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An Introduction to Hearing Loss: Examining Conductive & Sensorineural Loss

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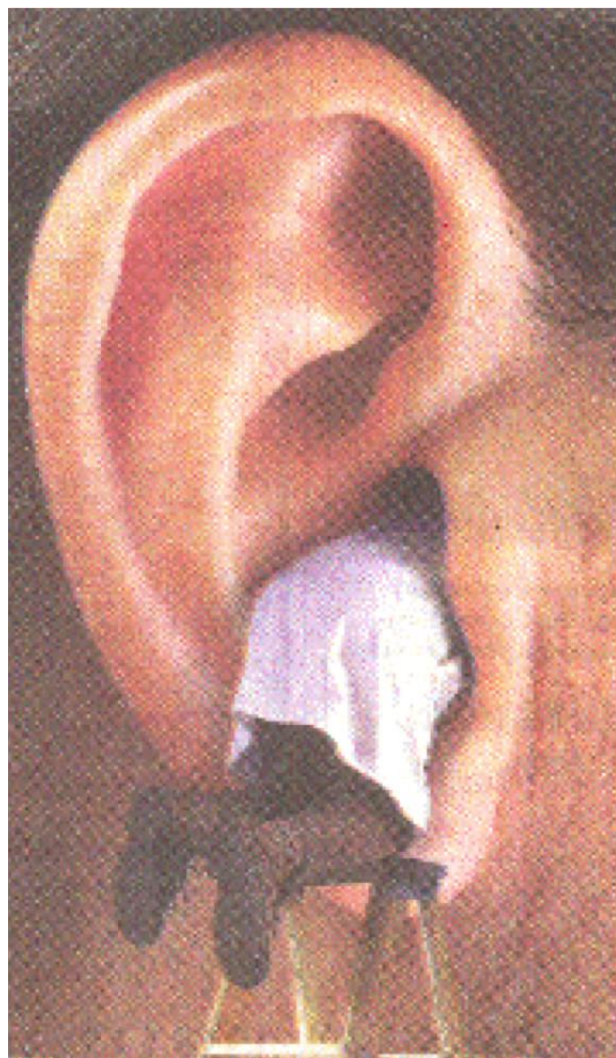


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An Introduction to Hearing Loss: Examining Conductive & Sensorineural Loss

Presented by:

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Learning Objectives

- To understand the profession of Audiology: what we can diagnose and treat
- To learn how to ask hearing-related case history questions
- To learn how to read all parts of an audiogram and to understand the associated terminology
- To understand the difference between subjective and objective hearing-related assessments
- To understand the difference between the various types and degrees of hearing loss and the associated terminology
- To have a basic understanding of how specific etiologies might present on the audiogram

The Profession of Audiology

- The inception of Audiology as a profession took place after World War II when several military personnel required services for the hearing problems they incurred during the war.
- In the U.S., the Department of Veteran's Affairs (VA) provided comprehensive services such as: hearing aid fitting, personal adjustment and orientation to hearing aids, auditory and speech reading training programs, training in the use of communication strategies, speech correction therapy, psychological counseling, and educational and vocational training.

The Profession of Audiology

- Audiologist is defined today as an individual who “by virtue of academic degree, clinical training, and license to practice and/or professional credential, is uniquely qualified to provide a comprehensive array of professional services related to the audiologic identification, assessment, diagnosis, and treatment of persons with impairment of auditory and vestibular function, and to the prevention of impairments associated with them” *American Academy of Audiology, 2004.*

The Profession of Audiology

- “The central focus of the profession of audiology is concerned with all auditory impairments and their relationship to disorders of communication. Audiologists identify, assess, diagnose, and treat individuals with impairment of either peripheral or central auditory and/or vestibular function, and strive to prevent such impairments.”
Academy of Doctors of Audiology, 2016.

The Prevalence of Hearing Loss

- According to the Hearing Loss Association of America (HLAA) 2016:
 - About 20 percent of Americans, 48 million, report some degree of hearing loss.
 - At age 65, one out of three people has a hearing loss.
 - 60 percent of the people with hearing loss are either in the work force or in educational settings.
 - While people in the workplace with the mildest hearing losses show little or no drop in income compared with their normal hearing peers, as the hearing loss increases, so does the reduction in compensation.
 - About 3 of every 1,000 children in the United States are born with a detectable hearing loss in one or both ears.
 - Almost 15% of school-age children (ages 6-19) have some degree of hearing loss.
 - **Among adults aged 70 and older with hearing loss who could benefit from hearing aids, fewer than one in three (30 percent) has ever used them. Even fewer adults aged 20 to 69 (approximately 16 percent) who could benefit from wearing hearing aids have ever used them.**

Our Scope of Practice

1. Identification of Hearing and Balance Disorders
2. Assessment and Diagnosis of Hearing and Balance Disorders
3. Treatment of Hearing and Balance Disorders
4. Hearing Conservation
5. Intraoperative Neurophysiologic Monitoring
6. Research

Work Settings

- Audiologists work in settings such as:
 - Clinical settings (hospitals, private practice, or other medical facility)
 - Professors at universities and colleges
 - Research
 - Hearing aid manufacturing companies
 - Industrial/hearing conservation

Basic Psychoacoustic Principles

- Frequency = Pitch
- Amplitude = Loudness
- Time = Duration

Assessment

- Audiologists use a battery of tests (subjective/behavioral and objective) to determine the degree and type of hearing loss that is present.
- Begin with a thorough case history and include questions such as:
 1. When did you start noticing trouble hearing?
 2. What type of situations do you notice the most difficulty?
 3. Are there situations where it is particularly difficult for you to follow a conversation, such as a noisy restaurant, the theater, in a car, or in large groups?
 4. Do you hear better in one ear than the other?
 5. Do you have ringing in the ears (one, both, can't tell?)
 6. Any dizziness or imbalance?
 7. Family history of hearing loss?
 8. History of noise exposure? Recreational? Occupational? Military?

Assessment



Assessment



Assessment



Audiogram Terminology

- **Audiograms will almost always have a legend**
- Pure tone = a single frequency
- Pure tone average (PTA) = average of thresholds at 500Hz, 1000Hz and 2000Hz
- Air conduction: when sound travels through the air into the ear canal and stimulation progresses through the middle ear, inner ear and to the brain
- Right ear= “0” or “Δ” (unmasked/masked)
- Left ear= “X” or “□” (unmasked/masked)
- Bone conduction: transmission of sound through the bones in the body, particularly the skull
- Right ear= “<” or “[” (unmasked/masked)
- Left ear= “>” or “]” (unmasked/masked)
- Air bone gap: The difference between air and bone conduction thresholds
- Masking: distracting the “non-test ear” in order to verify the true response of the “test ear”

The Audiogram Legend

AUDIOGRAM KEY		Right	Left	Examples of No Response Symbols		Ear Unspecified	
AC Unmasked	○		×	○	×	BC Unoccluded	↑
AC Masked	△		□	○	×	Unmasked Sound Field	S
BC Mastoid Unmasked	<		>	○	×	Aided Sound Field	A
BC Mastoid Masked	[]	○	×		

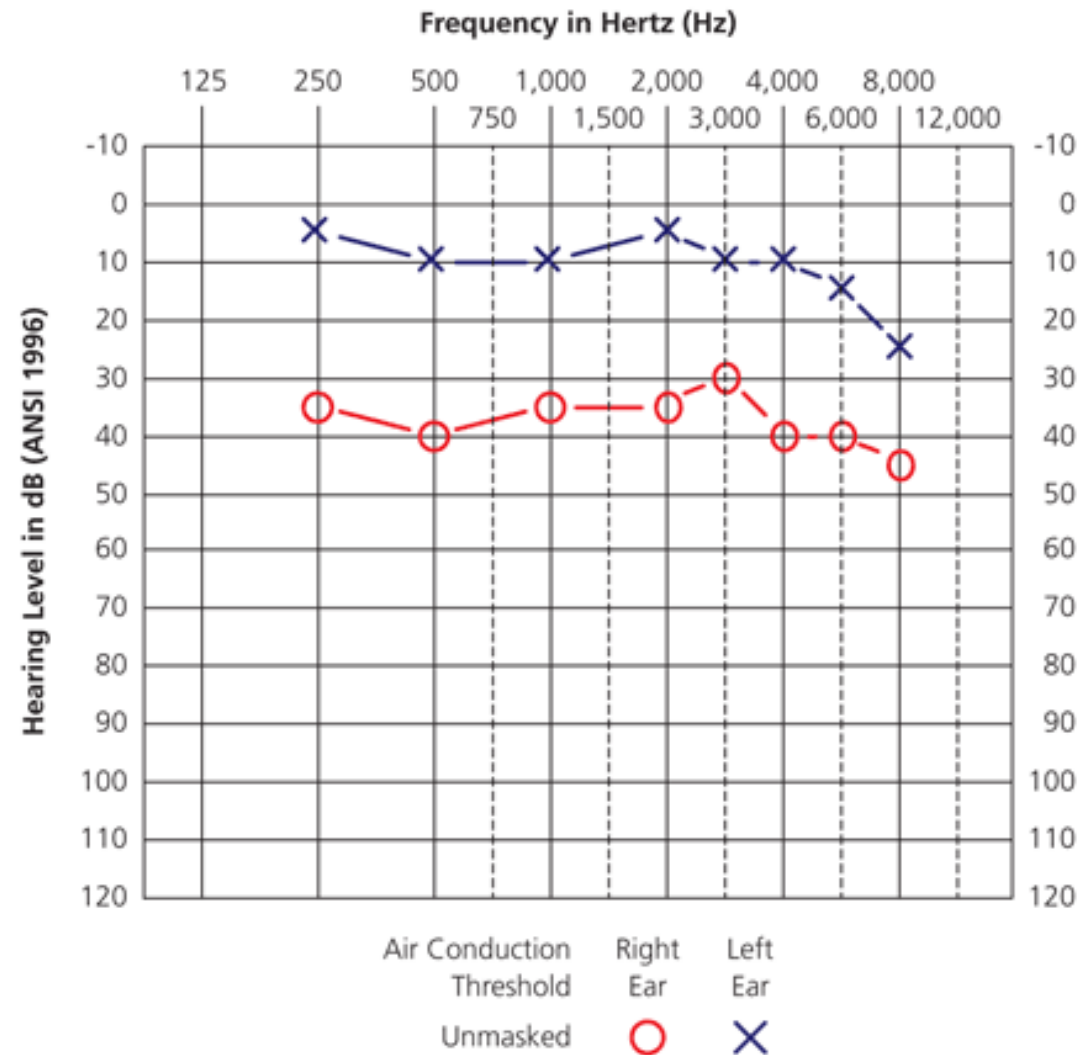
TEST TECHNIQUE: Conventional
BOA VRA TROCA CPA

EARPHONE: TDH-49 TDH-50 ER3-A

RELIABILITY: good fair poor

VALIDITY: acceptable questionable

Pure-Tone Thresholds



Pure-Tone Thresholds

- Finding a patient's threshold: plotting the softest sound a patient can hear 50% of the time
- Test frequencies from 250Hz to 8000Hz
- “Raise your hand when you hear the beep”
- Standard audiometry can be performed for patients school-age and up
- Different methods to obtain behavioral information for young children, can test as young as 9 months old
 - CPA= Conditioned Play Audiometry
 - VRA= Visual Reinforcement Audiometry
 - BOA= Behavioral Observation Audiometry

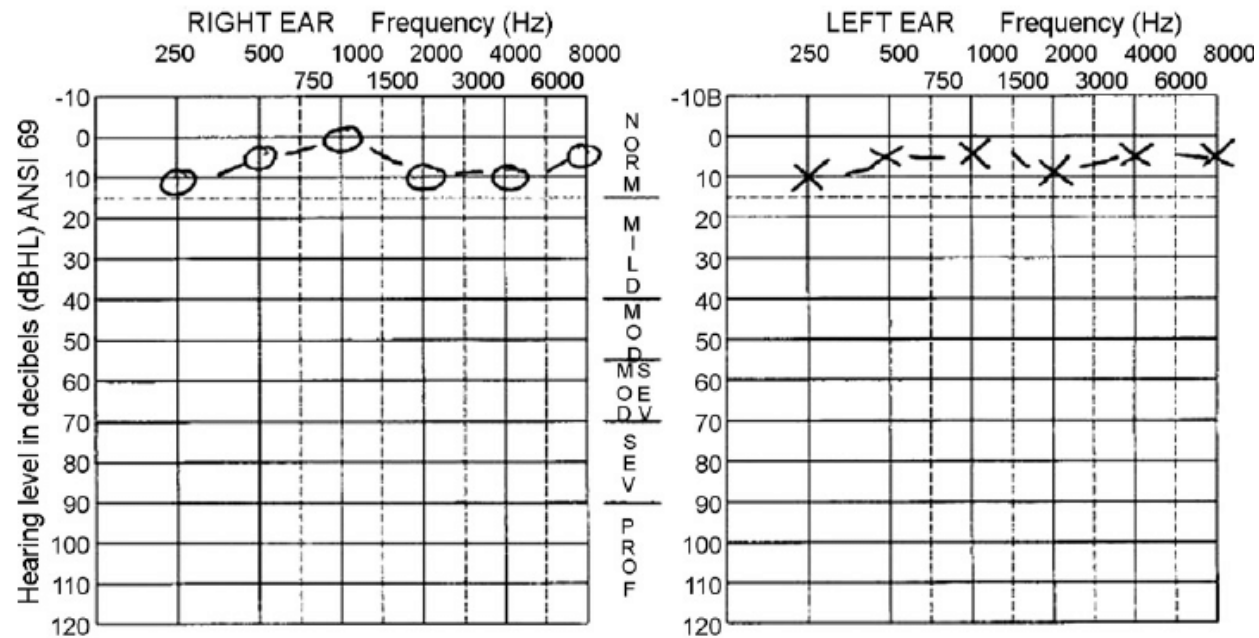
Speech Reception Threshold

- Finding the softest bi-syllable word a patient can repeat back at least 50% of the time
- Performed with “live voice” or recorded speech materials
- Example words:
 - Hot dog
 - Baseball
 - Airplane
 - Ice cream

Speech Discrimination/Word Recognition

- Used with **standardized** monosyllable word lists; performed with “live voice” or recorded materials
- Estimating how well a patient can understand speech when the words are “loud enough”
- Typically performed in quiet (no background noise)
- Start 40dB above patient’s speech reception threshold
- The word repeated back must be **exactly** correct, no exceptions (useful to write down the error made to see whether the patient falls into a pattern)
- Example words:
 - Pick
 - Room
 - Nice
 - Said

Speech Discrimination/Word Recognition



SPEECH TESTS

dBHL	RIGHT	LEFT	AIDED RIGHT	AIDED LEFT
SRT	5	0		
SAT				
WR%	100	90		
dBHL	50	45		
Masking			AIDED BINAURAL	
List	N/A	N/A	SRT/SAT	WR% dBHL
MCL				
UCL				

TYMPANOMETRY

	Volume (mL)	Peak Pressure (daPa)	Peak Compliance (cc)
Right	.9	10	.5
Left	.9	10	.5

LEGEND

Air Conduction
 unmasked ○ x
 masked △ □
 Bone Conduction
 unmasked < >
 masked < >
 No Response
 Aided R L
 Aided Binaural A

EARPHONES:
 inserts
 headphones
 earmolds
 Acoustic Reflexes
 crossed
 uncrossed

Summary So Far...

- Basic Subjective/Behavioral Battery:
 - Pure Tone Thresholds
 - Speech Reception Threshold
 - Speech Discrimination/Word Recognition

Next Up...

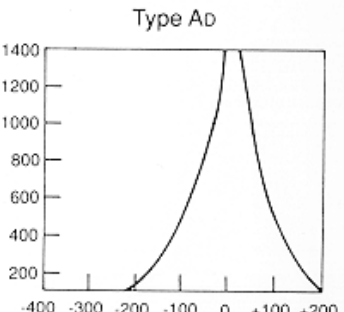
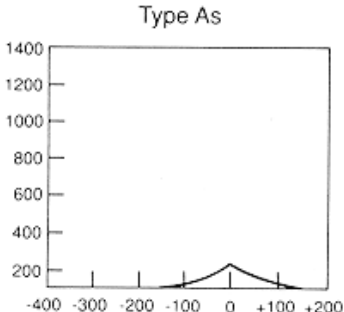
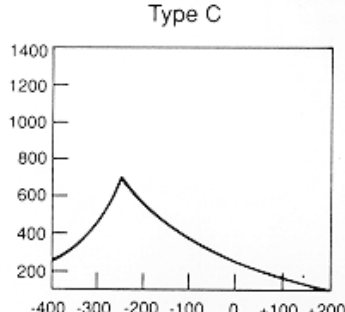
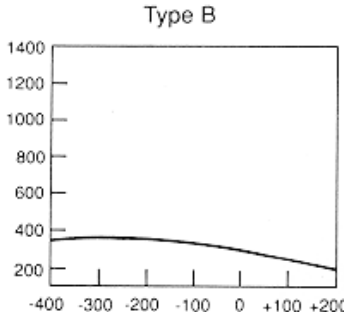
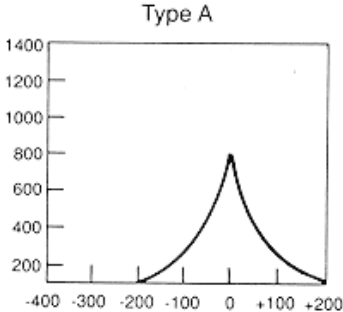
- Basic Objective Battery:
 - Tympanometry
 - Acoustic Reflex Thresholds
 - Otoacoustic Emissions

Tympanometry

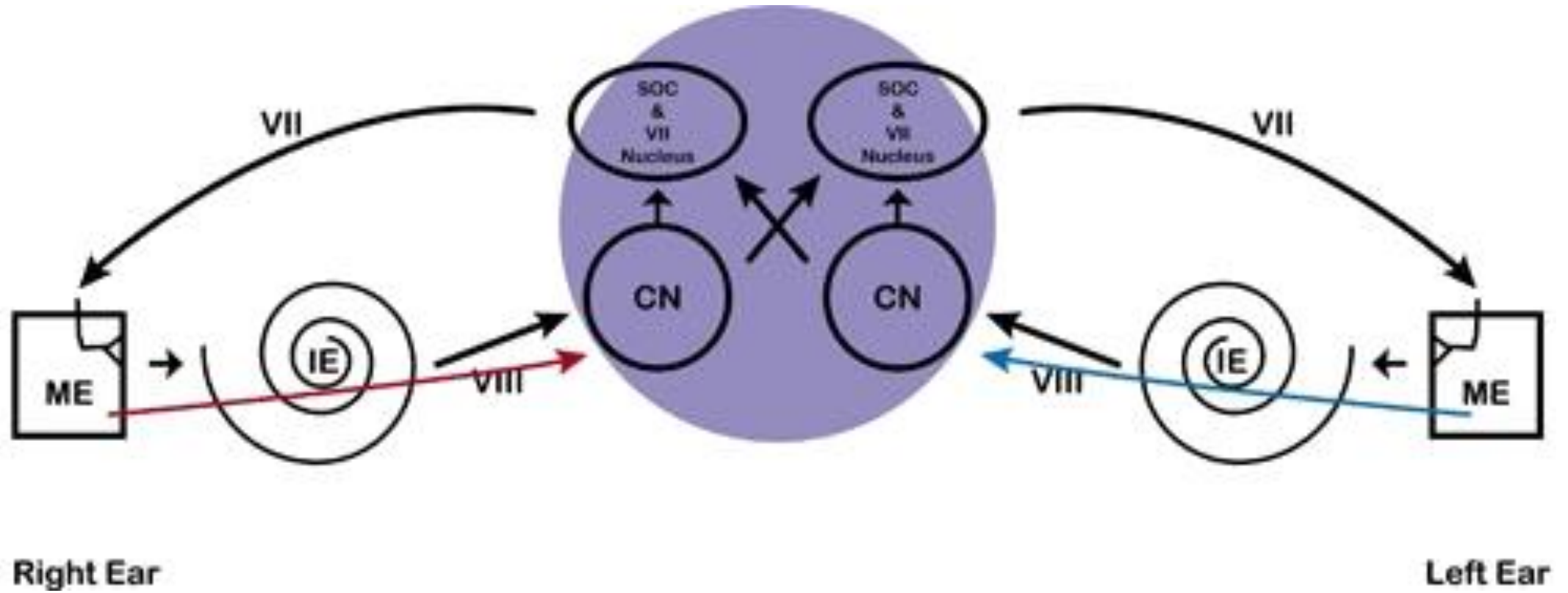
- A measure of middle ear function
- How well is the eardrum moving?



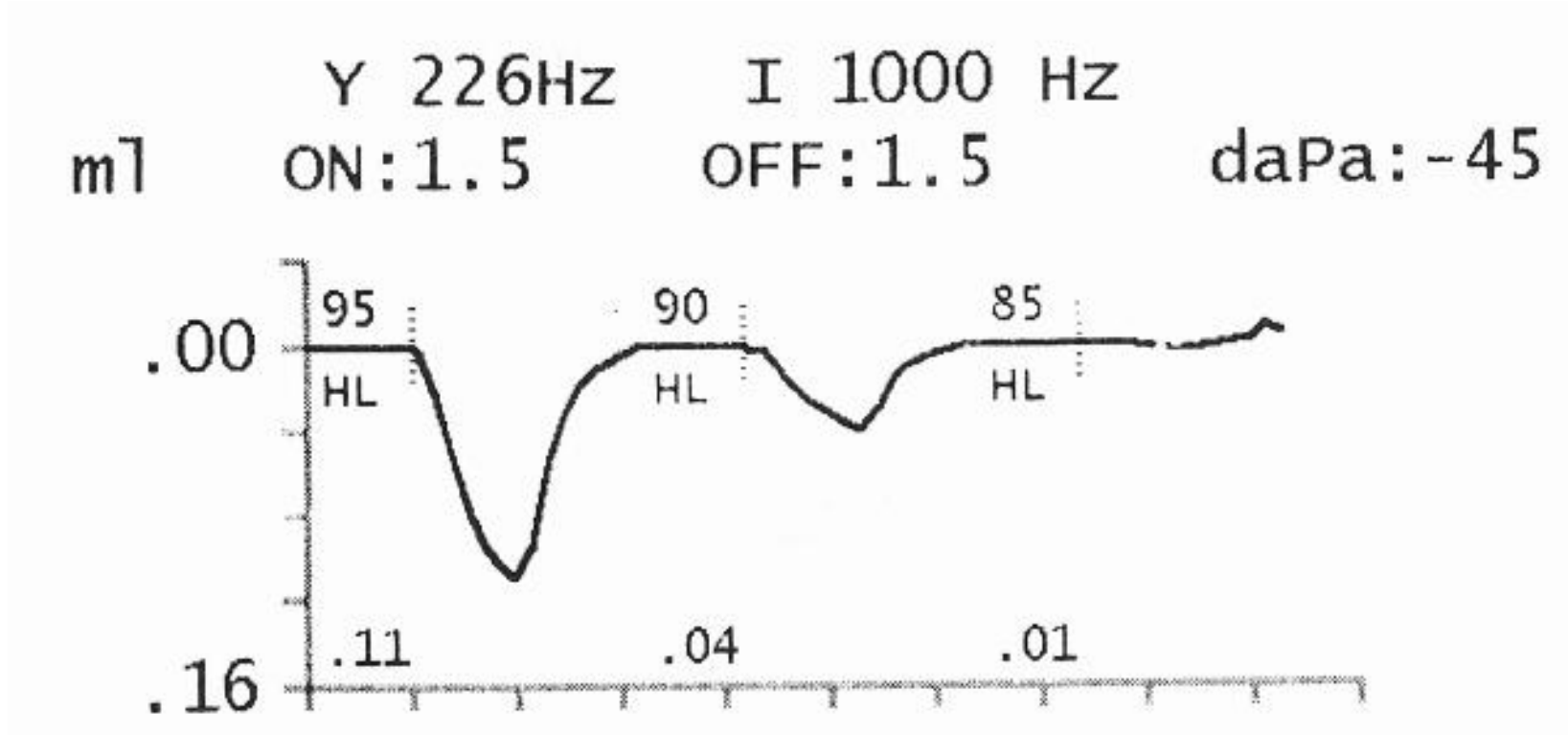
Tympanometry



Acoustic Reflex Threshold



Acoustic Reflex Threshold



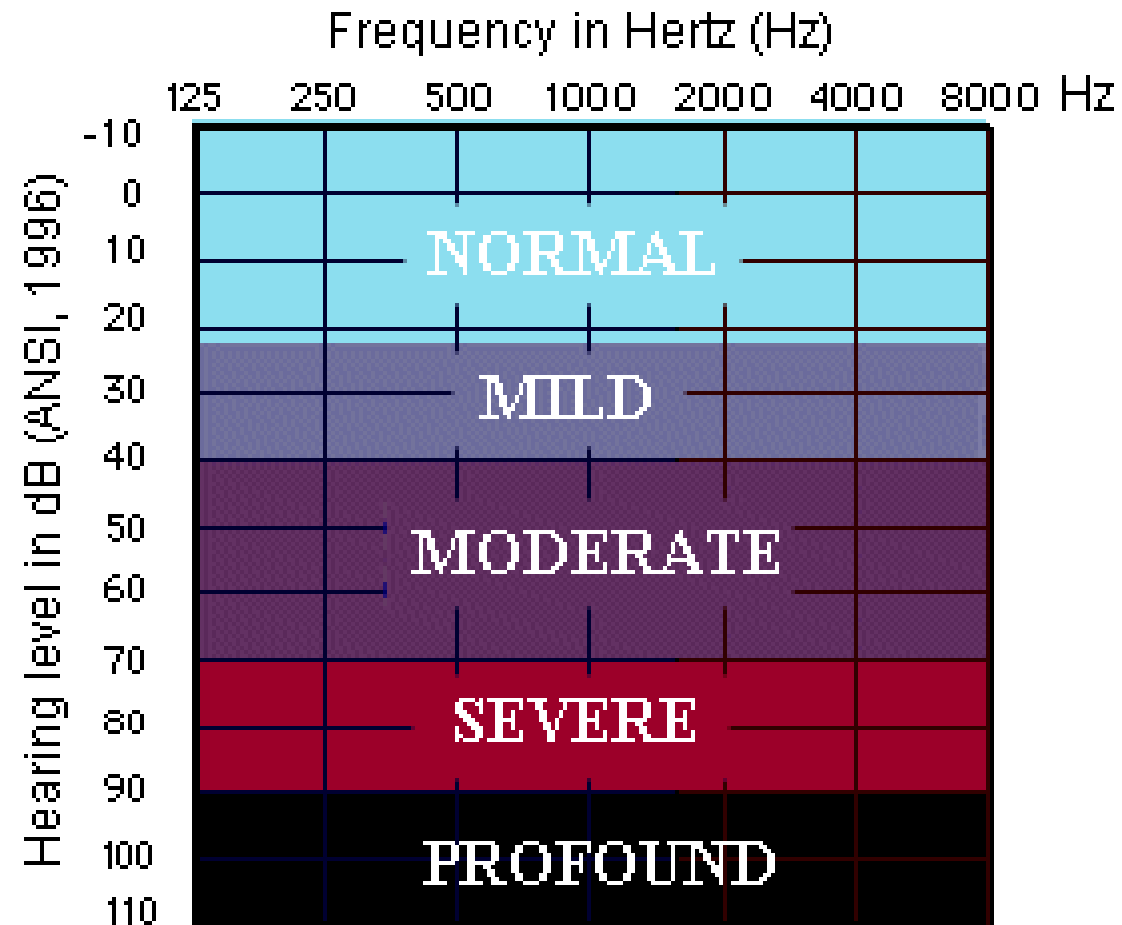
Otoacoustic Emissions



Now that we have detected hearing loss, how do we quantify it?

Degree of Hearing Loss

AUDIOGRAM



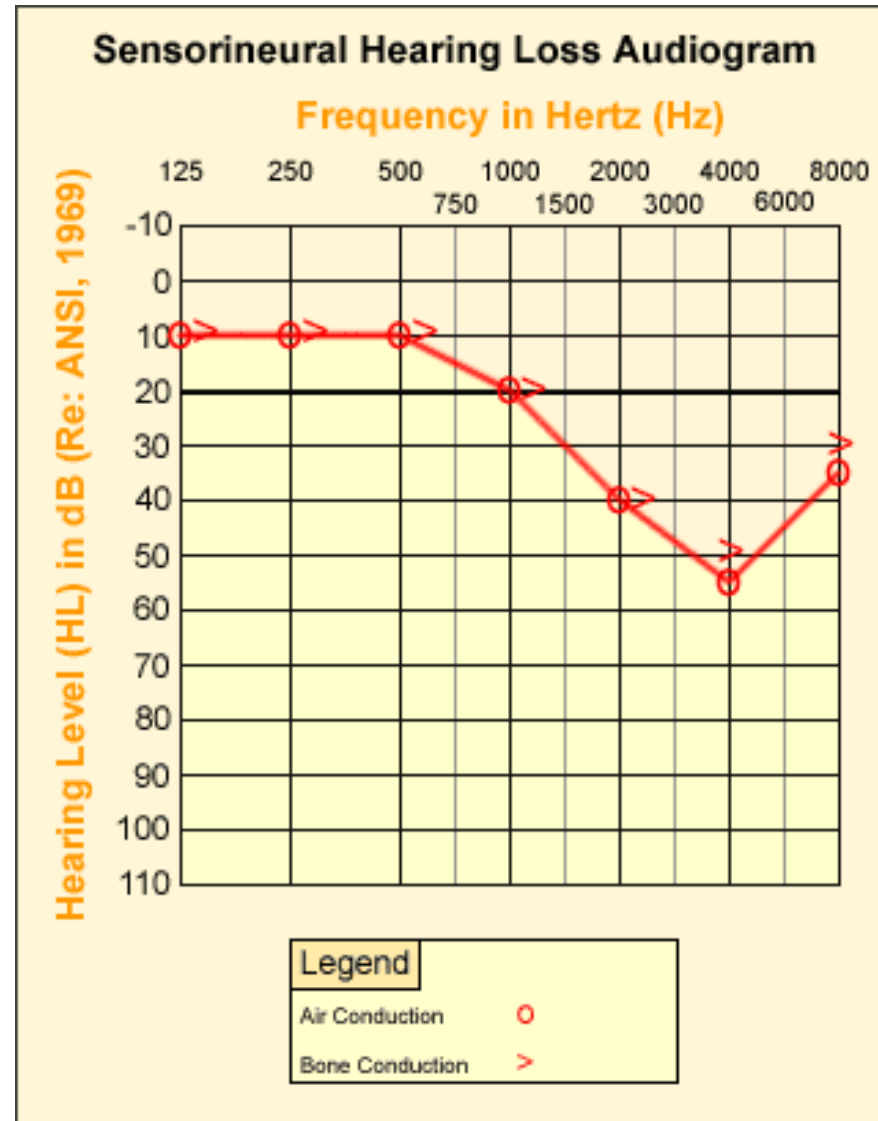
Degree of Hearing Loss

Hearing Loss	Effect on Word Recognition
Mild (PTA= 26-40dB HL)	In quiet situations, speech recognition will be fairly unaffected. In the presence of noise, speech recognition may decrease to 50% words correct if the PTA is 40dB HL. Consonants are most likely going to be missed, especially if the hearing loss involves high frequencies.
Moderate (PTA= 41-55dB HL)	The patient will understand much of the speech signal if it is presented in a quiet environment face-to-face, and if the topic of conversation is known and the vocabulary is constrained. If a hearing aid is not used, the individual may miss up to 50-75% of a spoken message if the PTA is 40dB HL and 80-100% if the PTA is 50dB HL.
Moderately-severe (PTA=56-70dB HL)	If the patient does not use a hearing aid, he or she may miss most or all of the message, even if talking face-to-face. He or she will have great difficulty conversing in group situations.
Severe (PTA=71-90dB HL)	The patient may not even hear voices, unless speech is loud. With amplification, the individual probably will not recognize some speech and detect environmental sounds.
Profound (PTA- 90dB HL or greater)	The patient may perceive sound as vibrations. An individual will rely on vision as the primary sense for speech recognition. He or she may not be able to detect the presence of even loud sound without amplification.

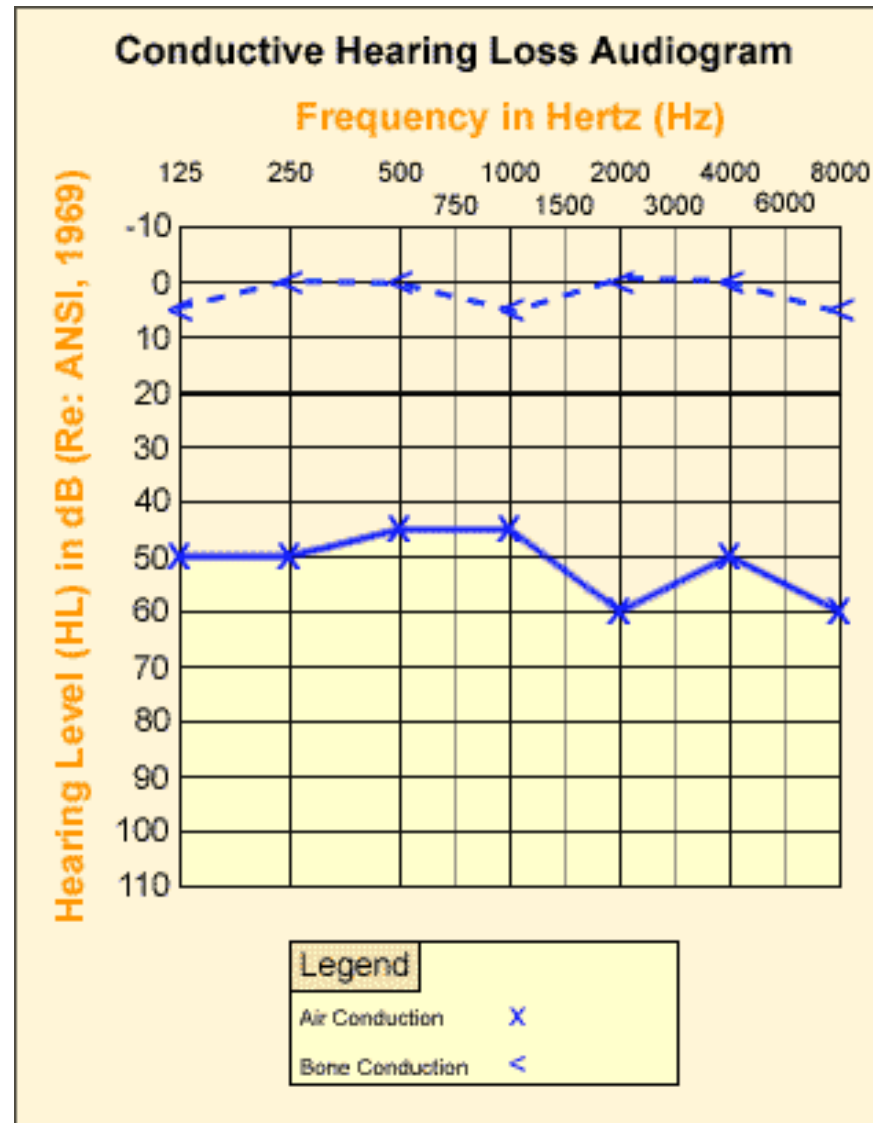
Types of Hearing Loss

- Sensorineural: Damage to the inner ear or auditory nerve (most always is permanent)
- Conductive: Damage to the outer or middle ear, problem with transmitting sound to the inner ear (can be temporary or permanent)
- Mixed: A problem transmitting sound to a damaged inner ear (can be temporary or permanent)

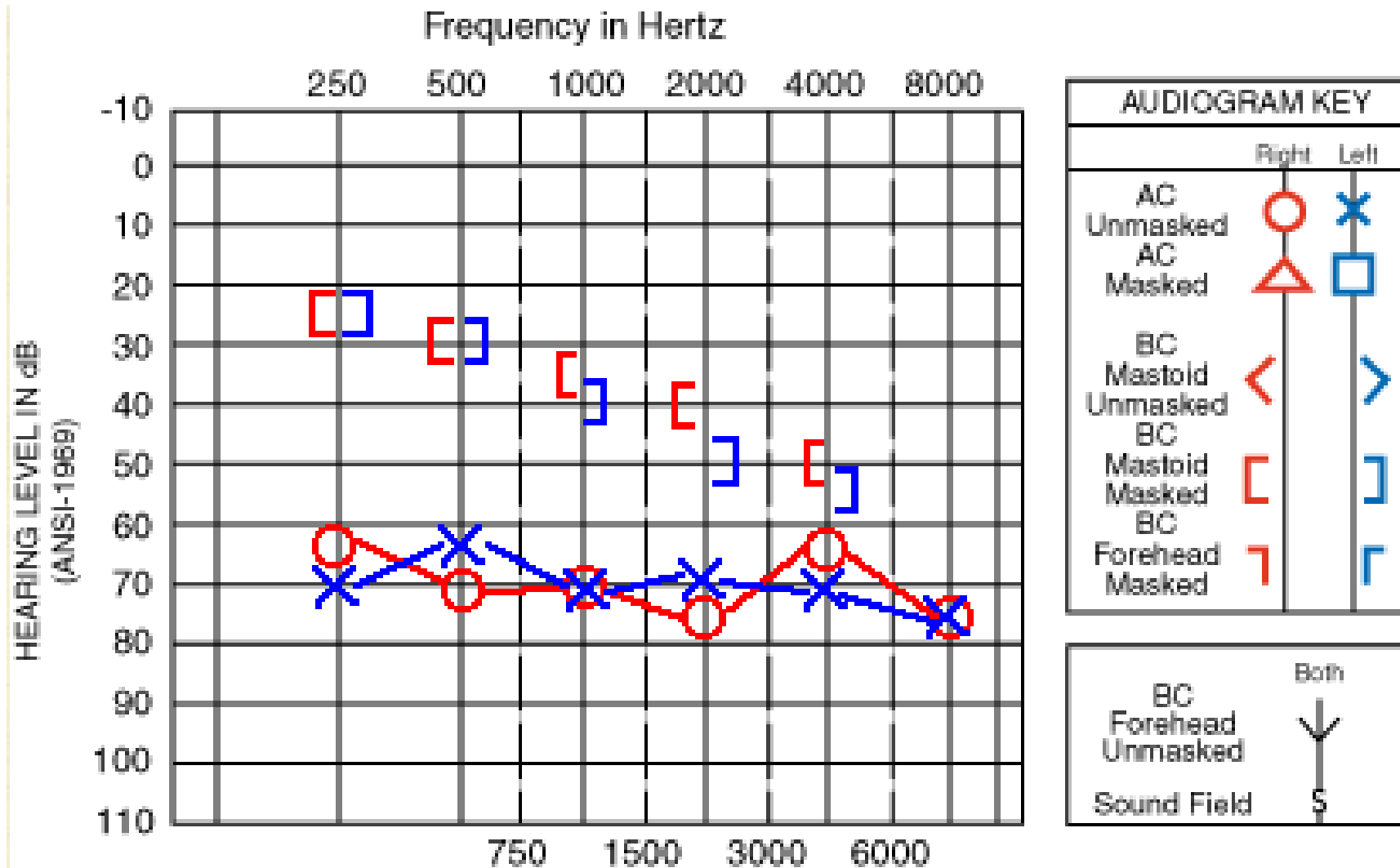
Sensorineural Hearing Loss



Conductive Hearing Loss



Mixed Hearing Loss



Some Causes of Conductive Hearing Loss

- Problems in the outer ear
 - Impacted ear wax
 - Foreign bodies in the ear canal
 - Otitis externa – Swimmer's ear
 - Exostoses – Tumors or growths in the ear canal
 - Microtia – deformity of pinna (several grades)
 - Anotia – absence of pinna
 - Aural atresia – lack of ear canal

Some Causes of Conductive Hearing Loss

- Problems in the middle ear
 - Ear infection or fluid behind the ear drum
 - Perforation of the ear drum
 - Otosclerosis
 - Cholesteatoma

Some Causes of Sensorineural Hearing Loss

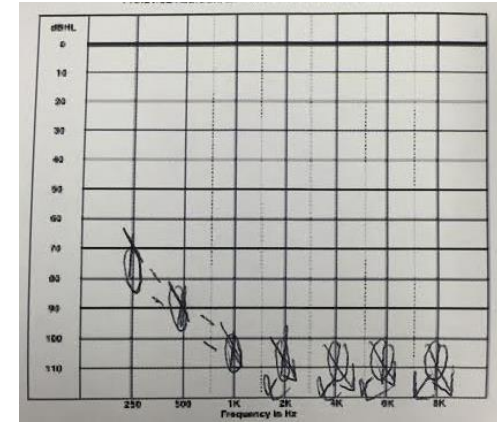
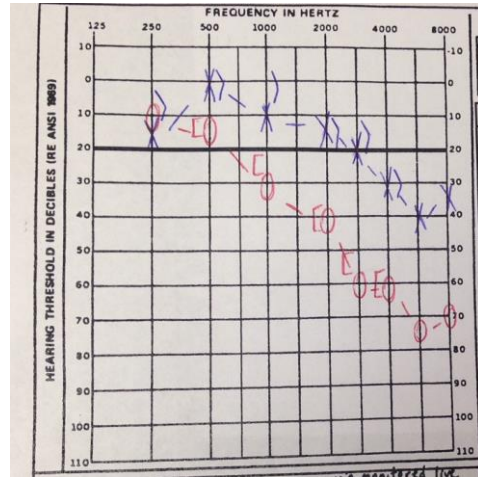
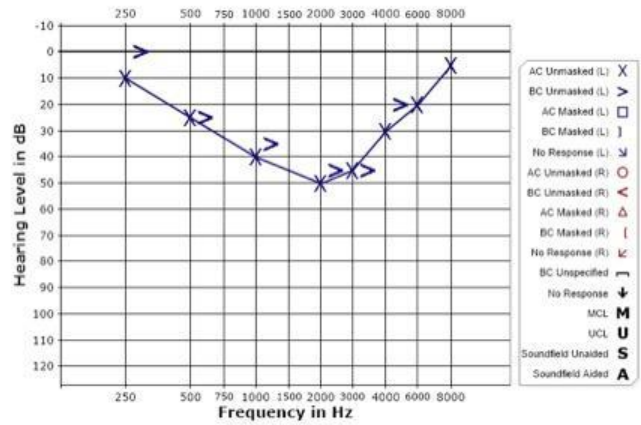
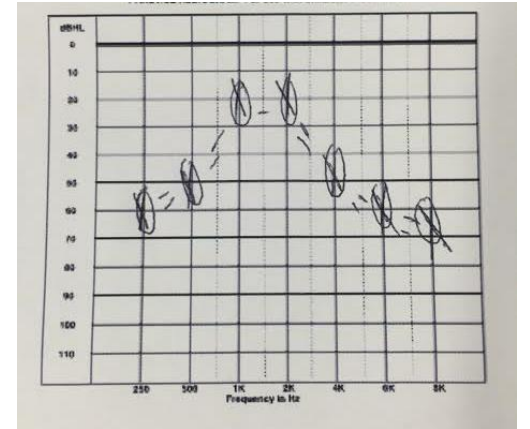
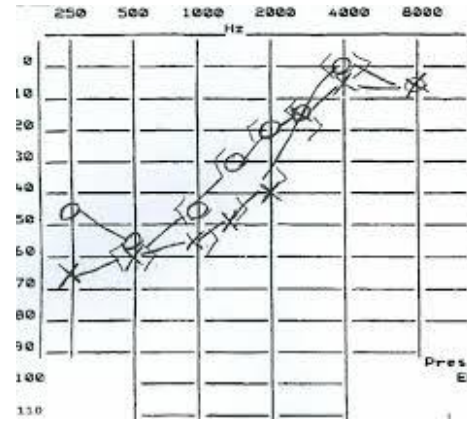
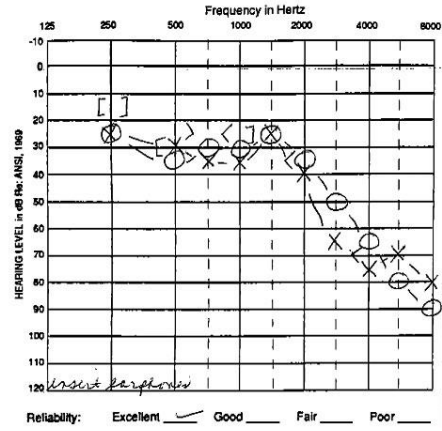
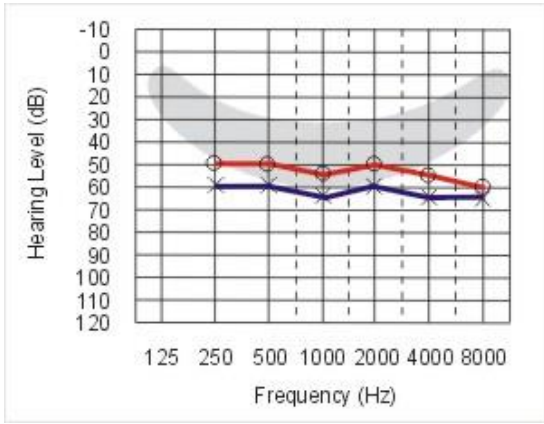
- Problems in the inner ear
 - Damaged outer hair cells
 - Aging
 - Excessive noise exposure
 - Ototoxic medications
 - Genetics
 - Viral and bacterial diseases (Meningitis)
 - Malformed cochlea (Mondini's malformation)

Onset of Hearing Loss

- Progressive: hearing loss that occurs over the course of several months, increases in severity over time
- Sudden: hearing loss that has an acute and rapid onset; examples, a virus that attacks the inner ear or hearing loss as a result of head trauma
- Congenital: hearing loss present at birth

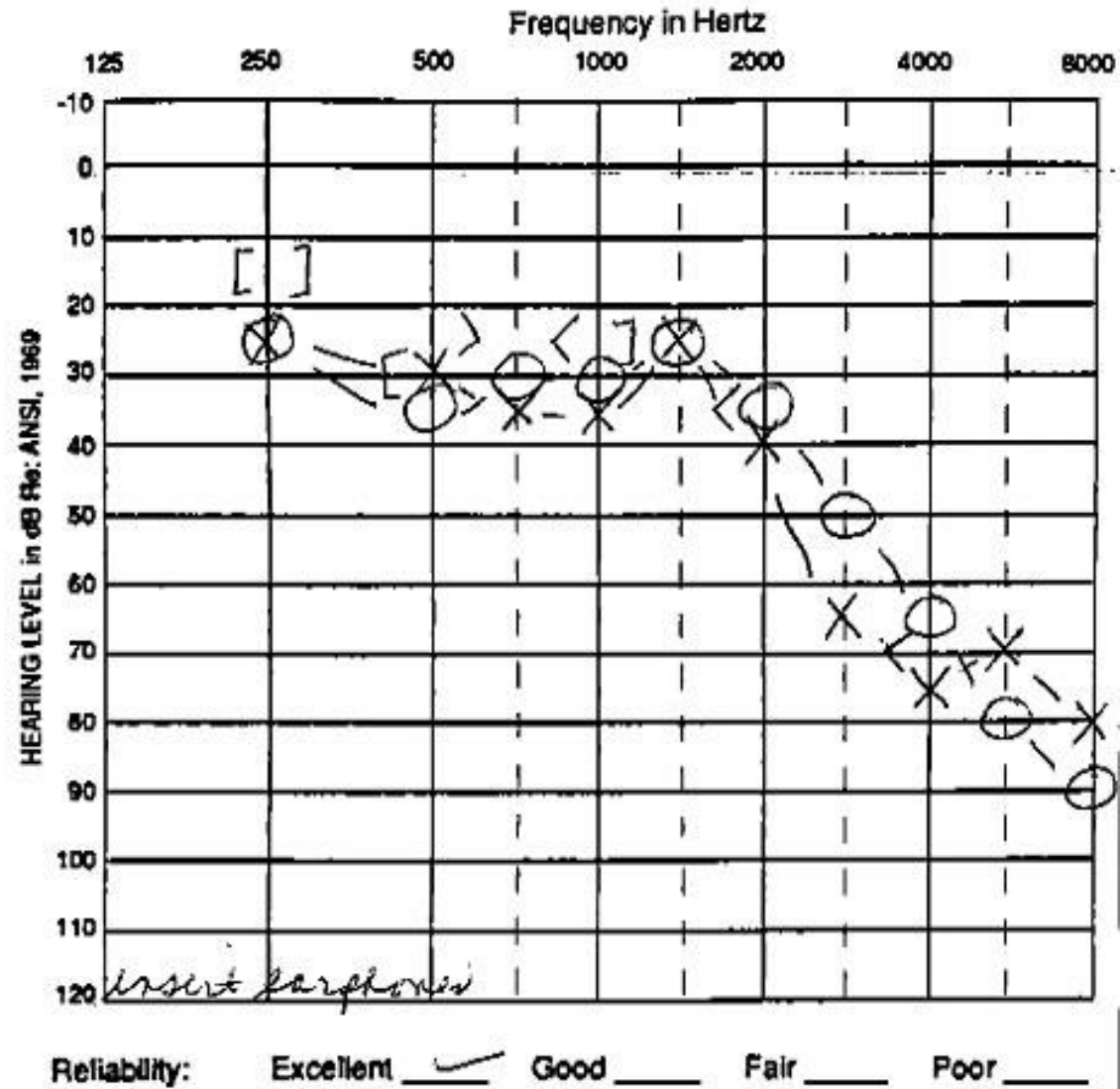
Other Hearing Loss Descriptors

- Flat
- Sloping
- Rising
- Peaked
- Trough or “Cookie-Bite”
- Asymmetric
- Corner

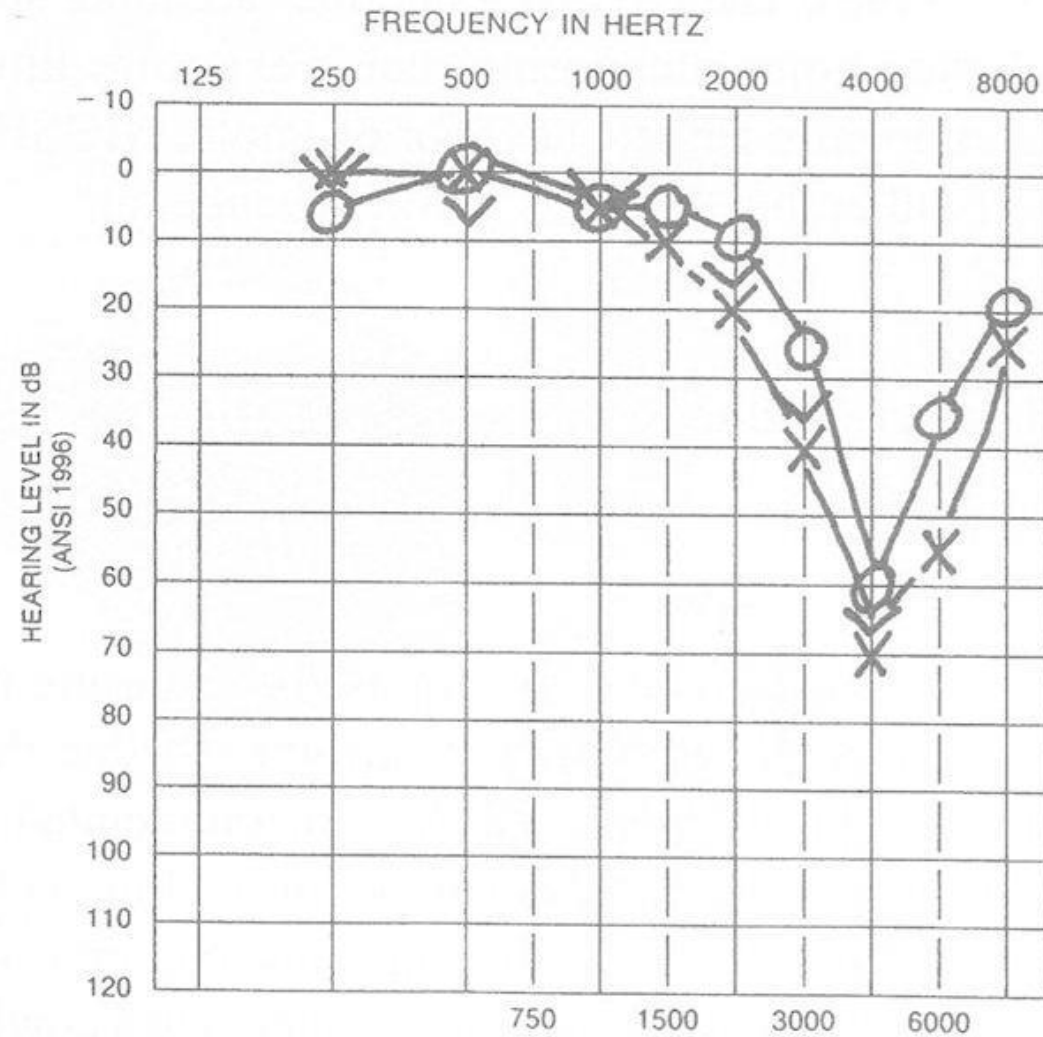


Let's look at a few etiologies of hearing loss and how they might present on the audiogram...

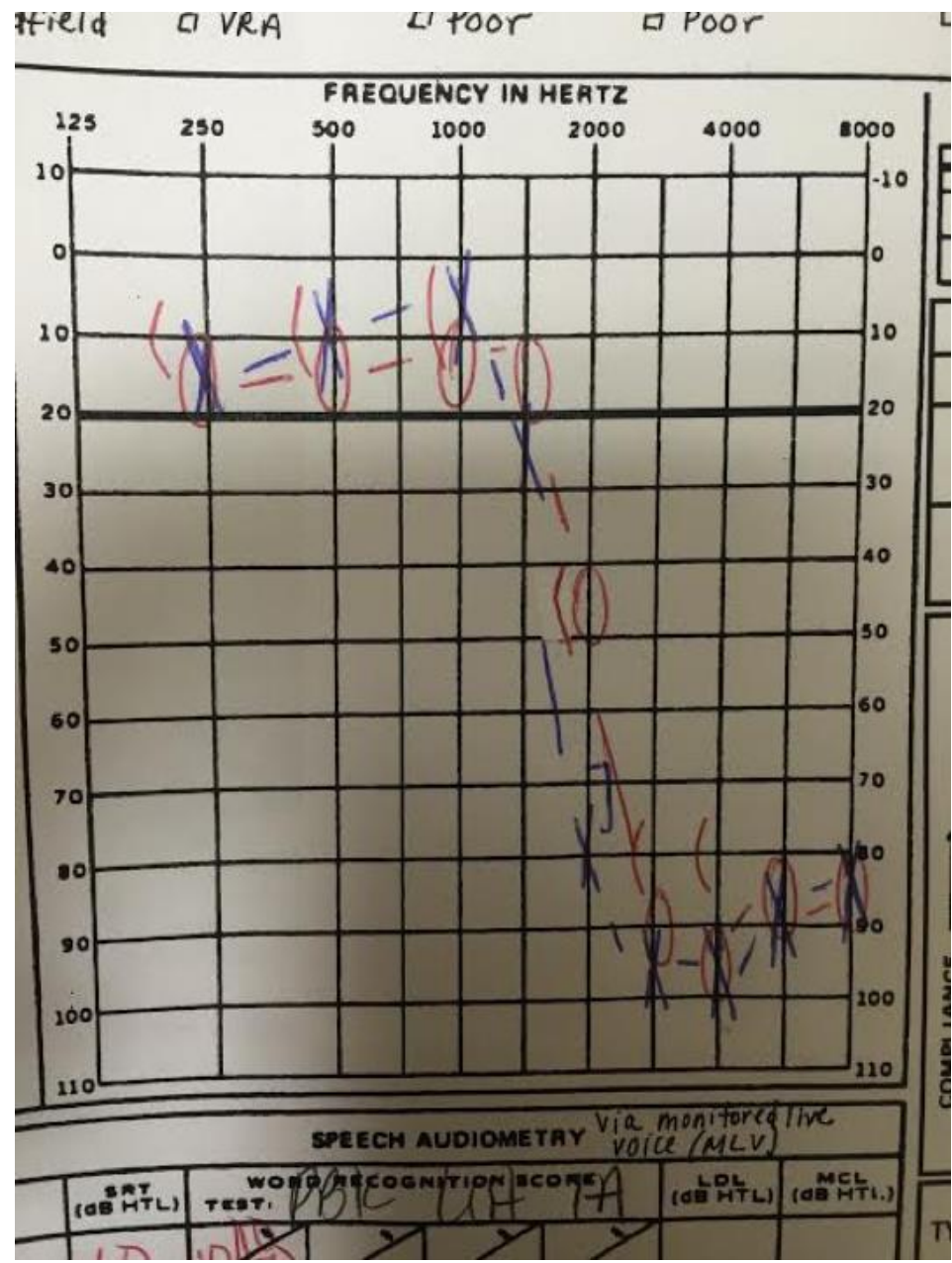
Presbycusis



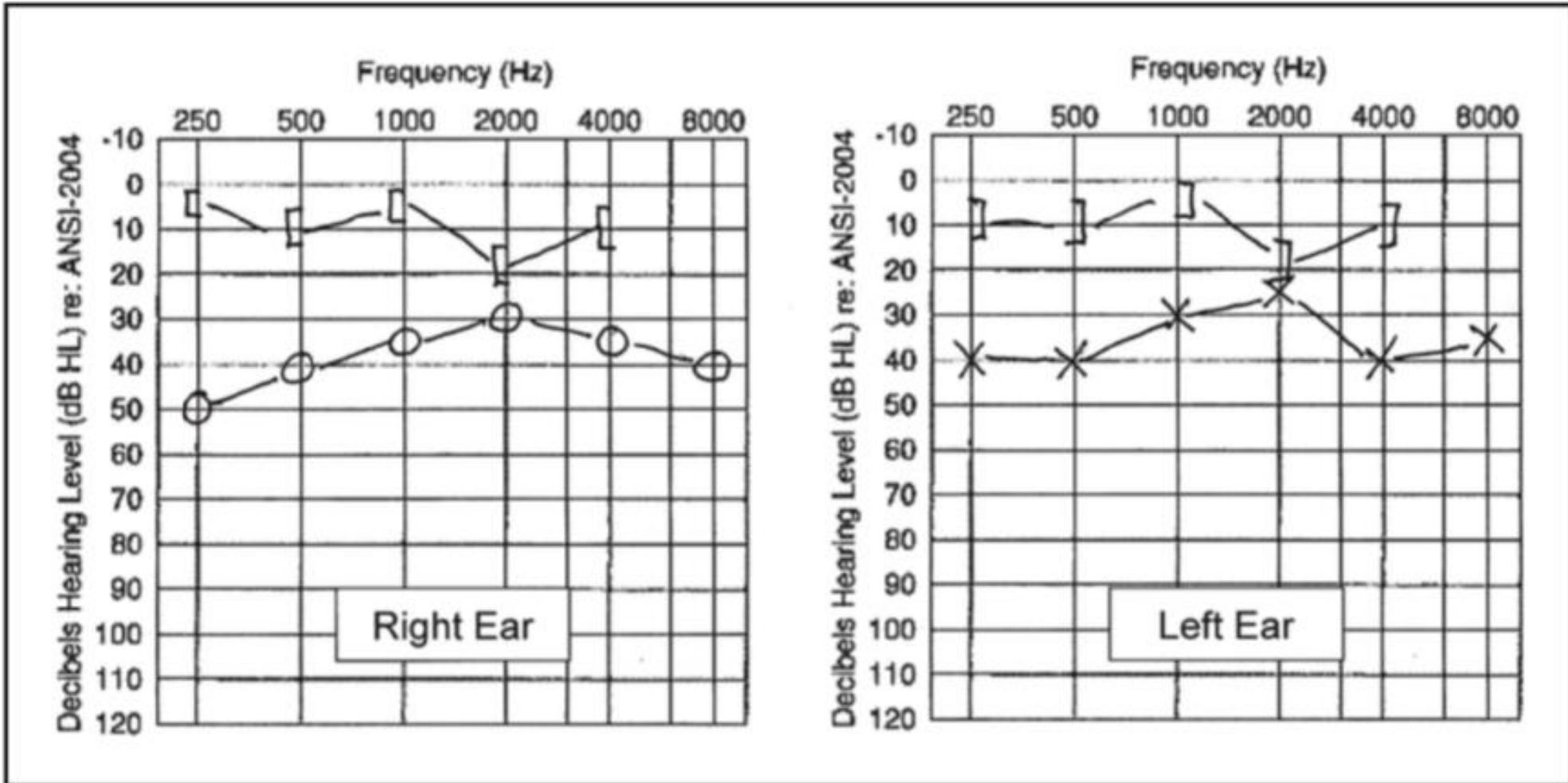
Noise-Induced Hearing Loss



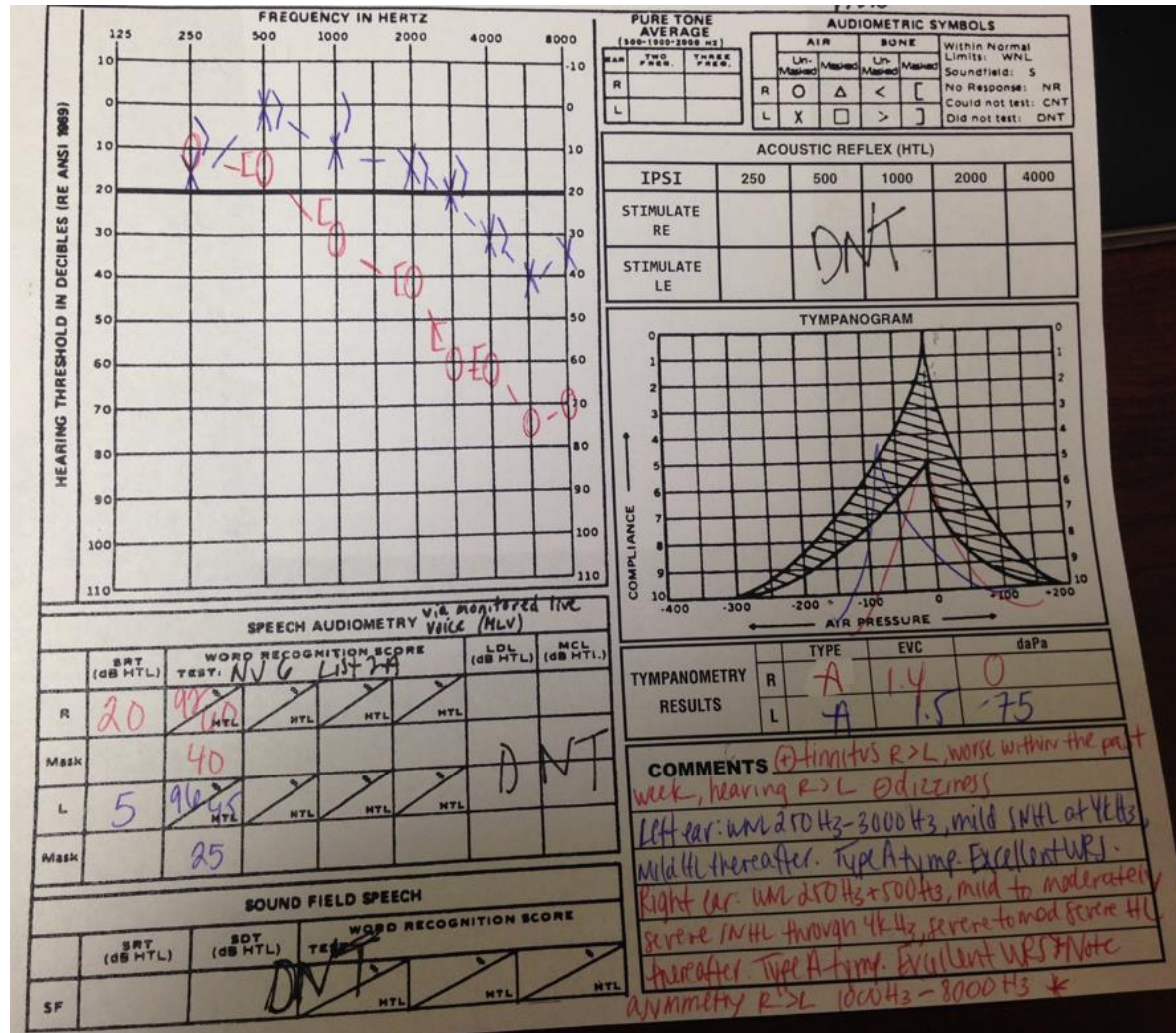
Ototoxicity



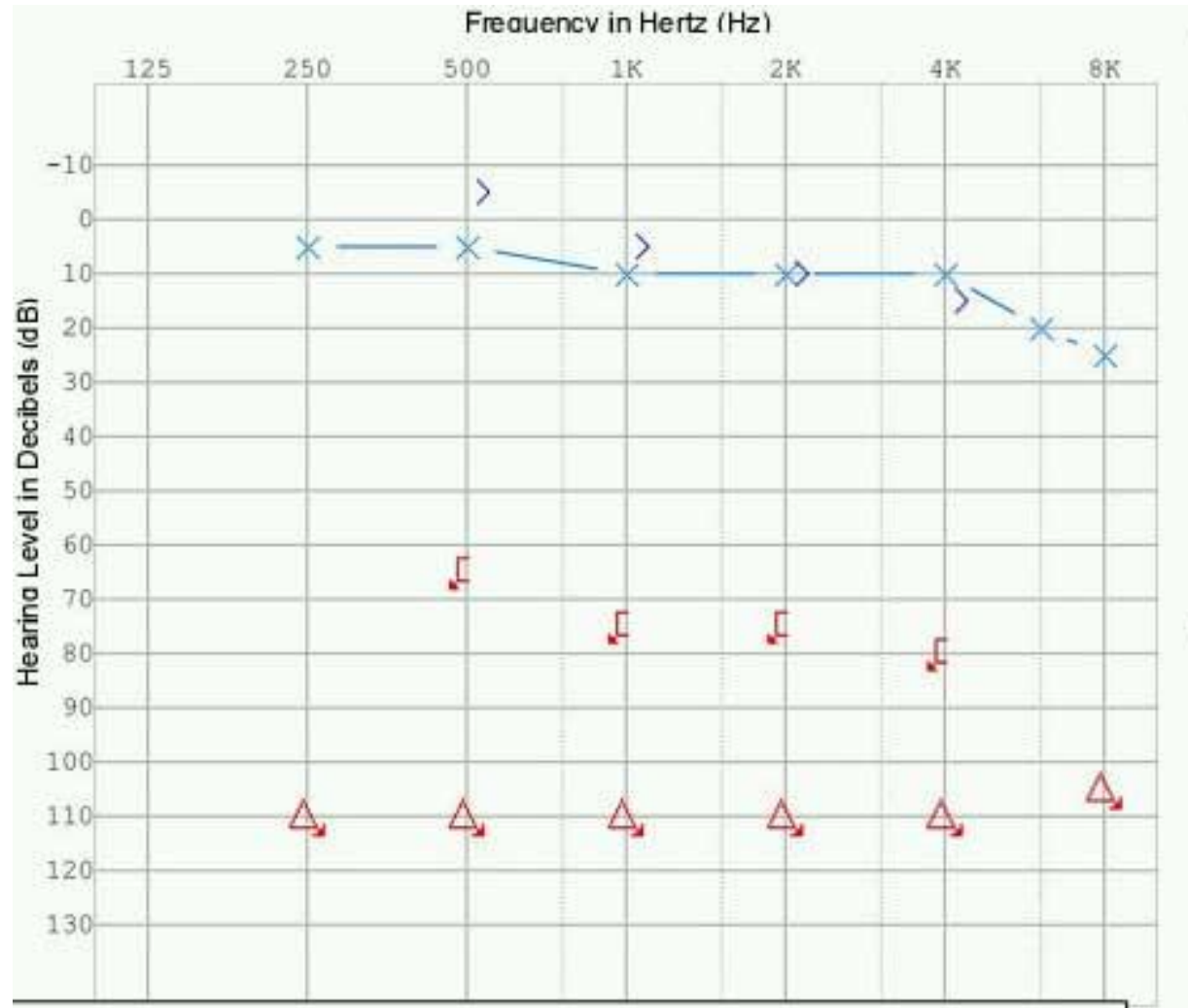
Otosclerosis



Asymmetric Hearing Loss



Sudden Sensorineural



What does it sound like to have a hearing loss?

- <https://youtu.be/Bcz7AeBMLSc>
- <https://youtu.be/ar1Dq-M2ok4>

Questions?



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