay (ARD)

ARD is utilized when retrocochlear pathology is suspected based on:

- An asymmetry of 12% or more in word recognition scores
- Positive rollover of word recognition scores
- A 10 dB difference over three consecutive frequencies, or 15 dB at 3000 Hz

The acoustic reflex response will be recorded during the presentation of a pure-tone stimulus (500 and 1000 Hz) for 10 seconds at 10 dB above the acoustic reflex threshold. Reflex decay is present if the response falls to <50% of the initial magnitude during the 10 second stimulus. If ARD is present, patient will be referred to neurotology for medical evaluation.

Distortion Product Otoacoustic Emissions (DPOAEs)

DPOAEs are acoustic signals generated by the cochlea in response to external auditory stimulation. They are a physiologically vulnerable indicator of cochlear status, specifically the outer hair cells. DPOAE generation is independent of neural activity, and thus, measures cochlear status independent of central nervous system status.

DPOAEs are utilized when:

- It is developmentally appropriate
- An objective measure is needed to confirm reliability
- A patient is undergoing ototoxic chemotherapy*

*DPOAEs are part of our Ototoxicity protocol (see separate document which details this protocol)

QuickSIN

The Quick Speech-in-Noise Test (QuickSIN) evaluates a patient's ability to understand speech in the presence of noise by calculating the signal-to-noise ratio loss. This is important to measure because hearing in background noise is a major complaint of patients with hearing loss and speech understanding in noise cannot be predicted from the audiogram (Killion & Niquette, 2000).

QuickSIN is used to assess:

- Patients with normal hearing but complain of difficulty hearing in background noise
- Patients who are hearing aid candidates. This will determine if directional microphones or assistive listening devices should be utilized in conjunction with their hearing aids

Tinnitus evaluation

A tinnitus evaluation will be performed on patients with complaints of bothersome tinnitus. Their tinnitus must be present on the day of the audiologic evaluation in order to complete the tinnitus evaluation. The tinnitus evaluation is comprised of three parts:

- 1) Tinnitus pitch matching
 - a. A continuous pure-tone is presented to the ear with lesser perception of tinnitus, or if tinnitus is symmetric, presented to the ear of preference. Presenting monaurally allows for pitch comparison of tinnitus perceived in the opposite ear. The tone is presented at a

supra-threshold level and gradually increased in frequency from 125 to 8000 Hz. The patient is instructed to raise their hand when the tone is similar to or matches the pitch of their tinnitus.

- 2) Tinnitus loudness matching
 - a. A continuous pure-tone is presented to the ear with lesser perception of tinnitus, or if tinnitus is symmetric, presented to the ear of preference. Presenting monaurally allows for loudness comparison of tinnitus perceived in the opposite ear. The tone is presented at the frequency identified in the pitch matching procedure. The starting presentation level is 0dB SL and gradually increased in intensity by 2dB HL. The patient is instructed to raise their hand when the volume of the tone is similar to the volume of their tinnitus.
- 3) Tinnitus minimal masking levels
 - a. Narrow-band noise (NBN) centered at the frequency identified in the pitch matching procedure is presented at 0 dB SL. The NBN is gradually increased in intensity by 2dB HL until the patient no longer hears their tinnitus and only hears the NBN. The patient is instructed to raise their hand when they no longer perceive their tinnitus and only hear the NBN. If NBN does not result in complete masking, white noise should be utilized.

Ultra-high frequency audiometry

Ultra-high frequency audiometry involved identifying thresholds at 10,000-16,000 Hz, which are beyond the typical audiogram (125-8000 Hz). Ultra-high frequency audiometry is utilized in our Ototoxicity protocol (see separate document which details this protocol) and also for patients that report bothersome tinnitus but have normal hearing thresholds. This will allow us to identify if hearing loss is present in the ultra-high frequencies that may be the source of the tinnitus.

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