Unit 1

Section One: Reading Comprehension

The Auditory System

ضروری

The auditory system is an obligatory one. We simply cannot turn it off. In simpler life forms the main function of the auditory system is protection. Because it is obligatory, it serves to constantly assess the surroundings for danger, as prey, and opportunity, as predator. In more evolved life forms, it takes on an increasingly important communication function, whether that be for mating calls or for talking on the telephone.

موجودات زنده ساده تر

دائمی ارزیابی محیط

شکارچی

تکامل یافته

پیچیده

The auditory system is highly complex. It is a sensitive system that can detect the smallest of pressure waves. In addition, it is a precise system that can effectively discriminate very small changes in the nature of sound. It is also a system with a large dynamic range. Remember that the difference in the magnitude of sound that can just barely be detected and the magnitude of sound that causes pain is on the order of 100 million to one.

دقیق

تمایز، افتراق

بزرگی، مقدار

به سختی

رشته

Describing the function of such a rich, complex system is an academic discipline in and of itself, called **psychoacoustics**. Psychoacoustics is a branch of psychophysics concerned with the quantification of auditory sensation and the measurement of the psychological correlates of the physical characteristics of sound. The knowledge base of this field is broad and well beyond the scope of this text. However, there are some fundamentals that are necessary for you to understand as you pursue the study of clinical audiology. Much in the way of quantification of disordered

شاخه اهمیت داشتن کمی سازی

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دنبال کردن

systems stems from our knowledge of the response of normal systems and the techniques designed to measure those responses.

Absolute Sensitivity of Hearing

One of the hallmarks of audiology is the assessment of hearing sensitivity. Sensitivity is defined as the capacity of a sense organ to detect a stimulus and is quantified by the determination of threshold of audibility or threshold of detection of change. There are at least two kinds of sensitivity: absolute and differential. **Absolute sensitivity** pertains to the capacity of the auditory system to detect faint sound. **Differential sensitivity** pertains to the capacity of the auditory system to detect differences or changes in intensity, frequency, or some other dimension of a sound.

Hearing sensitivity most commonly refers to absolute sensitivity to faint sound. In contrast, **hearing acuity** most accurately refers to the differential sensitivity, usually to the ability to detect differences in signals that differ in the frequency domain.

Inherent in the description of hearing sensitivity is the notion of **threshold**. A threshold is the level at which a stimulus or change in stimulus is just sufficient to produce a sensation or an effect. Here again, it is useful to differentiate between absolute and differential threshold. In hearing, **absolute threshold** is the threshold of audibility, or the lowest intensity level at which an acoustic signal can be detected. It is usually defined as the level at which a sound can be heard 50% of the times that it is presented. **Differential threshold**, or **difference limen**, is the smallest difference that can be detected between two signals that vary in some physical dimension.

Absolute sensitivity of hearing for humans varies as a function of numerous factors, including psychophysical technique, whether ears are tested separately or together, whether testing is done under earphones or in a sound field, the type of earphone that is used, the type of cushion on that earphone, and so on. Once these variables are defined and controlled, a

ثابت و پایدار
consistent picture of hearing sensitivity emerges.
آشکار شدن

Figure 1-1 shows a graph of hearing sensitivity, defined as the threshold of audibility of pure tone signals, graphed in sound pressure level (SPL) across a frequency range that encompasses most of human hearing. This curve representing hearing sensitivity is often referred to as the **minimum audibility curve**. The minimum audibility curve is clearly not a straight line, indicating that hearing sensitivity varies as a function of signal

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در بر گرفتن
نشان دادن
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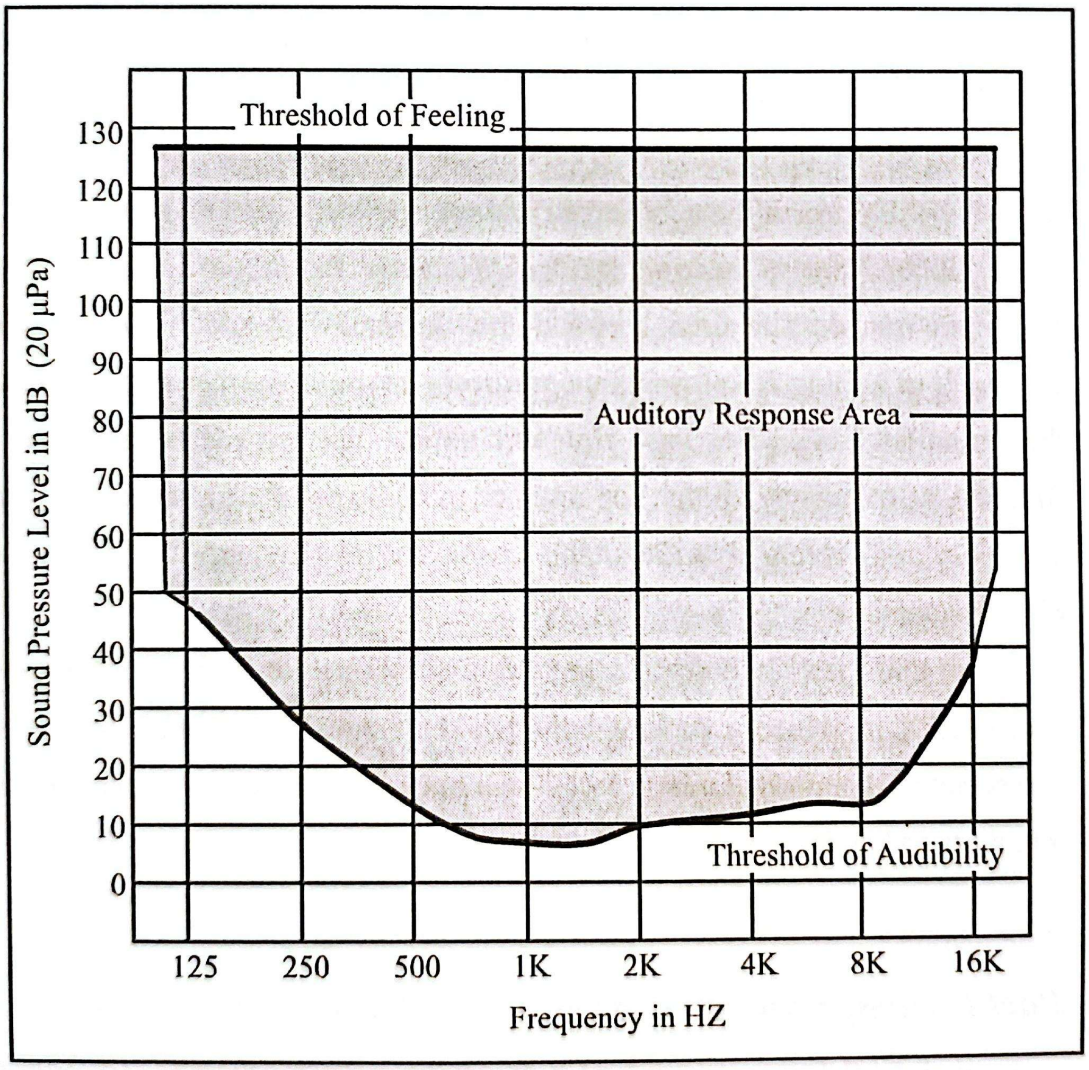


Figure 1-1. Auditory response area from the threshold of audibility to the threshold of feeling across the frequency range that encompasses most of human hearing.

frequency. That is, it takes more sound pressure at some frequencies to reach threshold than at others. You can see that hearing in the low-frequency and high-frequency ranges is not as sensitive as it is in the mid-frequency range. It should probably be no surprise that human audibility thresholds are best at frequencies corresponding (مطابقت) to the most important components (عناصر) of speech.

The minimum audibility curve will vary as a function of measurement parameters. If it is determined by delivering signals to one ear via an earphone, it is referred to as the **minimum auditory pressure** response. If it is determined by delivering signals to both ears via (از طریق) loudspeaker, it is called the **minimum audible field** response.

Also shown on Figure 1-1 is the threshold of feeling (لمس کردنی), at which a tactile response will occur (اتفاق افتادن) if the subject can tolerate (تحمل کردن) sounds of this magnitude. This is the upper limit of hearing and has a clearly flatter profile across the frequency range. The area between the threshold of audibility and the threshold of feeling is known as the **auditory response area** and represents the range of human hearing. You will notice that the range varies as a function of frequency so that the number of decibels of difference between audibility and feeling is substantially (به شکل قابل توجهی) less at the low frequencies than at the high frequencies.

The minimum audible pressure curve serves as the basis (مبنا) for pure-tone audiometry, in which a patient's threshold of audibility is measured and compared to this normal curve. For clinical purposes, this curve is converted into a graph known as the audiogram.

Stach (1998)

Part I. Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

T
..... 1. The auditory system is an obligatory system that cannot be turned off optionally.

....F.... 2. Except for the smallest of pressure waves, the auditory system can discriminate very small changes in the nature of sound.

....T.... 3. The capacity of a sense organ to detect a stimulus is defined as sensitivity.

....T.... 4. The ability to detect differences in signals that differ in the frequency domain can be referred to as differential sensitivity.

....T.... 5. Differential threshold is the difference between two signals.

....F.... 6. The same sound pressure is needed for all frequencies to reach threshold.

....T.... 7. When the minimum auditory curve is determined by delivering the signals to one ear via an earphone, the term 'minimum auditory pressure response' is used.

....F.... 8. Absolute sensitivity of hearing is an unchangeable characteristic of humans.

....F.... 9. The notion of threshold represents the smallest difference between two signals.

....T.... 10. The minimum audibility curve is not a straight line which indicates the variation of hearing sensitivity.

B. Choose a, b, c, or d which best completes each item.

1. The auditory system is a(an) ..... .
   a. opportunity to protect human beings against diseases
   (b.) obligatory system which serves as a protection and communication function
   c. precise system that can discriminate any change in the human body
   d. very simple and obligatory form of measuring the sound
2. Psychoacoustics is a branch of ..... .
   a. science which measures the knowledge of audiologists about the physical characteristics of sound
   b. psychophysics detecting the changes in sound waves

c. psychophysics measuring the auditory sensation and psychological correlates of sound

d. psychophysics which is concerned with the psychology of sound and qualification of auditory sensation

3. Absolute threshold is the ..... .

a. lowest sensation level at which an acoustic signal can be detected

b. level at which a person can hear a sound 50% of the times

c. smallest difference detected between two signals

d. level at which a stimulus produces a sensation

4. The capacity of detecting differences in signals that vary in the frequency scope is referred to as ..... .

a. hearing acuity

b. hearing sensitivity

c. absolute sensitivity

d. absolute threshold

5. In order to estimate the absolute sensitivity of hearing accurately, ...

a. the function of hearing as a psychophysical technique should be determined

b. it should be determined whether ears are tested separately or together

c. the factors that act as variables for the hearing sensitivity should be determined and controlled

d. the nature of hearing sensitivity and its function should be defined and a consistent picture of it emerged

6. The minimum audibility curve is not a straight line; this means that ..... .

a. the function of signal frequency is consistent all the time

b. human audibility thresholds are best at low frequencies

c. more sound pressure is needed to have a sensitive hearing

d. to reach threshold, it takes more sound pressure at some frequencies than others

7. Hearing is more sensitive in the ..... .

a. low- and high-frequency ranges

b. mid-frequency range

c. frequencies of speech

d. low frequencies

8. An audiogram is actually ..... .

a. the patient's threshold of audibility

b. a graph determined by delivering signals to one ear

c. a clinical graph that shows the audiometric frequency range

d. the minimum audible pressure curve converted into a graph

C. Answer the following questions orally.

1. What is the main function of the auditory system?
2. Why is the auditory system considered as a highly complex system?
3. What is psychoacoustics?
4. What are the two kinds of sensitivity? Define them.
5. What does hearing acuity refer to?
6. What is a threshold?
7. What is the difference between absolute and differential threshold?
8. What are the factors that cause a change in absolute sensitivity of hearing?
9. What does the minimum audibility curve represent?
10. What is the auditory response area and what does it represent?

Part II. Language Practice

A. Choose a, b, c, or d which best completes each item.

1. Patients with otitis media will ..... complain of otalgia.

a. effectively

b. sensitively

c. constantly

d. accurately

2. Clinical immittance ..... is often used to monitor a patient's middle ear status over time.

a. assignment
b. assessment
c. impairment
d. accomplishment

3. There are ..... differences between the two approaches to the treatment of conductive hearing loss.

a. fundamental
b. psychological
c. practical
d. notional

4. What characteristics ..... conductive hearing loss from sensorineural hearing loss?

a. correlate
b. indicate
c. distinguish
d. detect

5. To ensure accurate measurement, it is important to take every precaution to eliminate any ..... that can influence the threshold test.

a. variable
b. response
c. pressure
d. symbol

6. The study of behavioral responses to acoustic ..... is referred to as psychoacoustics.

a. protection
b. determination
c. detection
d. stimulation

7. The ..... of hearing loss can be determined through audiometric measurement of the auditory function.

a. discipline
b. sensitivity
c. magnitude
d. audibility

8. The patient was referred to an audiologist by a ..... of dizziness.

a. pressure
b. sensation
c. detection
d. conception

B. Fill in the blanks with the appropriate forms of the words given.

1. obligate

a. We attended the conference out of a sense of obligation than anything else.

b. The law obligate parents to send their children to school.

c. It is obligatory to attend classes on time.

d. She felt obligated to visit her parents.

2. precise

a. The results of the two tests were precisely the same.

b. The audiologist gave a precise instruction to the patient of what to do during the test.

c. You should have more precision in your report writing.

d. The class will be finished at 10 o'clock precisely.

3. quantify

a. The cost of having hearing-impaired individuals in society is difficult to quantify.

b. The research is based on a quantitative analysis.

c. Mathematics is the science of pure quantity.

d. The quantification of auditory sensation is a broad scope in audiology.

4. design

a. They are going to design this course as an introduction to the subject.

b. He is an industrial designer.

c. The town has been designed as a development area.

d. A machine of faulty design will not sell well.

5. vary

a. There are various kinds of audiograms in clinics and hospitals.

b. For a variety of reasons, hearing screening programs cannot be administered for all neonates in our country.

c. Opinions ..... on the results of the experiment. (vary)

d. Noise was a ..... in the experiment. (variable)

6. assess

a. After the patient's needs have been ..... through a written or oral questionnaire (پرسش نامه), the therapist must try to meet them. (assessed)

b. ..... of the intelligibility of speech is important for the planning of an intervention program. (assessment) فهم گفتار

c. There are several tests available for ..... a patient's speech-reading or lipreading (لب خوانی) skills. (assessing)

d. He is an ..... who calculates the value of property or the amount of income or taxes. (assessor)

7. describe

a. His words were very .....; I could understand exactly what he said. (descriptive)

b. This book gives a good ..... of the concept of life. (description)

c. He talked about his experience ..... . (describably)

d. The doctor asked the patient to ..... exactly how he felt. (describe)

8. correlate

a. It is said that there is a high ..... between unemployment and crime. (correlation)

b. Aging and hearing problems are thought to be ..... . (correlated)

c. Researchers cannot find sets of ..... figures. (correlation)

d. The results of this experiment do not ..... with the results of earlier ones. (correlate)

C. Fill in the blanks with the following words.

designation تعیین	across در طول	average متوسط	intervals فواصل
flat صاف	effectively به طور موثر	pressure فشار	called نامیده شده
audibility شنید پذیری	absolute مطلق	frequency فرکانس	reach

The audiogram is a graphic representation of the threshold of audibility across ..... the audiometric frequency range. It is a plot of absolute ..... threshold, designated in dB hearing level (HL), at octave or mid-octave intervals ..... from 125 to 8000 Hz.

The designation ..... of intensity in dB HL is an important one to understand. Recall from the minimum audibility ..... curve that hearing sensitivity varies as a function of frequency ..... . For clinical purposes, this curve is simply converted into a straight line and called ..... audiometric zero. Audiometric zero is the sound pressure ..... level at which the threshold of audibility occurs in average ..... normal listeners. We know from the minimum audibility curve that the SPL required to reach ..... threshold will vary as a function of frequency. If a standard SPL level is applied at each frequency, and threshold for the average normal listener is designated as 0 dB HL for each frequency, then we have effectively ..... flattened out the curve and represented average normal hearing sensitivity as a(an) flat ..... line of 0 dB.

D. Put the following sentences in the right order to form a paragraph. Write the corresponding letters in the boxes provided.

a. Signals presented in this manner are considered air-conducted, and thresholds are called *air-conduction* thresholds.

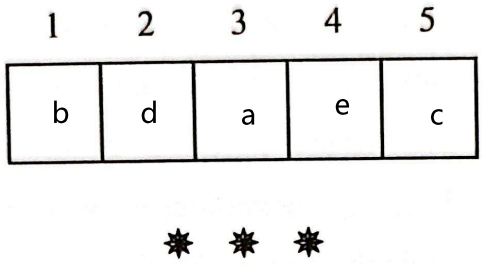
b. There are two main ways to deliver signals to the ear, and they are plotted separately on the audiogram.

c. Signals presented in this manner are considered bone-conducted, and thresholds are called *bone-conduction* thresholds.

d. One way is by the use of earphones, in which signals are presented through the air to the tympanic membrane and middle ear to the cochlea.

e. The other way is by use of a bone vibrator through which signals are

delivered via a vibrator, usually placed on the forehead or on the mastoid process behind the ear, through the bones of the skull directly to the cochlea.



Section Two: Further Reading

Differential Sensitivity

Differential sensitivity is the capacity of the auditory system to detect changes in intensity, frequency, or some other dimension of sound. It is usually measured as the **differential threshold** or **difference limen** (DL), defined as the smallest change in a stimulus that is detectable. When we measure absolute threshold, we are trying to determine the presence (حضور) or absence (عدم حضور) of a stimulus.

When we measure differential threshold, we are trying to determine how small a change in some parameter of the signal can be detected. Another term that is often used to describe differential threshold is **just noticeable difference**, a term that accurately describes the perception (ادراک) that is being measured (قابل توجه).

The difference limens (حد تفاوت) for intensity and frequency have been studied extensively (بطور جامع). A typical **paradigm** (الگو) for determining difference limen would be to present a standard stimulus of a given intensity (شدت معین), followed by a variable stimulus of a slightly different intensity. The intensity of the variable

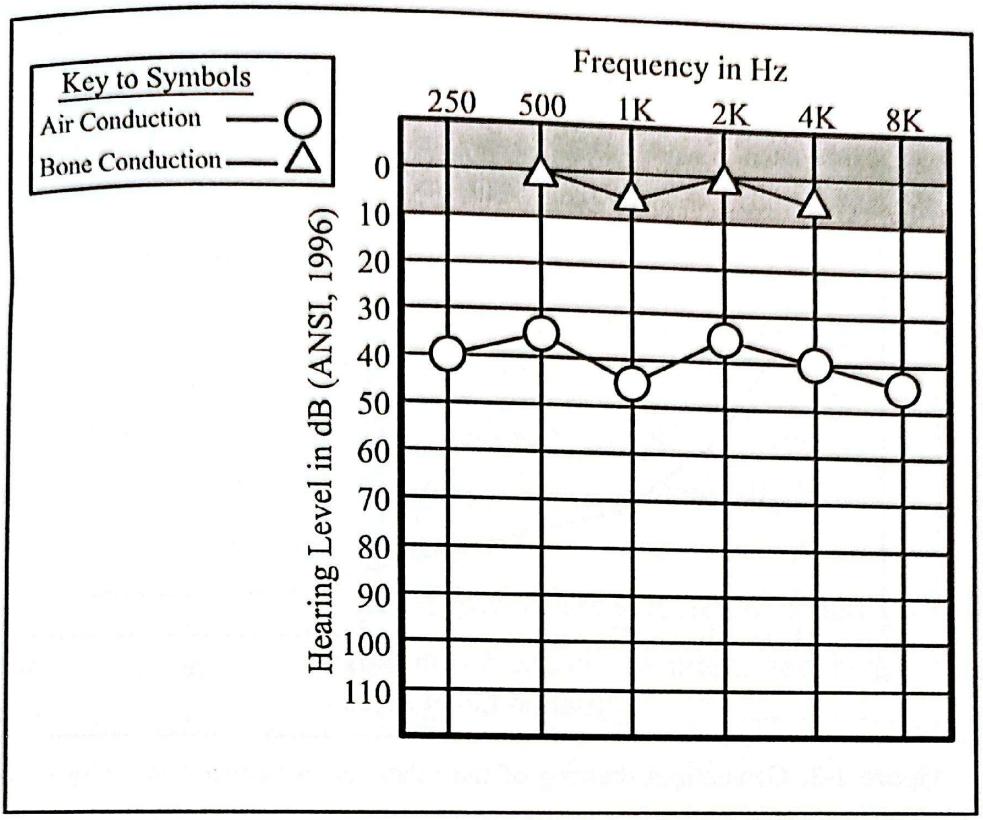


Figure 1-2. An audiogram demonstrating that when the outer or middle ears are not functioning normally, resulting in a conductive hearing loss, the intensity of the air-conducted signals must be raised before threshold is reached, while the bone-conduction thresholds remain normal.

دستکاری کردن

stimulus would be manipulated over a series of trials until a determination was made of the intensity level at which a difference could be detected. An example of the difference limen for intensity is shown in Figure 1-3. The difference limen for intensity varies little across frequency. However, it is significantly poorer at levels near absolute threshold than at higher intensity levels.

An example of the difference limen for frequency is shown in Figure 1-4. In general, the difference limen for frequency increases with increasing frequency, so that a larger change in Hz is required at higher frequencies than at lower frequencies. As with intensity, the ability to detect changes becomes significantly poorer at intensity levels near absolute threshold.

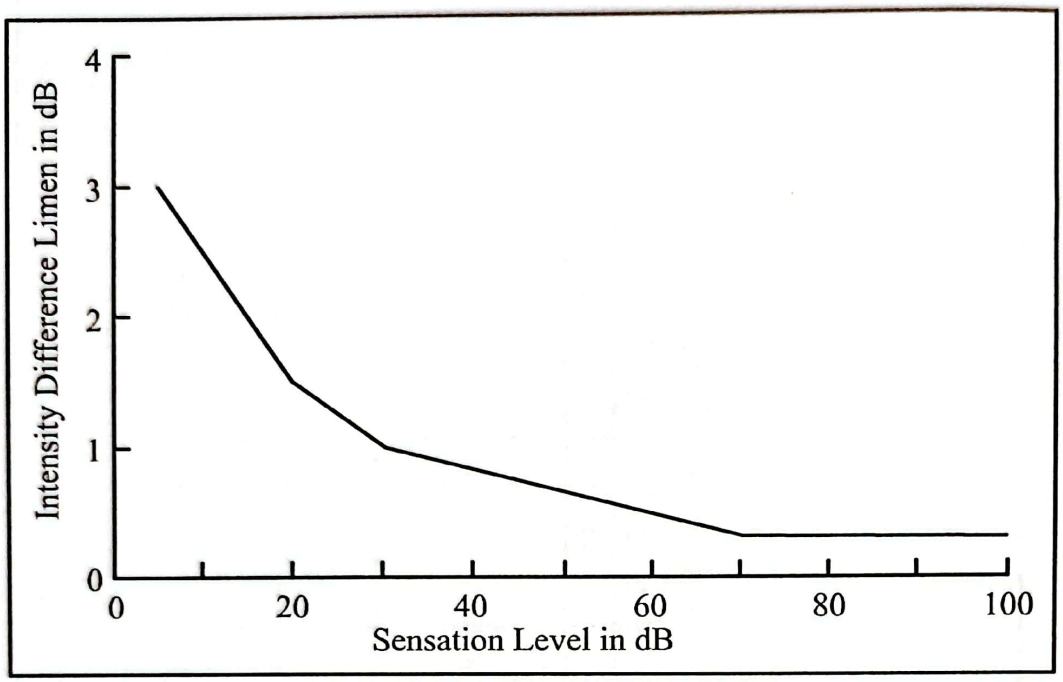


Figure 1-3. Generalized drawing of the relationship between intensity of a signal and difference limen for intensity.

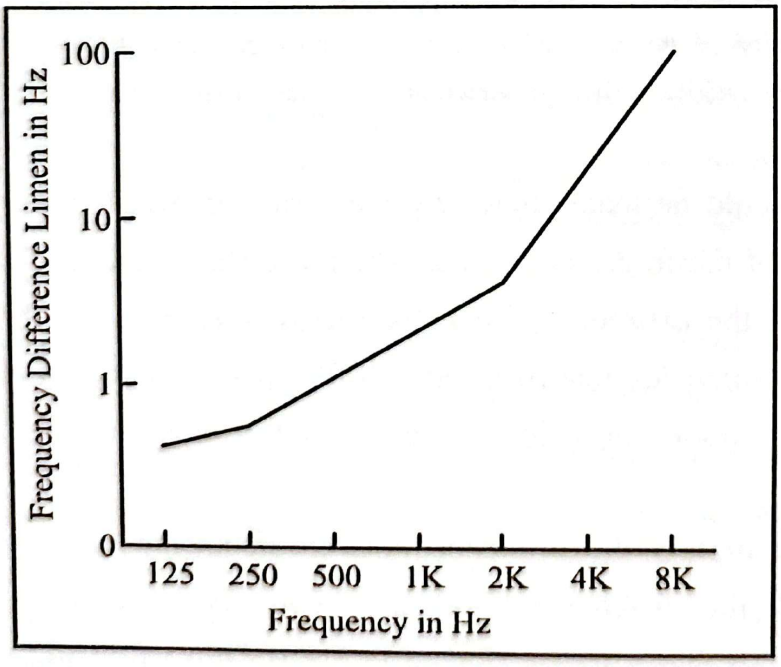


Figure 1-4. Generalized drawing of the relationship between frequency of a signal and the difference limen for frequency.

Properties of Pitch and Loudness

The threshold of hearing sensitivity is just one way to describe hearing ability. It can also be described in terms of suprathreshold hearing perception.

We are all familiar with the physical properties of intensity and frequency of an acoustic signal. The psychological correlates of these physical measures of sound are loudness and pitch, respectively.

Loudness refers to the perception that occurs at different sound intensities. Low-intensity sounds are perceived as soft sounds, while high-intensity sounds are perceived as loud sounds. As intensity increases, so does the perception of loudness.

Pitch refers to the perception that occurs at different sound frequencies. Low-frequency sounds are perceived as low in pitch, and high-frequency sounds as high in pitch. As frequency increases, so does the perception of pitch.

Understanding of these basic aspects of hearing, absolute threshold, differential threshold, and perception of pitch and loudness, is, of course, only the beginning of understanding the full nature of how we hear. Once sound is audible, the auditory mechanism is capable of processing complex speech signals, often in the presence of similar, yet competing, background noise. The auditory system's ability to process changes in intensity and frequency in rapid sequence to perceive speech is truly a remarkable processing accomplishment.

Measurement of Sound

The accurate measurement of sound is an important component of hearing assessment. The standard audiogram is a plot of frequency versus intensity. The intensity level is referenced to a standard sound pressure level. Specifications for this sound pressure level are based on internationally-accepted standards. To meet those standards, the instrumentation that produces the signals, the **audiometer**, must do so in an accurate and consistent manner.

The output of any audiometer is periodically checked to ensure that it meets **calibration** standards. An audiometer is considered to be calibrated if the pure tones and other signals emanating from the earphones are equal to the standard levels set by the American National Standards Institute or the International Organization for Standardization (IOS). To ensure calibration, the output must be measured. The instrument used to measure the output is called a **sound level meter**.

A sound level meter is an electronic instrument designed specifically for the measurement of acoustic signals. For audiometric purposes, the components of a sound level meter include:

- a standard coupler to which an earphone can be attached;
- a sensitive microphone to convert sound from acoustical to electrical energy;
- an amplifier to boost the low-level signal from the microphone;
- adjustable attenuators to focus in on the intensity range of the signal;
- filtering networks to focus in on the frequency range of the signal; and
- a meter to display the measured sound pressure level.

As You might expect all of these components must meet certain specifications as well to ensure that the sound level meter maintains its accuracy. Sound level meters are used for purposes other than audiometric calibration. Importantly, sound level meters are used to measure noise in the environment and are an important component of industrial noise measurement and control. A photograph of a coupler and sound level meter is shown in Figure 1-5.

For audiometric calibration purposes, the sound level meter is used to measure the accuracy of the output of the audiometer through its transducers, either earphones or a bone-conduction vibrator. The process is one of placing the earphone or vibrator onto the standard coupler and turning on the pure tone or other signal at a specified level. The sound level meter is set to

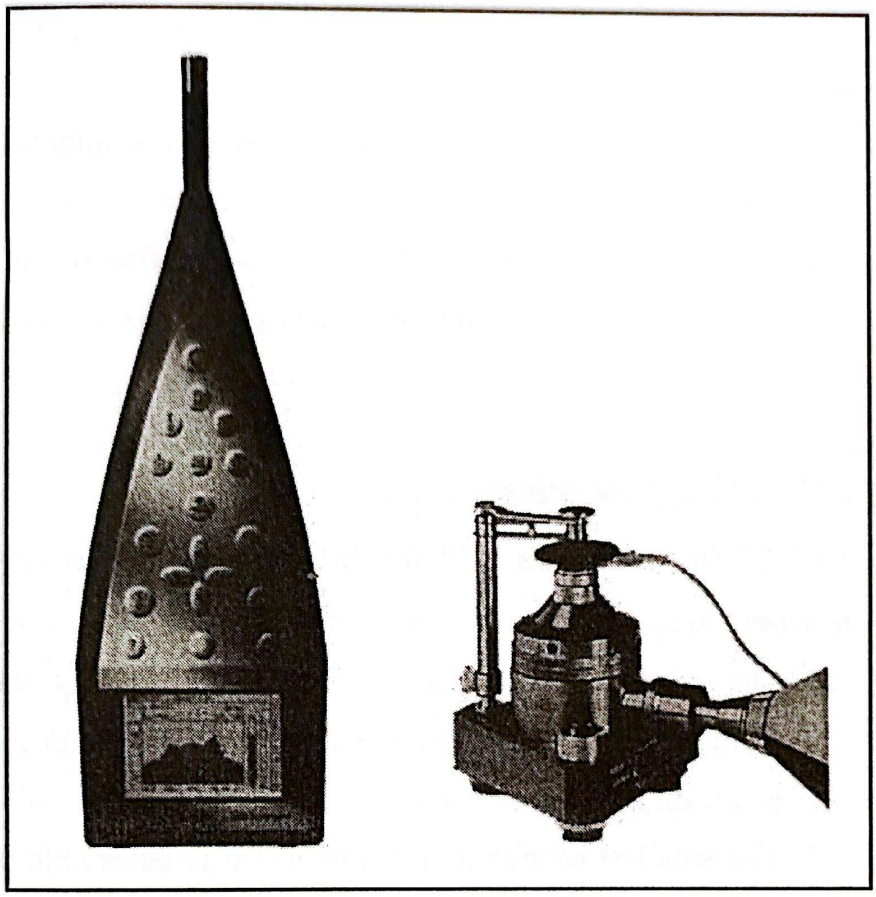


Figure 1-5. Photograph of a sound level meter and earphone coupler.

an intensity and frequency range, and the output level of the earphone is read from the meter. The output is expressed in dB SPL. Standard output levels for audiometric zero have been established for the earphones that are commonly used in audiometric testing. If the output measured by the sound level meter is equal to the standard output, then the audiometer is in calibration. If it is not in calibration, the output of the audiometer must be adjusted. The following measurements are typically made during a calibration assessment:

- output in dB SPL to be compared to a standard for audiometric zero for a given transducer;
- attenuator linearity to ensure that a change of 5 or 10 dB on the audiometer's attenuator dial is indeed that much change in intensity of the output;

- frequency in Hz to ensure that it is accurate within standardized tolerances;
- distortion of the output to ensure that a pure tone is relatively pure or undistorted; and
- rise-fall time to ensure that the onset and offset of a tone are sufficiently slow to avoid transient distortion of a pure-tone signal.

Stach (1998)

Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

..... 1. The capacity of the auditory system to detect changes in intensity, frequency and other dimension of sound is measured as the differential threshold.

..... 2. The smallest change in a stimulus that is detectable is referred to as difference limen.

..... 3. The difference limen for intensity does not vary across frequency.

..... 4. When frequency increases, the difference limen for frequency decreases.

..... 5. Loud sounds are the perception of high-intensity sounds.

..... 6. As intensity decreases, the perception of loudness increases.

..... 7. Certain standard levels are used to calibrate an audiometer.

..... 8. In order to boost the low-level signal from the microphone, an amplifier can be used.

..... 9. All sound level meters are merely used for audiometric calibration.

..... 10. Distortion of the output should be measured during a calibration assessment.

B. Choose a, b, c, or d which best completes each item.

1. The degree of the changes in signal parameter and its perception can be determined by measuring ..... .
   a. absolute threshold
   b. difference limen
   c. differential threshold
   d. difference limen for intensity
2. According to the passage, ...
   a. intensity and loudness are the same, and pitch is the perception of sound frequencies
   b. intensity translates to the perception of loudness, and frequency translates to pitch
   c. low- and high-intensity sounds are equally perceived and increase in loudness
   d. pitch and frequency are contradictory to each other, that is, an increase in one causes a decrease in the other
3. In order to perceive speech, ...
   a. the speech signals should be complex
   b. the auditory mechanism should compete with the background noise
   c. complex speech signals should be presented in the competing background noise
   d. the auditory system should process change in intensity and frequency immediately
4. "The output of any audiometer is periodically checked to ensure that it meets calibration standards." In which of the following sentences does the word 'meet' have the same meaning?
   a. This proposal of yours hardly meets the case.
   b. Each person should meet three conditions to be able to borrow money from the bank.
   c. The hotel bus meets all the trains at the station.
   d. He knew he would meet with difficulties and obstacles.

5. A sound level meter is an instrument used ..... .
   a. merely in audiometric calibration
   b. to measure hearing sensitivity
   c. in audiometric calibration and measurement of noise in the environment
   d. to convert sound from acoustical to electrical energy by the use of an amplifier
6. ..... is considered as an important part of hearing assessment.
   a. A standard audiogram
   b. An accurate measurement of sound
   c. A calibrated audiometer
   d. Standard specification for sound pressure level
7. The perception that occurs at different sound intensities is called ..... .
   a. intensity
   b. pitch
   c. frequency
   d. loudness
8. An audiometer is considered calibrated when the ..... .
   a. standard output and the output measured by the sound level meter are equal
   b. output of the earphone can be read from the sound level meter
   c. output of the audiometer is measured through its transducers
   d. transient distortion of a pure-tone signal is assessed

C. Write answers to the following questions.

1. What is the purpose of absolute threshold measurement?
2. What does the term 'just noticeable difference' mean?
3. What are 'loudness' and 'pitch'?
4. When is an audiometer considered to be calibrated?
5. What is a sound level meter?
6. What is the use of a standard coupler in a sound level meter?

7. How is it possible to ensure that a sound level meter maintains its accuracy?

* * *

Section Three: Translation Activities

A. Translate the following passage into Persian.

Audiogram

Figure 1-6 shows an audiogram. The abscissa on the graph is frequency in Hz. It is divided into octave intervals, ranging from 250 Hz to 8000 Hz. The

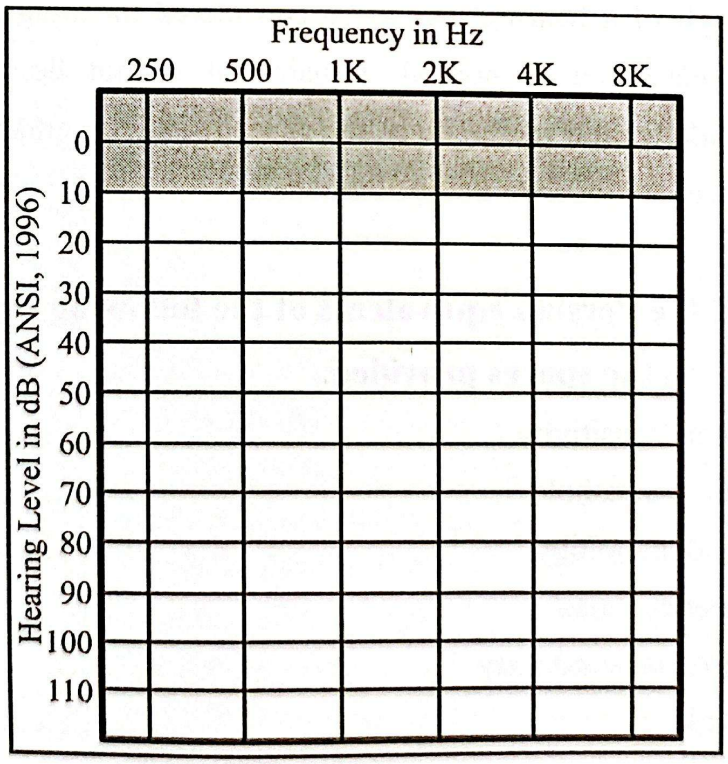


Figure 1-6. An audiogram with intensity, expressed in hearing level, plotted as a function of frequency, expressed in Hertz.

ordinate on the graph is signal intensity in dB HL. It is divided into 10 dB segments, usually ranging from –10 dB to 120 dB HL. Typically on an audiogram, the HL will be further referenced to a standard, such as ANSI 1996. This standard, from the American National Standards Institute (ANSI), relates to the SPL assigned to 0 dB HL, depending on the type of earphone and cushion used.

An audiogram will usually also have a shaded area, designating the range of normal hearing. You will learn later that there is some variability in determining hearing threshold and that normal responses can vary by as many as 10 decibels around audiometric zero. It is not uncommon then to have a shaded range from –10 to +10 dB to designate the normal range of hearing. On some audiograms, that range will be extended to 25 dB or so. This idea defines the normal range not in statistical terms, but in some notion of functional terms. The assumption here would be that, for example, 20 dB is not enough of a hearing loss to be considered meaningful; therefore, it should be classified as normal. Impairment cannot be defined by the audiogram alone, and increasingly the shaded range is either being defined by a statistical approach or being eliminated.

B. Find the Persian equivalents of the following items and write them in the spaces provided.

1. absolute sensitivity ..... حساسیت مطلق .....
2. absolute threshold ..... آستانه مطلق .....
3. clinical audiology ..... شنود شناسی بالینی .....
4. difference limen ..... حد افتراق .....
5. differential sensitivity ..... حساسیت افتراق .....
6. dimension ..... بُعد .....
7. hearing acuity ..... حدت شنوایی .....
8. intensity ..... شدت .....
9. just noticeable difference ..... حداقل تفاوت قابل توجه .....

10. loudness ..... بلندی صدا .....

11. minimum audibility curve ..... منحنی حداقل شنیدپذیری .....

12. paradigm ..... الگو .....

13. pitch ..... زیر و بمی .....

14. psychoacoustics ..... سایکوآکوستیک .....

15. quantification ..... کمّی سازی .....

16. sound level meter ..... صدا سنج .....

17. suprathreshold ..... فوق آستانه .....

18. transducer ..... مبدل .....

19. variable stimulus ..... محرک متغیر .....

Unit 4

Section One: Reading Comprehension

Clinical Evaluation of Hearing Loss

More than 28 million Americans had some degree of hearing impairment in 1993. Estimates of significant hearing loss in infants range from 1:1000 to 1:2000, while by age 6 the prevalence may be as high as 2:1000. The cost to society is difficult to estimate but includes lost productivity, special education, and medical treatment. Given the prevalence of hearing loss, a cost-effective and accurate diagnostic approach is essential to assess the degree and nature of hearing loss and to arrive at the underlying cause. Patients may undergo assessment for hearing loss (Figure 4-1) because of their subjective complaints or because they belong to groups that have been shown to be at risk for hearing loss such as low birth weight infants or those receiving ototoxic chemotherapy. In either case, an understanding of the differential diagnosis of hearing loss is helpful in guiding clinical evaluation.

Differential Diagnosis

A crucial step in establishing a differential diagnosis is to determine whether hearing loss is **conductive** or **sensorineural**. A sensorineural hearing loss may be caused by a lesion of the cochlea or the auditory nerve. While not strictly fitting the definition of sensorineural, processes affecting the central

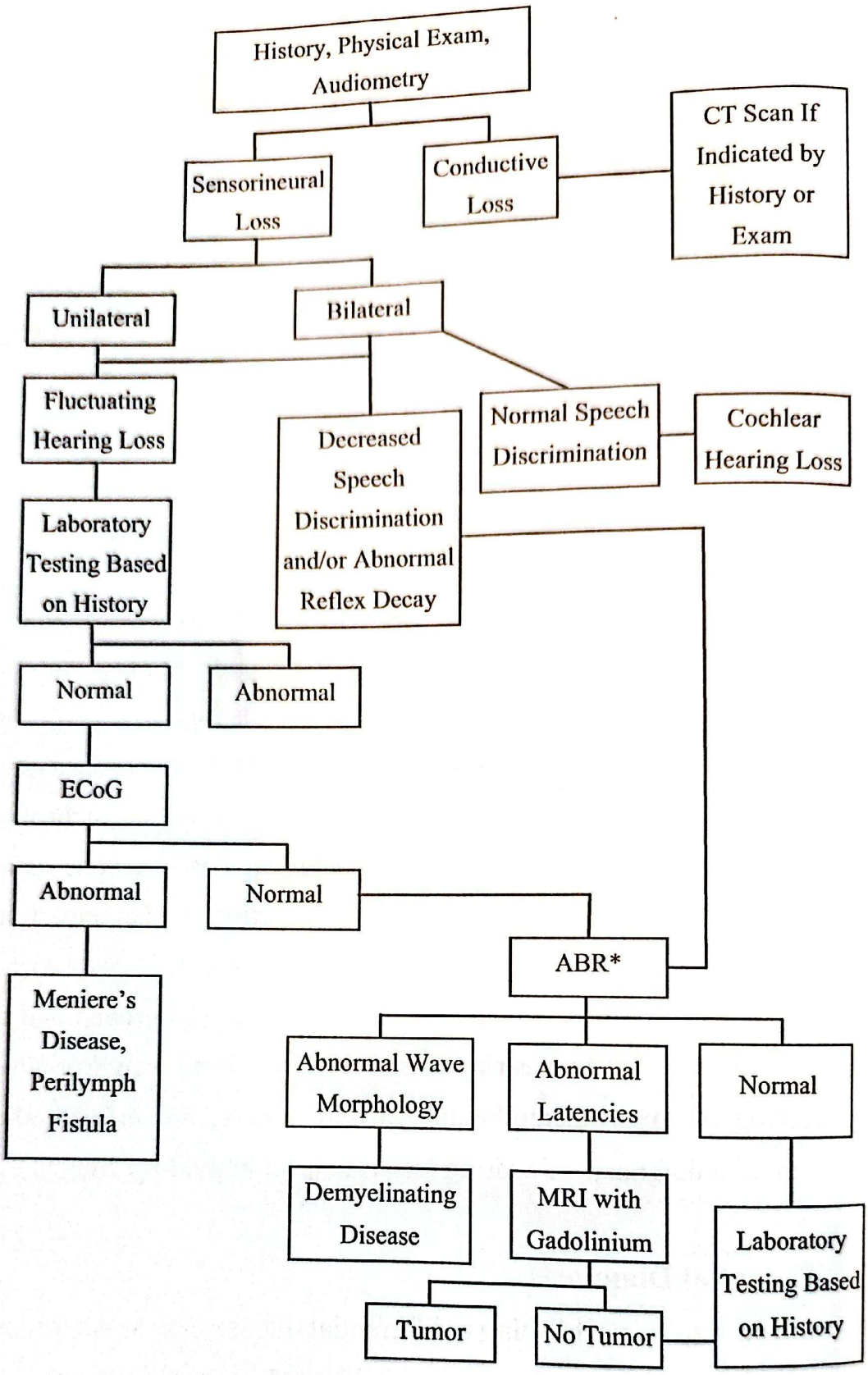


Figure 4-1. Algorithm for clinical assessment of hearing loss. CT, computed tomography; ECoG, electrocochleography; ABR, auditory brain stem response; MRI, magnetic resonance imaging. * For ABR, patient must have 65-70 dB HL between 2000 and 4000 Hz.

nervous system can be considered with this group. A conductive hearing loss is caused by a lesion affecting the mechanism that transmits sound energy from the external environment to the cochlea and may involve the external ear, the tympanic membrane, or the contents of the middle ear. Some patients may have both sensorineural and conductive hearing loss simultaneously, in which case the loss is categorized as mixed. Conditions that may be associated with a mixed hearing loss include chronic otitis media, acquired cholesteatoma, temporal bone trauma, and otosclerosis. The pattern of the audiogram as well as additional data obtained from impedance testing and speech audiometry will also help to refine the differential diagnosis. History and physical findings are extremely important in narrowing the list of clinical possibilities. The differential diagnosis for a patient with unilateral sensorineural hearing loss varies considerably from that for a patient with bilateral slowly progressive sensorineural loss. However, for the purposes of giving a broad overview, differential diagnoses for sensorineural and conductive hearing losses are discussed here (Tables 4-1 and 4-2).

Sensorineural Hearing Loss. Congenital hearing loss is that which is present from birth, whether due to hereditary factors, prenatal exposure, or perinatal events. In contrast, **hereditary hearing loss** may not be present at birth. Causes of congenital sensorineural hearing loss include a variety of genetic disorders, intrauterine infections, exposure to teratogenic agents, prematurity, perinatal anoxia, and hyperbilirubinemia. Some of these factors may result in inner ear aplasia; however, such deformities may also exist without identifiable cause. While the mechanism is not understood, full-term low-birth-weight infants are also at increased risk for sensorineural hearing loss as well as problems with figure/ground differentiation and auditory memory. Genetic factors can also cause delayed-onset hearing loss. Hereditary hearing loss may be dominant, recessive, or X-linked, and may exist with or without abnormalities in other organ systems.

Table 4-1. Differential diagnosis of sensorineural hearing loss.

- Congenital
  - Genetic disorders, e.g. Usher's syndrome, Jervell and Lange-Nielsen syndrome
  - Intrauterine infection
  - Teratogens
  - Perinatal anoxia – hypoxia
  - Prematurity
  - Low birth weight
  - Hyperbilirubinemia
  - Inner ear dysplasia
- Hereditary – delayed onset
  - Dominant, e.g. Paget's disease, dominant progressive hearing loss
  - Recessive, e.g. early-onset nonsyndromic sensorineural hearing loss
  - X-linked, e.g. Alport's syndrome
- Infectious
  - Postmeningitis
  - Chronic otitis media
  - Syphilis
  - Viral – CMV, HSV, HIV
  - Lyme disease
  - Tuberculosis
- Inflammatory
  - Systemic autoimmune disease
  - Primary autoimmune ear disease
- Neoplastic
  - Primary tumors arising within the temporal bone
  - Metastatic tumors
- Metabolic
  - Diabetes
  - Hypothyroidism
  - Hyperlipoproteinemia
- Traumatic
  - Temporal bone fracture
  - Perilymph fistula
  - Barotrauma
  - Noise exposure

Table 4-1. (cont.)

	Auditory concussion
	Traumatic brain injury
	Postsurgical
Vascular-hematologic	
	Hypertension
	Vascular occlusion/emboli
	Inner ear hemorrhage
Miscellaneous	
	Meniere's disease
	Presbycusis
	Cochlear otosclerosis
	Multiple sclerosis
	Ototoxicity
	Radiation injury

CMV: cytomegalovirus

HSV: herpes simplex virus

HIV: human immunodeficiency virus

Infectious agents and inflammatory processes can also lead to sensorineural hearing loss. The infectious agents include both bacteria and viruses. Some individuals with otitis media may develop sensorineural hearing loss through round window membrane permeability to bacterial toxins. Tuberculosis may also be associated with sensorineural hearing loss. The spirochetes causing both syphilis and Lyme disease can involve the perilymph resulting in sudden or fluctuating sensorineural hearing loss. Hearing loss has also been reported from more unusual infectious diseases such as brucellosis. Cytomegalovirus, herpes simplex, and the human immunodeficiency virus (HIV) can also lead to sensorineural hearing loss. In HIV, the hearing loss may result from the opportunistic infections characteristic of the acquired immunodeficiency syndrome, ototoxic medications used to treat infections, or possibly direct effects of the virus upon the cochlea. Lastly, 5% to 35% of patients are left with sensorineural

Table 4-2. Differential diagnosis of conductive hearing loss.

Congenital
Ossicular fusion/malformation
Ossicular fixation
Atresia of the external auditory canal
Congenital cholesteatoma
Hereditary
Otosclerosis
Osteogenesis imperfecta
Paget's disease (osteitis deformans)
Osteopetrosis (Albers-Schönberg disease)
Crouzon's syndrome
Marfan's disease
Infectious-inflammatory
Otitis media with effusion
Acquired cholesteatoma
Otitis externa
Neoplastic
Ear canal carcinoma
Glomus tumor
Histiocytosis
Fibrous dysplasia
Traumatic
Tympanic membrane performation
Ossicular discontinuity
Hemotympanum
Mechanical
Cerumen impaction
Foreign body of the ear canal
Exostoses

hearing loss following bacterial meningitis. A number of immune-mediated diseases may also lead to sensorineural hearing loss. These include systemic diseases such as Cogan's syndrome, relapsing polychondritis, Wegener's granulomatosis, lupus erythematosus, Takayasu's disease, and giant cell

arteritis. In addition, isolated immune-mediated hearing loss may present without systemic manifestations.

Sensorineural hearing loss may result from primary tumors arising within the temporal bone or metastatic lesions. The most common neoplasm causing sensorineural hearing loss is acoustic neuroma. While more often associated with conductive losses, squamous cell carcinoma and paragangliomas arising within the temporal bone may also affect sensorineural hearing. Metastatic lesions include those with a proclivity for bony metastases such as carcinoma of the prostate.

Associations have been suggested but not conclusively proven between several metabolic disorders and sensorineural hearing loss. These include diabetes mellitus in which microangiopathy has been postulated to lead to auditory damage, hypothyroidism, and hyperlipoproteinemia. Hypertension as well as vascular and hematologic problems are also thought to cause hearing loss. Decreased blood flow to the inner ear may result from narrowed blood vessels, as in atherosclerosis or diabetes mellitus, or from abnormal flow or coagulability, as in sickle cell and hypercoagulable disorders. Platelet dysfunction, thrombocytopenia, and hypocoagulable states can also lead to hemorrhage within the inner ear, thus causing hearing loss.

Trauma can cause sensorineural hearing loss in several ways. Both longitudinal and transverse fractures of the temporal bone can disrupt the labyrinth, although this is more likely to happen with the latter. Perilymphatic fistula can result from both blunt injury to the head and barotrauma. Head trauma may also cause concussive injury to the middle ear or traumatic brain injury with central hearing loss. Surgical trauma may result in sensorineural hearing loss. Excessive noise exposure damages the outer hair cells of the cochlea; thus, noise trauma can cause hearing loss. Other conditions known to lead to sensorineural hearing loss include Meniere's disease, cochlear otosclerosis, multiple sclerosis, ototoxic drugs, radiation injury, and aging (presbycusis).

Huges et al. (1997)

Part I. Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

....F... 1. The prevalence of hearing loss in young children is higher in comparison with older ones.

.....T..... 2. In order to assess the degree and nature of hearing loss, it is necessary to take an accurate diagnostic approach.

F
..... 3. Low-weight children may undergo assessment for hearing loss.

....F.... 4. Low-birth-weight infants usually receive ototoxic chemotherapy.

....T.... 5. It is important to differentiate the kind of hearing loss in the process of diagnosis.

...F..... 6. Since central nervous system disorders do not fit the definition of sensorineural hearing loss, no relationship can be found between them.

...T..... 7. In cases of otosclerosis, the patient may have both sensorineural and conductive hearing loss simultaneously.

...T..... 8. Bacteria and viruses can cause sensorineural hearing loss.

...F..... 9. Wegener's granulomatosis is a kind of immune-mediated disease which may cause conductive hearing loss.

...F..... 10. Genetic disorders are the only causes of congenital sensorineural hearing loss.

B. Choose a, b, c, or d which best completes each item.

1. Infectious agents causing sensorineural hearing loss include .....

a. bacteria and viruses
b. inflammatory factors
c. hereditary factors
d. some toxins

2. All of the following factors can cause delayed occurrence of hearing loss except ..... hereditary hearing loss.

a. dominant
b. infectious
c. recessive
d. X-linked

3. In paragraph 3 the writer ..... hearing loss.
   a. mostly explains the causes of congenital
   b. believes that just genetic factors may lead to delayed onset
   c. merely introduces the causes of hereditary
   d. just puts forward prenatal factors as the causes of
4. "... may result from primary tumors arising within ..." (paragraph 5, line 1). In which of the following sentences does the word 'arising' have the same meaning?
   a. We keep them informed of the arising change.
   b. Several new industries are arising in the country.
   c. Emotional or mental problems arising from a physical cause should be considered.
   d. The workers of the company are arising against their employer.
5. In 1993 it was reported that in America the prevalence of hearing loss was ..... .
   a. less than 1:1000 among infants
   b. more than 1:2000 among infants
   c. to the extent of 2:1000 by age 6
   d. as high as 2:1000 before the age of 6
6. The most important factor in a differential diagnosis is to ..... .
   a. recognize the type of hearing loss
   b. distinguish the lesion of the cochlea
   c. search for the processes affecting the central nervous system
   d. look for a lesion of the auditory nerve

C. Answer the following questions orally.

1. Why do some people undergo assessment for hearing loss?
2. What should be determined in establishing a differential diagnosis?
3. What is the cause of a sensorineural hearing loss?
4. Which kind of hearing loss is called a mixed one?

5. Can you name some of the conditions that may be associated with a mixed hearing loss?
6. What causes a conductive hearing loss?
7. How can we decrease the number of clinical possibilities?
8. Which kind of hearing loss is called a congenital hearing loss?
9. What is the difference between a congenital and hereditary hearing loss?
10. Can you name some of the factors that may lead to sensorineural hearing loss?

Part II. Language Practice

A. Choose a, b, c, or d which best completes each item.

1. The manager of the hospital has decided to adopt a different ..... to discipline.

   a. diagnosis b. approach
   c. finding d. fluctuation

2. It is important for a nurse to ..... a patient's needs.

   a. undergo b. cause
   c. assess d. receive

3. It is difficult to ..... between the two varieties of an illness.

   a. link b. differentiate
   c. process d. report

4. In some diseases patients may have hearing loss and tinnitus ..... .

   a. strictly b. physically
   c. lastly d. simultaneously

5. One week after being released from hospital, she ..... into a coma.

   a. relapsed b. postulated
   c. proved d. refined

6. On admittion, the man was injured with a(an) ..... instrument.

a. concussive
b. expose
c. blunt
d. conclusive

7. Some kinds of hearing loss are called ..... deafness, because they were passed on from parents to their offspring.
a. auditory
b. sensory
c. infectious
d. hereditary

B. Fill in the blanks with the appropriate forms of the words given.

1. differentiate

a. People often give ..... accounts of the same event. (different)
b. The ..... treatment of prisoners based on their social class still exists. (differential)
c. There is a ..... between db SPL and db HL. (difference)
d. It is important to ..... between cochlear and retrocochlear lesion. (differentiate)

2. signify

a. Vertigo is one of the ..... symptoms of Meniere's disease. (significant)
b. A high fever usually ..... a disorder of the body. (signifies)
c. The new drug has great ..... for the treatment of the disease. (significance)
d. The two groups of patients are not ..... different from each other. (significantly)

3. inflame

a. Otitis externa refers to ..... of the auricle and external auditory canal. (inflammation)
b. There are different kinds of ..... and infectious diseases of the ear. (inflammatory)
c. Labyrinthitis is a term used when the inner ear, or labyrinth, is ..... (inflamed)
d. For safety, it is forbidden to take ..... material into some places. (inflammable)

4. deficiency

a. Deaf people are sometimes treated as being mentally ..... deficient .

b. Vitamin ..... deficiency in the diet can cause serious illnesses.

c. The trade balance has been in ..... deficit for the past five years.

5. develop

a. Her son ..... developed asthma when he was two.

b. Children with highly ..... developed hearing problems may need hearing aids.

c. Macrotia is a kind of congenital and ..... developmental disorder of the ear.

d. The ..... development of vaccines against certain diseases was considered a revolution.

6. medicine

a. Many commonly-used ..... medicines can cause hearing loss.

b. A ..... medical audiologist assists the physician in establishing an accurate diagnosis of auditory disorders.

c. Every practitioner should pay attention to the ethical problems in ..... medication .

d. Some ..... medicinal herbs have healing properties.

C. Fill in the blanks with the following words.

ages	assessment	audiologic	audiometry
field	headphones	under	perform
sound	source	response	used

All patients suspected of having hearing loss should undergo audiologic examination, including pure tone threshold testing for air and bone as well as ..... assessment of speech threshold and discrimination. For children ..... under 3 years or those with developmental delay, visual reinforcement ..... audiometry (VRA) or conditioned play audiometry (CPA) replace conventional ..... audiologic examination. VRA is commonly used in children between the ..... ages of

6 and 24 months. A signal is presented in the sound field and the child is conditioned to turn toward the sound by the activity of a toy that is located close to the sound source. For older children, CPA can be used. In this technique the child is taught to perform a simple task, such as dropping a toy into a bucket, in response to auditory signals. In CPA the child wears headphones, and pure tone thresholds for both air and bone can be obtained.

D. Put the following sentences in the right order to form a paragraph. Write the corresponding letters in the boxes provided.

a. Therefore, associated otologic symptoms such as tinnitus, otalgia, aural fullness, and otorrhea should be noted as well as any vertigo or instability suggestive of vestibular dysfunction.

b. Of course, it is important to establish whether the hearing loss is unilateral or bilateral, sudden in onset or gradual, stable or fluctuating.

c. Then, particular attention should be paid to both current and past medications, ototoxic potential, taking care to include over-the-counter drugs.

d. The history should include the patient's age, and progression of symptoms.

e. After the otologic history has been taken, further questioning should establish the existence of other systemic illnesses, symptoms of such illnesses, or history of head trauma.

1	2	3	4	5
D	B	A	E	C

Hearing Loss

Causes of Conductive Hearing Loss

Congenital causes of conductive hearing loss include ossicular fixation and ossicular malformation, as well as atresia or stenosis of the external auditory canal. These anomalies may exist in conjunction with other craniofacial abnormalities as well as sensorineural hearing loss. Hereditary, delayed-onset conductive hearing loss can be caused by otosclerosis, which is thought to be an autosomal dominant disease with incomplete penetrance. Osteogenesis imperfecta, another autosomal dominant disorder, also leads to delayed-onset conductive hearing loss caused by stapes fixation or ossicular fracture. Other hereditary causes of hearing loss include osteopetrosis, Marfan's disease, Paget's disease, and Crouzon's syndrome. The presence of congenital cholesteatoma in the middle ear can also cause conductive hearing loss.

The most common cause of conductive hearing loss is otitis media with effusion, which can be either acute or chronic. Cholesteatoma and granulation tissue caused by chronic otitis media can interfere with the transmission of sound to the oval window, sometimes even causing ossicular erosion. Other sequelae of infection that may cause conductive hearing loss include tympanosclerosis and atelectatic middle ear. Another infectious cause of conductive hearing loss is severe otitis externa, in which edema of the ear canal interferes with hearing. Trauma may also lead to conductive hearing loss, caused by tympanic membrane perforation, hemotympanum, or ossicular discontinuity.

Rarer causes of conductive hearing loss include neoplasms involving the external auditory canal or middle ear. These may be benign or malignant.

Lastly, mechanical occlusion of the external canal from cerumen, foreign bodies, or large exostoses can also cause conductive hearing loss.

History

The history is the first and most essential step in the clinical evaluation of hearing loss. Indeed, the history may identify individuals with hearing loss by identifying risk factors for such losses, particularly in children.

Infants and Children. Family history, pregnancy history and birth history are particularly important in the clinical evasluation of infants and children, because they can identify factors that may increase the child's risk of hearing loss. While screening programs based on risk factors have helped to identify infants with sensorineural hearing loss, as many as half of children with severe to profound hearing loss may not belong to high-risk groups, thus delaying their diagnosis and treatment. Thus the 1994 Position Statement of the Joint Committee on Infant Hearing endorses universal infant screening by the age of 3 months. Controversy still exists regarding the efficacy and cost-effectiveness of such programs. Because such screening is not currently routine, the Joint Committee has also established indicators for testing in newborn infants and children. For neonates (birth through 28 days) these are:

1. Family history of hereditary childhood sensorineural hearing loss;
2. In utero infection, including cytomegalovirus, rubella, syphilis, herpes, and toxoplasmosis;
3. Craniofacial anomalies, including abnormal morphology of the pinna and ear canal;
4. Birth weight less than 1500 g;
5. Hyperbilirubinemia at a serum level requiring exchange transfusion;
6. Ototoxic medications used in multiple courses or in combination with loop diuretics;
7. Bacterial meningitis;

8. Apgar scores of 0 to 4 at 1 minute or 0 to 6 at 5 minutes;

9. Mechanical ventilation lasting for 5 days or longer; and

10. Stigmata or other findings associated with a syndrome known to include sensorineural and/or conductive loss.

In addition, to detect delayed-onset hearing loss, the Committee proposed indicators for audiologic evaluation in children between the ages of 29 days and 2 years who develop certain health conditions. These include:

1. Parent/caregiver concern about hearing, speech, language, and/or developmental delay;

2. Bacterial meningitis or other infections associated with sensorineural hearing loss;

3. Head trauma associated with loss of consciousness or skull fracture;

4. Stigmata or other findings associated with a syndrome known to include sensorineural and/or conductive hearing loss;

5. Ototoxic medications used in multiple courses or in combination with loop diuretics; and

6. Recurrent or persistent otitis media with effusion for at least 3 months.

Huges et al. (1997)

Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

..... 1. Stapes fixation or ossicular fracture are caused by delayed-onset conductive hearing loss.

..... 2. Acute otitis media with effusion is the main cause of conductive hearing loss.

..... 3. Hereditary factors may cause conductive hearing loss.

..... 4. Benign or malignant neoplasms are common causes of conductive hearing loss.

..... 5. Taking history is one of the most important factors in identifying individuals with hearing loss.

..... 6. Screening programs based on risk factors may fail in the diagnosis of some of the children who do not belong to high-risk groups.

..... 7. Universal infant screening is rejected by all the organizations.

..... 8. Neonates who have been infected with bacterial meningitis should undergo assessment for hearing loss.

B. Choose a, b, c, or d which best completes each item.

1. "Controversy still exists regarding the efficacy and cost-effectiveness of such programs" (paragraph 5, line 9). This sentence can be rewritten as ".....".
   a. It was proved that it is not an efficient and cost-effective way to use such programs.
   b. It is believed that such programs are efficient and cost-effective.
   c. There is a great disagreement about the efficacy and cost-effectiveness of such programs.
   d. The efficacy and cost-effectiveness of such program were regarded.
2. Screening programs based on risk factors ..... .
   a. can help achieve early identification of infants with any kind of hearing loss
   b. may ignore children with severe to profound hearing loss who do not belong to high-risk groups
   c. may cause a delay in the diagnosis and treatment of infants with sensorineural hearing loss
   d. proved to be useless in identification of infants and children with hearing loss
3. All of the following items are hereditary causes of conductive hearing loss except ..... .

a. severe otitis media
b. osteopetrosis
c. otosclerosis
d. Paget's disease

4. "Controversy still exists regarding the efficacy and cost-effectiveness of such programs" (paragraph 5, line 9). What do the underlined words refer to?
   a. screening programs based on risk factors
   b. diagnosis and treatment programs for children with profound hearing loss
   c. universal infant screening programs
   d. establishing indicators for testing infants
5. "Parent/caregiver concern ... developmental delay" (paragraph 6, line 4). In which of the following sentences does the word 'concern' have the same meaning?
   a. Don't interfere in what doesn't concern you.
   b. This chapter concerns itself with family history.
   c. What concerns me is our lack of preparation for the change.
   d. He didn't concern himself with the details.

C. Write answers to the following questions.

1. Can you name some of the congenital causes of conductive hearing loss?
2. Can you name some autosomal dominant disorders which may cause conductive hearing loss?
3. What is the most common cause of conductive hearing loss?
4. Can you mention some of the infectious causes of conductive hearing loss?
5. How does cholesteatoma affect the patient's hearing?
6. Can you mention some rarer causes of conductive hearing loss?
7. Why is the history the most important step in the clinical evaluation of hearing loss?

8. What does the 1994 Position Statement of the Joint Committee on Infant Hearing endorse?
9. How can you assess parental concern about speech development?

* * *

Section Three: Translation Activities

A. Translate the following passage into Persian.

Physical Examination

Physical examination begins with examination of the external ear. The size, shape, and position of the pinna should be noted. In cases of microtia, the degree of external malformation can be used to assess the development of the middle ear, because a more deformed auricle is more likely to be associated with a greater degree of middle ear atresia. The preauricular area should be examined carefully for pits or skin tags, while postauricular inspection should make چرخاندن rote of tenderness, erythema, or swelling. Even before the external auditory canal is inspected visually, pain may be elicited by traction on the pinna, suggesting otitis externa.

Visual inspection of the external auditory canal and tympanic membrane can be performed with the handheld otoscope or the microscope. The former affords the opportunity for pneumatic otoscopy, while the latter may provide improved visualization and capacity to use instruments. In either case, the examination should include thorough inspection of the bony and cartilaginous ear canal. Cerumen, foreign bodies, pus, fungal infection, keratinaceous debris, and granulation tissue may be noted. The canal itself may be erythematous and edematous or dry and flaky. Sagging of the

posterosuperior canal wall suggests mastoid disease. For optimal visualization, the canal should be carefully but thoroughly cleaned, and if indicated, material from the canal may be sent for culture. Polyps, osteomas, or exostoses may partially or completely occlude the ear canal, making visualization of the tympanic membrane difficult. However, under optimal circumstances the entire tympanic membrane should be inspected, making note of perforations, sclerotic areas, and retraction pockets. The color of the tympanic membrane provides additional clinical information.

B. Find the Persian equivalents of the following items and write them in the spaces provided.

1. acoustic neuroma ..... تومور عصب شنوایی
2. acquired cholesteatoma ..... کلستئاتوم اکتسابی
3. barotrauma ..... ضربه ناشی از فشار هوا
4. differential diagnosis ..... تشخیص افتراقی
5. dominant ..... غالب
6. fluctuating sensorineural hearing loss ..... کاهش شنوایی حسی عصبی نوسانی
7. intrauterine infections ..... عفونت های داخل رحمی
8. otitis media ..... التهاب گوش میانی
9. ototoxic medication ..... دارو های سمی گوش
10. oval window ..... دریچه گرد
11. permeability ..... نفوذ پذیری
12. prenatal exposure ..... مواجهه حین تولد
13. recessive ..... مغلوب
14. round window ..... دریچه گرد
15. speech audiometry ..... ادیومتری گفتار
16. teratogenic agents ..... عوامل تراتوژن

Unit 5

Section One: Reading Comprehension

Audiologic Measurement

disability, inability :ناتوانی

The nature of auditory impairment (اختلال) is dependent on such factors as the severity (شدت) of the hearing loss, the age at onset, the cause of the loss, and the location of the lesion (ضایعه) within the auditory system. The hearing evaluation (ارزیابی) plays an important role in determining some of these factors. Audiometric measurement of auditory function can: (a) determine the degree of hearing loss; (b) estimate (تخمین زدن) the location of the lesion (ضایعه) within the auditory system that is producing the problem; (c) help establish (مشخص کردن) the cause of the hearing problem; (d) estimate the extent (وسعت) of the handicap (معلولیت) produced by the hearing loss; and (e) help to determine the client's habilitative or rehabilitative needs and the appropriate (مناسب) means (وسایل) of filling (رفع) those needs. This section will focus on those tests used most commonly in the evaluation of auditory function. This battery (مجموعه) of tests includes pure-tone audiometry, speech audiometry, and acoustic immittance measures.

Before the audiologic evaluation begins, the audiologist obtains (بدست آوردن) a history from the client. For adults, this history may be supplied (ارائه کردن) by completing a printed form prior (قبل از) to the evaluation. The form contains pertinent (مرتبط) identifying information for the client such as home address, social security number, and referral (ارجاع) source. Questions regarding (در نظر گرفتن) the nature of past and present hearing problems, other medical problems, and prior use of amplification are also usually included. The written responses are then

followed up during an interview between the audiologist and the client prior to any testing.

For children, the case history form is usually more comprehensive than the adult version. In addition to questions such as were mentioned for adults, detailed questions about the mother's pregnancy and the child's birth are included. The development of gross and fine motor skills and the development of speech and language are also probed. The medical history of the child is also reviewed in detail, with special emphasis on childhood diseases (measles, mumps, etc) capable of producing a hearing loss.

Pure-Tone Audiometry

Pure-tone audiometry represents the basis of a hearing evaluation. With pure-tone audiometry, hearing thresholds are measured for pure tones at different test frequencies. Hearing threshold is typically defined as the lowest (softest) sound level needed for a person to detect the presence of a signal approximately 50% of the time. Threshold information at each frequency is then plotted on a graph known as audiogram. Before examining the audiogram, however, we shall describe the equipment used to measure hearing.

The Audiometer

An audiometer is the primary instrument used by the audiologist to measure hearing threshold. Types of audiometers vary from the simple, inexpensive screening devices used in schools and public health programs to the more elaborate and expensive diagnostic audiometers found in hospitals and clinics. Certain basic components, however, are common to all audiometers. An example of one of these basic units is shown in Figure 5-1. A frequency selector dial provides for the selection of different pure-tone frequencies. Ordinarily these frequencies are available at octave intervals ranging from

قطع کننده
125 to 8000 Hz. An interrupter switch or presentation button provides the
قابلیت، توانایی
capability of presenting the tone to the listener. A hearing level dial controls the intensity of the signal. Most audiometers have the capacity to deliver
گستردگی
signals spanning a 100-dB range in 5-dB steps. An output selector determines whether the pure tone will be presented to the earphones for air conduction testing (for either the right or left ear), or whether the tone is to be sent to a bone vibrator for bone conduction testing. Many audiometers also have a masking level dial, which controls the intensity of the masking noise presented to the nontest ear when masking is necessary. The more elaborate diagnostic audiometers not only can generate masking noise and pure-tone signals but also provide a
ابزاری
means for measuring the understanding of speech signals.

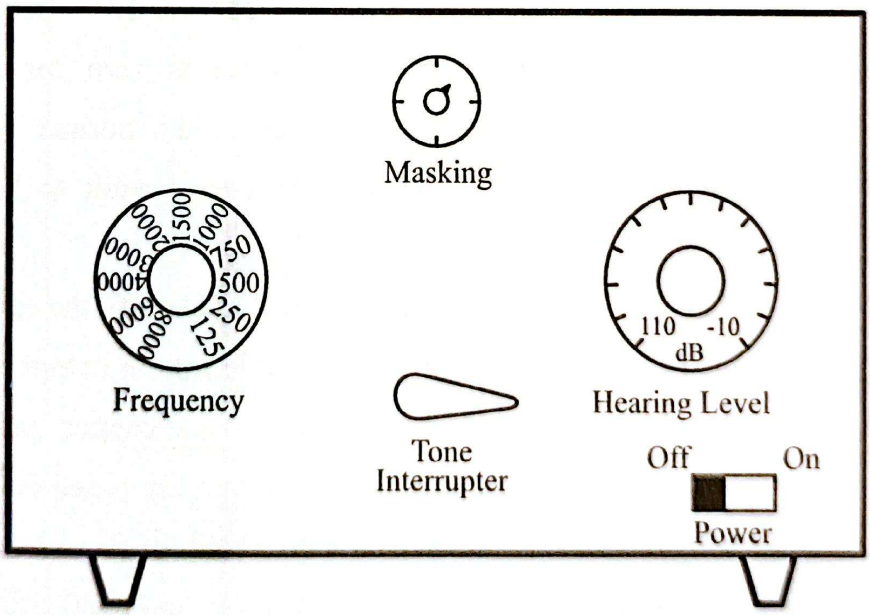


Figure 5-1. Representation of the basic components seen on the control panel of a pure-tone audiometer.

The Audiogram

نمودار
The audiogram is a chart used to record graphically the hearing thresholds
مرتبط
and other test results. An example of an audiogram and the associated symbol system recommended by the American Speech-Language-Hearing

نشان دادن شرح دادن

Association is illustrated in Figure 5-2. The audiogram is shown in graphic form, with the signal frequencies (in Hertz) displayed on the x axis and hearing level (in decibels) represented on the y axis. The graph is designed in such a manner that 1 octave on the frequency scale is equal in size to 20 dB on the hearing level scale.

محور

به گونه ای، به روشی

The horizontal line at 0 dB hearing level (HL) represents normal hearing sensitivity for the average young adult. However, the human ear does not perceive sound equally well at all frequencies. Recall that the ear is most sensitive to sound in the intermediate-frequency region from 1000 to 4000 Hz and is less sensitive at both the higher and lower frequencies. Greater sound pressure is needed to elicit a threshold response at 250 Hz than at 2000 Hz in normal ears. The audiometer is calibrated to correct for these differences in threshold sensitivity at various frequencies. Consequently, when the hearing level dial is set at zero for a given frequency, the signal is automatically presented at the normal threshold sound pressure level required for the average young adult to hear that particular frequency.

درک کردن

در نتیجه

Results plotted on the audiogram can be used to classify the extent of a hearing handicap. This information plays a valuable role in determining the habilitative or rehabilitative needs of a hearing-handicapped individual. Classification schemes using the pure-tone audiogram are based on the fact that there is a strong relationship between the threshold for those frequencies known to be important for hearing speech (500, 1000, and 2000 Hz) and the lowest level at which speech can be recognized accurately 50% of the time. The latter measure is generally referred to as the **speech recognition threshold**, or **SRT**. Given the pure-tone thresholds at 500, 1000, and 2000 Hz, the hearing loss for speech and the potential handicapping effects of the impairment can be estimated. This is done by simply calculating the average (mean) loss of hearing for these three frequencies. This average is referred to

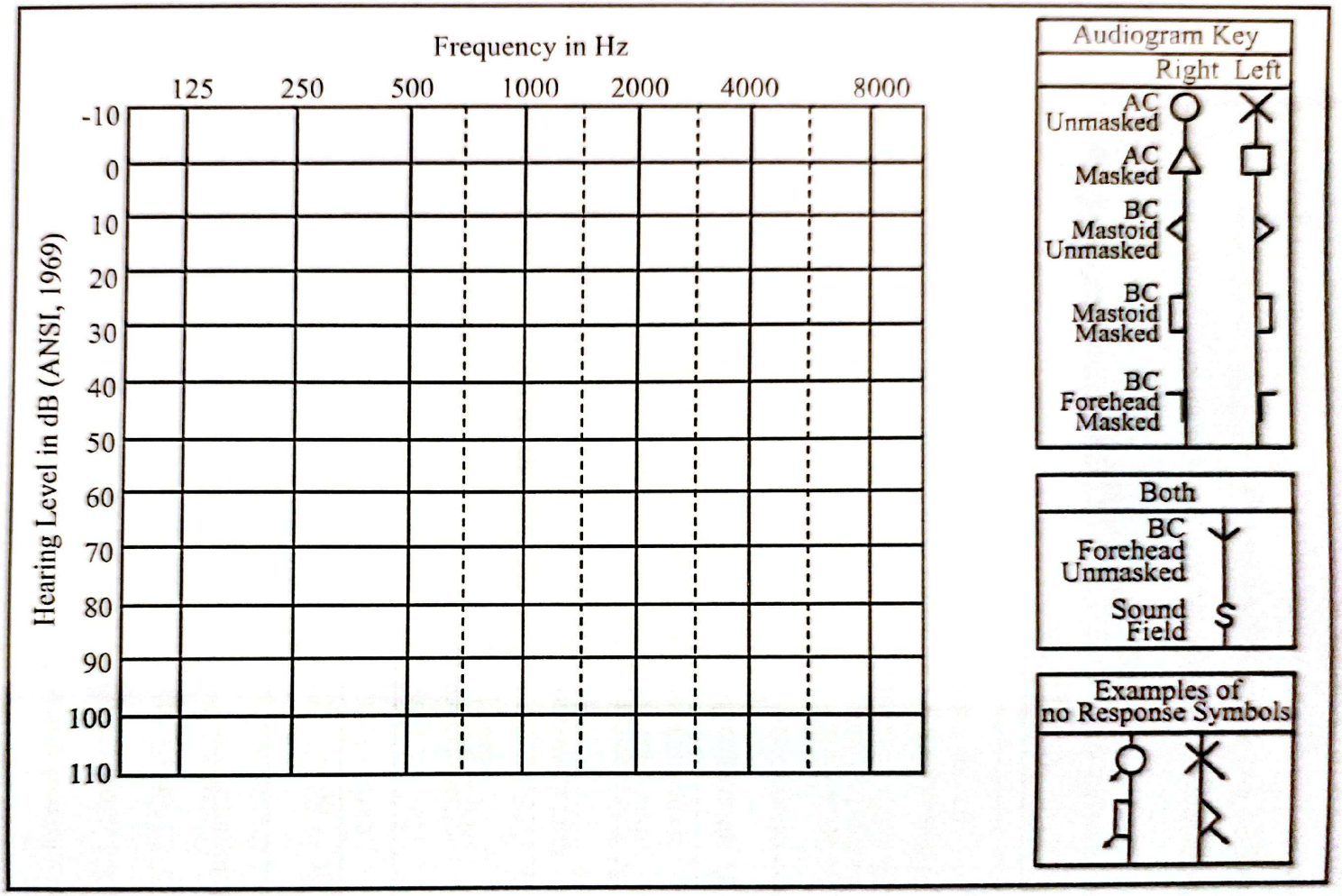


Figure 5-2. *Left,* audiogram used for plotting pure-tone air and bone conduction thresholds. *Right,* the *Audiogram Key* displays the symbols commonly used in audiograms. *AC,* air conduction; *BC,* bone conduction.

as the **three-frequency pure-tone average**. An example of a typical classification system based on the pure-tone average is shown in Figure 5-3. This scheme, adapted from several other systems, reflects the different classifications of hearing loss as well as the likely effects of the hearing loss on an individual's ability to hear speech. The hearing loss classes, ranging from mild to profound, are based on the pure-tone average at 500, 1000, and 2000 Hz. The classification of normal limits extends to 25 dB HL, and hearing levels within this range have typically been thought to produce

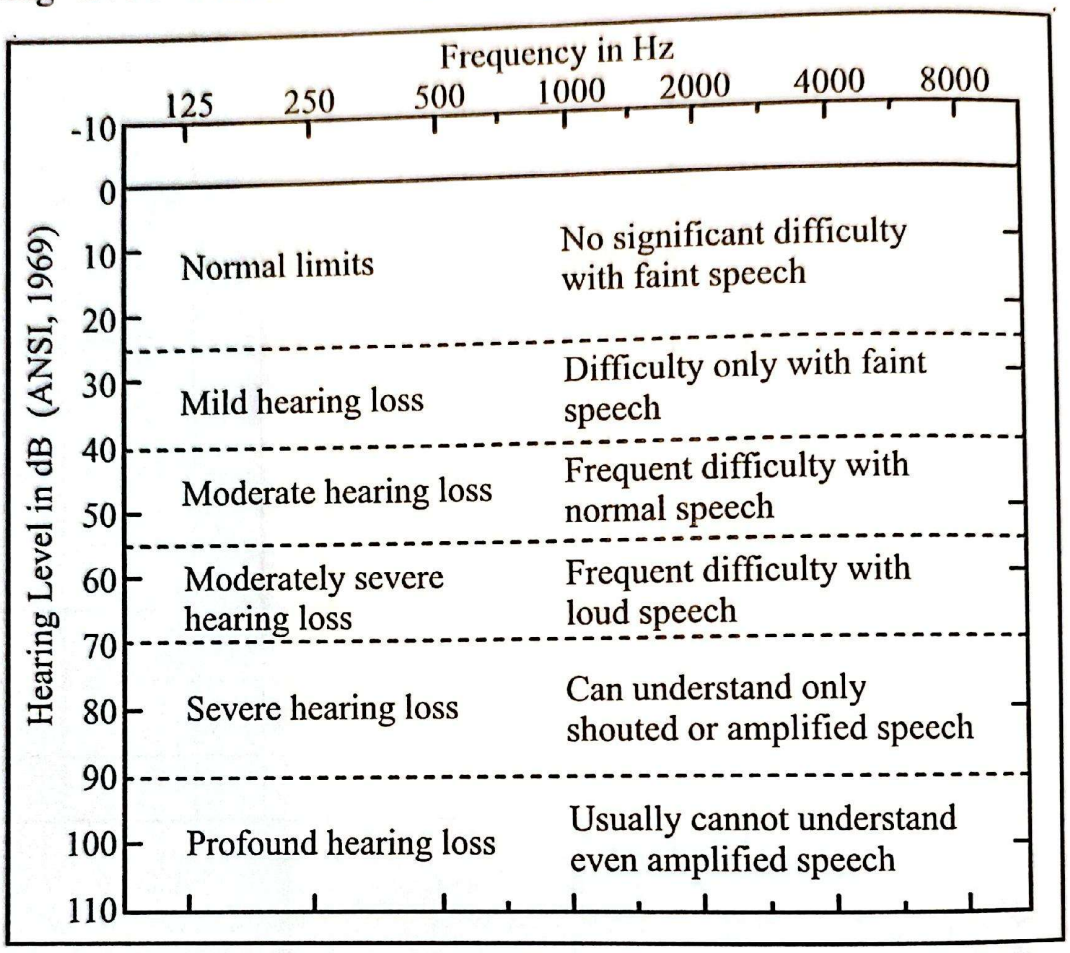


Figure 5-3. Classification of hearing impairment in relation to handicap for speech recognition.

essentially no problems with even faint speech. Some evidence indicates that any loss from 15 to 25 dB HL, however, can have negative effects educationally on children.

Bess & Humes (1999)

Part I. Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

....T.... 1. The location of the lesion within the auditory system has an impact on auditory impairment.

...F.... 2. Case history should be taken following any kind of audiologic evaluation.

....T.... 3. There are more details in the case history form for children than that of adults.

....T.... 4. In an audiometer the intensity of the signal is controlled by a hearing level dial.

...F.... 5. The human ear distinguishes sound equally well at all frequencies.

...T.... 6. Results plotted on the audiogram are used to categorize the extent of a hearing handicap.

...T.... 7. The highest sensitivity of the ear to sound is in the intermediate-frequency region.

..F..... 8. Children with any loss from 15 to 25 dB HL will be affected educationally.

...T.... 9. Hearing levels up to 25 dB HL are considered normal.

....F... 10. Children whose hearing is within 15 to 25 dB HL will have problems with faint speech.

B. Choose a, b, c, or d which best completes each item.

1. The hearing evaluation plays an important role in determining the ..... .

a. factors that cause auditory impairment

b. factors that are dependent on auditory impairment

c. nature of auditory impairment

d. extent of physical capability of the patient

2. Questions regarding the nature of the past and present hearing problems ..... .

a. are asked after the audiologic evaluation begins

b. are exclusively asked in an interview between the audiologist and the client

c. are used mostly if there is a medical problem

d. help the audiologist to find more information about adult clients

3. The childhood diseases ..... .

a. are the main causes of hearing loss

b. can cause a hearing loss but are ignored by the audiologist

c. may be the possible cause of a hearing loss

d. will not be considered as a potential cause of a hearing loss

4. It is stated in the text that ..... .

a. pure-tone audiometry represents the highest sound level needed for a person to detect the noise

b. an audiogram is an equipment used to measure hearing

c. the audiogram is a graphical plot showing threshold information at each frequency

d. in pure-tone audiometry the patient is able to detect the signal 50% of the time

5. Some complicated and detailed diagnostic audiometers ..... .

a. can measure the understanding of speech signals but are not used to generate masking noise and pure-tone signals

b. are used as a means of measuring the understanding of speech signals as well as generating masking noise

c. are merely a means of measuring the understanding of speech signals

d. neither generate masking noise nor measure the understanding of speech signals

6. The human ear ..... .

a. has the highest sensitivity at frequencies higher than 4000 Hz

b. does not perceive sound in the intermediate-frequency region

c. has the least sensitivity in frequencies between 1000 and 4000 Hz

d. is less sensitive at frequencies lower than 1000 Hz and higher than 4000 Hz

7. All types of audiometers ..... .

a. have exactly the same parts and components

b. measure the recognition of speech signals

c. are common in some of their basic components

d. are inexpensive screening devices used in different places

8. It is stated in the last paragraph that ..... .

a. there is a relationship between SRT and thresholds of important frequencies for hearing speech

b. the frequencies of 500, 1000, and 2000 Hz are the lowest level at which speech can be recognized

c. estimation of the loss of hearing for the frequencies of 500, 1000, and 2000 Hz is referred to as PTA

d. loss of speech recognition is associated with loss of hearing at the frequencies of 500, 1000, and 2000 Hz is an indication of loss of speech recognition

C. Answer the following questions orally.

1. What dose the nature of auditory impairment depend on?
2. How can the degree of hearing loss be determined?
3. What is a typical definition for hearing threshold?
4. What are the basic components in all audiometers?
5. What is the use of an audiogram?
6. How is the graph in an audiogram designed?
7. How dose the sensitivity of the human ear vary with different sounds?

8. How is it possible to determine the habilitative and rehabilitative needs of hearing-handicapped individuals?
9. What does the speech recognition threshold (SRT) refer to?
10. What does the three-frequency pure-tone average refer to?

Part II. Language Practice

A. Choose a, b, c, or d which best completes each item.

1. The ..... of the injury caused the old man undergo an operation.
   a. lesion
   b. possibility
   c. severity
   d. history
2. The physician gave a very ..... explanation of his/her method of treatment.
   a. expensive
   b. comprehensive
   c. conductive
   d. habilitative
3. The instructor gave some comments ..... to the subject we were discussing.
   a. detailed
   b. equal
   c. presented
   d. pertinent
4. The ability to control the apparent cues ..... by one's facial expressions is a valuable clinical skill when dealing with patients who have a functional hearing loss.
   a. provided
   b. classified
   c. recognized
   d. estimated
5. Otitis media can take on several forms depending on such factors as the ..... and time course of the disease.
   a. impairment
   b. measurement
   c. development
   d. placement
6. The smallest ..... of a sound that a person needs to detect its presence is called his/her threshold for that sound.

a. dependence b. intensity

c. capacity d. range

7. There are always some ..... clues that can lead to the diagnosis of the disease.

a. completing b. hearing

c. including d. identifying

8. The cost of hearing-handicapped individuals for society can be ..... .

a. estimated b. calibrated

c. intermediated d. adapted

B. Fill in the blanks with the appropriate forms of the words given.

1. sense

a. The ability of a screening test to identify accurately an ear that is abnormal is referred to .....sensitivity

b. Normally the human ear is not equally .....sensitive to sound at all frequencies.

c. The ear responds to sound .....sensitively in the intermediate-frequency region.

d. Even a very .....sensitive screening test would be useless if it is failed by too many people who are normal.

2. determine

a. In hearing aid selection, the kind of hearing aid evaluation procedure is .....determined by the audiologist.

b. The .....determination of the degree of hearing loss is done by audiometric measurement of auditory function.

c. It should be considered if cost and effectiveness are .....determining factors in applying screening programs for all neonates in the world.

d. The main determinant of diagnostic success was the audiologist's knowledge and experience.

3. locate

a. The forehead is a common location for placement of the bone vibrator.

b. When a person exhibits a hearing loss by air conduction, it is impossible to localize the pathology in the auditory pathway.

c. The physician is trying to localize the lesion along the nervous system.

d. localization of the pain within the auditory system is an important procedure.

4. diagnose

a. diagnostic audiology tries to detect all or most auditory pathologies.

b. Audiology is a helping profession, concerned with prevention, diagnosis, and rehabilitation of auditory problems.

c. The physician diagnosed the tumor as benign.

d. The differential diagnosis for a patient with unilateral sensorineural hearing loss varies from that of a bilateral sensorineural loss.

5. represent

a. Information shown in the neural code from one ear has multiple representations at various locations within the auditory system.

b. Many representatives of different medical associations were present in the congress.

c. Air conduction thresholds represent the integrity of the total peripheral auditory mechanism.

d. Is a questionnaire answered by 500 people truly representative of national opinion?

6. affect

a. Little is known about the effects of elevated perilymphatic pressure on the function of the ear.

b. Meniere's disease is the most common disease that may ..affect.. the function of the cochlea.

c. Aging can effectively ..... influence the individual's hearing.

d. effective ..... masking refers to a condition in which noise is just sufficient to mask a given signal when the signal and noise are presented to the same ear simultaneously.

7. communicate

a. Language is the primary means by which humans communicate ..... with one another.

b. Speechreading refers to the ability of a person to use vision as a supplement to audition when ..communicating.....

c. There are different communicative ..... modes used in educational instruction.

d. The patient does not seem very communicative ....., he is not willing to talk and give information.

8. measure

a. It is usually assumed that pure-tone audiograms are accurate measures ..... of conductive hearing loss.

b. The amplitude of a sound wave is expressed as sound pressure which is due to the fact that most measuring ..... devices are pressure detectors.

c. Microphones, sound level meters and oscilloscopes are some of the basic tools used in the measurement ..... of sound.

d. There has been a measurable ..... improvement in his health.

C. Fill in the blanks with the following words.

initial آغازین	instructing آموزش دادن	measurements	noise
responding	carefully	interfere دخالت کردن	tone
matter	inaudible	intervals فواصل	raising

The hearing examination is generally conducted in a sound-treated

room where noise levels are kept at a minimum and do not interfere with or influence the hearing test results. Pure-tone audiometry begins with air conduction measurement at octave intervals ranging from 125 or 250 Hz to 8000 Hz; these are followed by bone conduction measurements at octave intervals ranging from 250 to 4000 Hz. (Air conduction measurements at 125 Hz are optional. Some audiometers do not include this frequency.) The initial step in measuring threshold involves instructing the patient as to the listening and responding procedures. The listener is instructed to respond to the pure-tone signals no matter how soft they might be, to respond as soon as the tone is heard, and to stop responding when the sound becomes inaudible. The most common form of response is merely raising or lowering the forefinger. Earphones should be placed carefully and snugly on the patient's head so that the signal source is directed toward the opening of the ear canal.

D. Put the following sentences in the right order to form a paragraph. Write the corresponding letters in the boxes provided.

a. Such services can usually be obtained at a university hearing clinic or at the manufacturer's distributorship.

b. Like all pieces of electronic equipment, the audiometer is subject to malfunction, especially with extensive usage.

c. It is critical that the audiometer be handled carefully to ensure reliable results.

d. Audiometers should be checked electroacoustically and biologically (listening checks) on a periodic basis.

1	2	3	4
b	c	d	a

Measurement of Hearing

In pure-tone audiometry, thresholds are obtained by both air conduction and bone conduction. In air conduction measurement, the different pure-tone stimuli are transmitted through earphones. The signal travels through the ear canal, across the middle ear cavity via the three ossicles to the cochlea, and on to the auditory central nervous system. Air conduction thresholds reflect the integrity of the total peripheral auditory mechanism. When a person exhibits a hearing loss by air conduction, it is not possible to determine where along the auditory pathway the pathology is located. The hearing loss could be the result of either: (a) a problem in the outer or middle ear; (b) a difficulty at the level of the cochlea; (c) damage along the neural pathways to the brain; or (d) some combination of (a), (b), or (c). When air conduction measurements are used in combination with bone conduction measurements; however, it is possible to differentiate between outer ear and middle ear problems (conductive hearing loss) and inner ear problems (sensorineural hearing loss).

In bone conduction measurement, signals are transmitted by means of a bone vibrator that is usually placed on the mastoid prominence of the skull (a bony prominence located behind the pinna, slightly above the level of the concha). The forehead is another common position for placement of the bone vibrator. A signal transduced through the vibrator causes the skull to vibrate. The pure tone directly stimulates the cochlea, which is embedded in the skull, effectively bypassing the outer ear and middle ear systems. If an individual exhibits a reduction in hearing sensitivity when tested by air conduction yet shows normal sensitivity by bone conduction, the impairment is probably due to an obstruction or blockage of the outer or middle ear. This

condition is referred to as a **conductive hearing loss**. An audiometric example of a young child with a conductive hearing loss due to middle ear disease is shown in Figure 5-4. The bone conduction thresholds (*[*, right-ear thresholds; *]*, left-ear thresholds) appear close to 0 dB HL for all test frequencies. Such a finding implies that the inner ear responds to sound at normal threshold levels. The air conduction thresholds (*0-0*, right ear; *X-X*, left ear), on the other hand, are much greater than 0 dB HL. Greater sound intensity is needed for this child to hear the air-conducted pure-tone signals than is required by the average normal hearer. Since the bone conduction thresholds suggest that the inner ear is normal, the loss displayed by air conduction must result from a conductive lesion affecting the outer or middle ear.

The difference between the air conduction threshold and the bone conduction threshold at a given frequency is generally referred to as the **air-bone gap**. In Figure 5-4, for example, at 250 Hz there is a 30-dB air-bone gap in the right ear and a 40-dB gap in the left ear. Conductive hearing loss is especially prevalent among preschool and young school-age children who experience repeated episodes of otitis media (middle ear infection). Other examples of pathologic conditions known to produce conductive hearing loss include congenital atresia (absence of ear canals), blockage or occlusion of the ear canal, perforation or scarring of the tympanic membrane, ossicular chain disruption, and otosclerosis.

As we noted, hearing thresholds better than a hearing level of 25 dB HL are considered normal. Air-bone gaps of 10 dB or more, however, represent a significant conductive hearing loss and may require medical referral, even if the air conduction thresholds are less than 25 dB at all frequencies.

A sensorineural hearing loss is suggested when the air conduction thresholds and bone conduction thresholds are approximately the same (±5 dB) at all test frequencies. The cause of a sensorineural hearing impairment may be either congenital or acquired. Some of the congenital causes include

heredity, complications of maternal viral and bacterial infections, and birth trauma. Factors producing acquired sensorineural hearing loss include noise, aging, inflammatory diseases (measles, mumps, etc) and ototoxic drugs (e.g. aminoglycoside antibiotics).

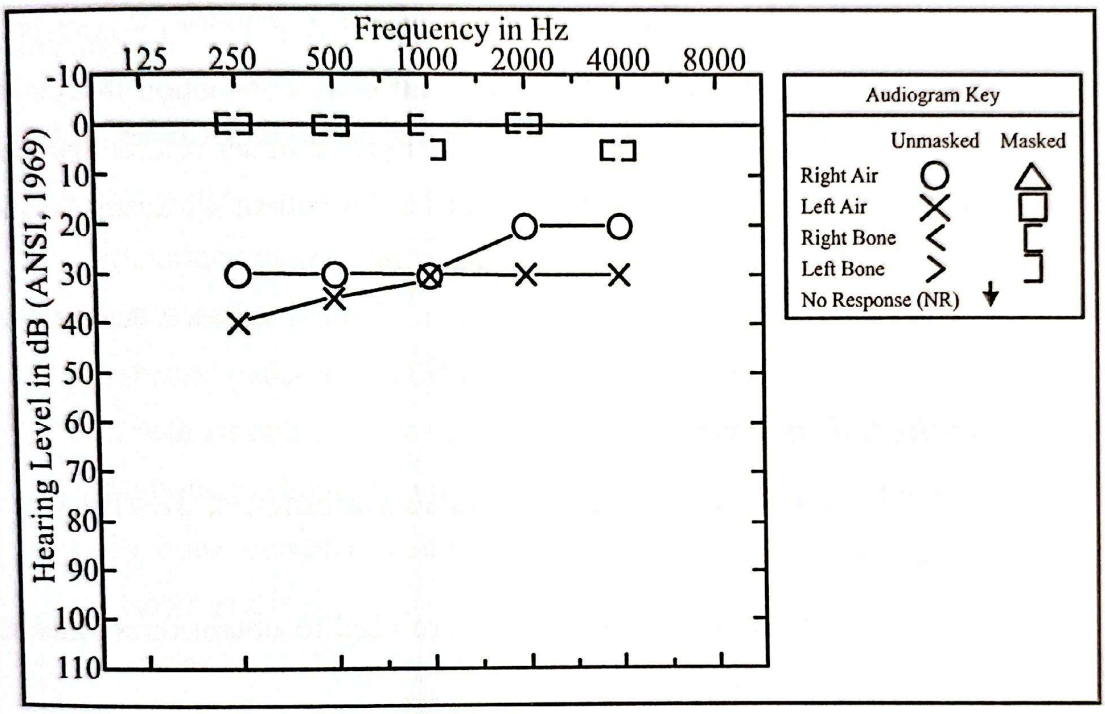


Figure 5-4. Pure-tone audiogram demonstrating the relation between air and bone conduction thresholds typifying mild conductive hearing impairment.

The majority of sensorineural hearing losses are characterized by audiometric configurations that are flat, trough-shaped, or slightly to steeply sloping in the high frequencies. The latter is probably the most common configuration associated with acquired sensorineural hearing loss. Occasionally, however, patients display a sensorineural hearing loss in which the greatest hearing loss occurs at low and intermediate frequencies, with normal or near-normal hearing sensitivity at the high frequencies.

Young children whose audiograms display the low-frequency hearing impairment are difficult to identify and are sometimes the unfortunate

victims of misdiagnosis. Because of their near-normal hearing sensitivity in the high frequencies, these children may respond to whispered speech and broad-band stimuli at low intensity levels. In addition, unlike children with a high-frequency hearing loss, their articulation of speech is usually good. These manifestations are not typical of sensorineural hearing loss in children which makes them more prone to misdiagnosis.

When both air conduction thresholds and bone conduction thresholds are reduced in sensitivity but bone conduction yields better results than air, the term **mixed hearing loss** is used. That is, the patient's hearing loss is partially conductive and partially sensorineural in nature.

Bess & Humes (1999)

Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

..... 1. Both air and bone conduction are used to obtain thresholds in pure-tone audiometry.

..... 2. Locating the pathology along the auditory pathway is easily done when air conduction reveals a hearing loss.

..... 3. In bone conduction measurement, the bone vibrator is always placed on the mastoid prominence of the skull.

..... 4. Obstruction or blockage of the outer or middle ear causes a conductive hearing loss.

..... 5. The difference between the air conduction threshold and that of the bone at a given frequency is called the 'air-bone gap'.

..... 6. Otosclerosis is a pathologic condition which produces conductive hearing loss.

..... 7. If the air conduction thresholds are less than 25 dB and air-bone gap more than 10 dB, the hearing is considered normal.

..... 8. Inflammatory diseases are some of the congenital causes of sensorineural hearing impairment.

..... 9. Slightly to steeply sloping is the most common configuration indicating a conductive hearing loss.

..... 10. The articulation of speech of those children with a high-frequency hearing loss is not usually good.

B. Choose a, b, c, or d which best completes each item.

1. In order to distinguish between conductive hearing loss and sensorineural hearing loss, ...
   a. air conduction measurements should be used
   b. neural pathways to the brain should be tested
   c. both air and bone conduction measurements are used
   d. attention should be paid to inner ear problems
2. In bone conduction measurement the bone vibrator is commonly placed on the ..... .
   a. pinna
   b. forehead
   c. pinna or forehead
   d. forehead or mastoid prominence
3. Conductive hearing loss will be diagnosed if ..... .
   a. there is a reduced sensitivity after air conduction and bone conduction testing
   b. hearing sensitivity increases in bone conduction testing
   c. air conduction testing shows a decrease in sensitivity but in bone conduction testing the sensitivity is normal
   d. there is a reduction in hearing sensitivity when tested by bone conduction but air conduction shows a normal sensitivity
4. In a child with conductive hearing loss due to middle ear disease ..... .

a. greater sound intensity is needed to hear the air-conducted pure-tone signals in comparison with normal individuals

b. the inner ear does not respond to sound at normal threshold levels

c. a conductive lesion that affects the outer or middle ear causes the abnormality of the inner ear

d. air conduction thresholds display a loss as a result of inner ear abnormality

5. Young children with frequent middle ear infection are more prone to ……. .

a. mixed hearing loss

b. conductive hearing loss

c. otosclerosis

d. sensorineural hearing loss

6. ……. is one of the most frequent audiometric configurations suggesting acquired sensorineural hearing loss.

a. Flat-shaped in the high frequencies

b. Near-normal-shaped

c. Trough-shaped

d. Sloping shaped in the high frequencies

7. Children with low-frequency hearing impairment ……. .

a. do not have a good articulation of speech in comparison with children with a high-frequency hearing loss

b. have difficulty identifying broad-band stimuli at low intensity levels

c. may respond to whispered speech but are poor in their articulation of speech

d. whose hearing sensitivity in the high frequencies are near-normal cannot be diagnosed easily

8. In mixed hearing loss ……. .

a. both air and bone conduction thresholds are equally reduced in sensitivity

b. although there is a reduction in sensitivity of air and bone conduction, the patient's hearing loss is sensorineural in nature

c. bone conduction sensitivity is better than air conduction leading to a better result in bone conduction test

d. the patient's hearing loss is more sensorineural in nature than conductive

C. Write answers to the following questions.

1. What is the process of signal transmission in air conduction measurement?
2. Which condition is referred to as conductive hearing loss?
3. What does the term 'air-bone gap' refer to?
4. Which thresholds are considered normal?
5. When is a sensorineural hearing loss suggested?
6. Can you name some of the congenital causes of the sensorineural impairment?
7. What audiometric configurations are the characteristics of sensorineural hearing loss?
8. When is the term 'mixed hearing loss' used?

* * *

Section Three: Translation Activities

A. Translate the following passage into Persian.

Testing Children 2 to 5 Years Old

When the child reaches 2-5 years of age, he/she has matured sufficiently to

permit more structured procedures to be used in the hearing evaluation. Those techniques used most frequently are conditioned play audiometry, tangible reinforcement operant conditioning audiometry (TROCA) or visual reinforcement operant conditioning audiometry (VROCA), and conventional (hand-raising) audiometry.

Conditioned play audiometry is the most well-accepted procedure for measuring the hearing thresholds of infants in this age group. The child participates in some form of play activity (e.g. placing a ring on a cone, putting blocks in a box, placing pegs in a hole) each time the signal is heard. The play activity serves as both the visible response for the clinician and the reinforcement for the child. Usually, social reinforcement also accompanies an appropriate response. The child is prevented from playing the game if an inappropriate response is made. The evaluation consists of a conditioning period in which the child is trained to perform the play activity in response to the delivery of a sound stimulus that is clearly audible. This is then followed by a threshold-seeking period. The technique may be employed in a sound-field condition or with earphone and bone conduction measurements. The application of play audiometry is limited to youngsters above the age of 2 years and those children who are not multiply handicapped.

Tangible reinforcement operant conditioning audiometry is a highly structured test procedure that was introduced originally as a means of assessing the hearing sensitivity of mentally retarded children. Although TROCA test procedures vary somewhat from clinic to clinic, the basic principle is that a tangible material, such as candy or trinkets (reinforcer), is automatically dispensed if the child depresses a button when a tone is perceived. If an inappropriate response is made, the child does not receive the reinforcement. TROCA incorporates specialized instrumentation that electromechanically controls the stimulus presentation, monitors the responses, and dispenses the tangible reinforcers.

B. Find the Persian equivalents of the following items and write them in the spaces provided.

1. air-bone gap .....
2. amplification .....
3. auditory impairment .....
4. broad-band stimuli .....
5. concha .....
6. congenital atresia .....
7. frequency scale .....
8. gross and fine motor skills .....
9. hearing level (HL) .....
10. hearing threshold .....
11. intermediate frequencies .....
12. interrupter switch .....
13. interval .....
14. mastoid prominence .....
15. maternal rubella .....
16. mild .....
17. ossicular chain disruption .....
18. otosclerosis .....
19. output selector .....
20. pinna .....
21. scarring of the tympanic membrane .....
22. selector dial .....
23. severity .....
24. speech recognition threshold (SRT) .....

Unit 6

Section One: Reading Comprehension

Speech Audiometry

As the principal (اصلی) avenue (راه) of human communication (ارتباط) and interaction (تعامل), it is clear that speech is the most important signal we hear. Consequently (در نتیجه), the pure-tone audiogram provides only a partial (جزئی) picture of the patient's auditory status (وضعیت) because it does not give any direct information about his/her ability to hear and understand speech. To find out how a patient hears speech involves (شامل) testing him/her with speech stimuli, and this process is called **speech audiometry**.

The instrument used for speech audiometry is the **speech audiometer**. Although devices designed specifically for speech audiometry were used in the past, this function is now incorporated into general-purpose clinical audiometers. The **speech mode** (or the **speech channel**) of the clinical audiometer includes the following components: (1) various sources of recorded speech material such as a tape deck, compact disk (CD) player, or even a computer; (2) a microphone for live-voice testing; (3) an input selector to choose the desired source of the speech material; (4) an input level control, which is used with a VU (Volume Unit) (حجم سنج صدا) meter to ensure that the speech signals are at the levels necessary for them to be properly calibrated; (5) an attenuator to control the level of speech being presented to the patient; (6) an output selector to direct the speech stimuli to the desired output transducer; and (7) output transducers (earphones, loudspeakers, bone

vibrator). These components are illustrated in Figure 6-1. In addition, there

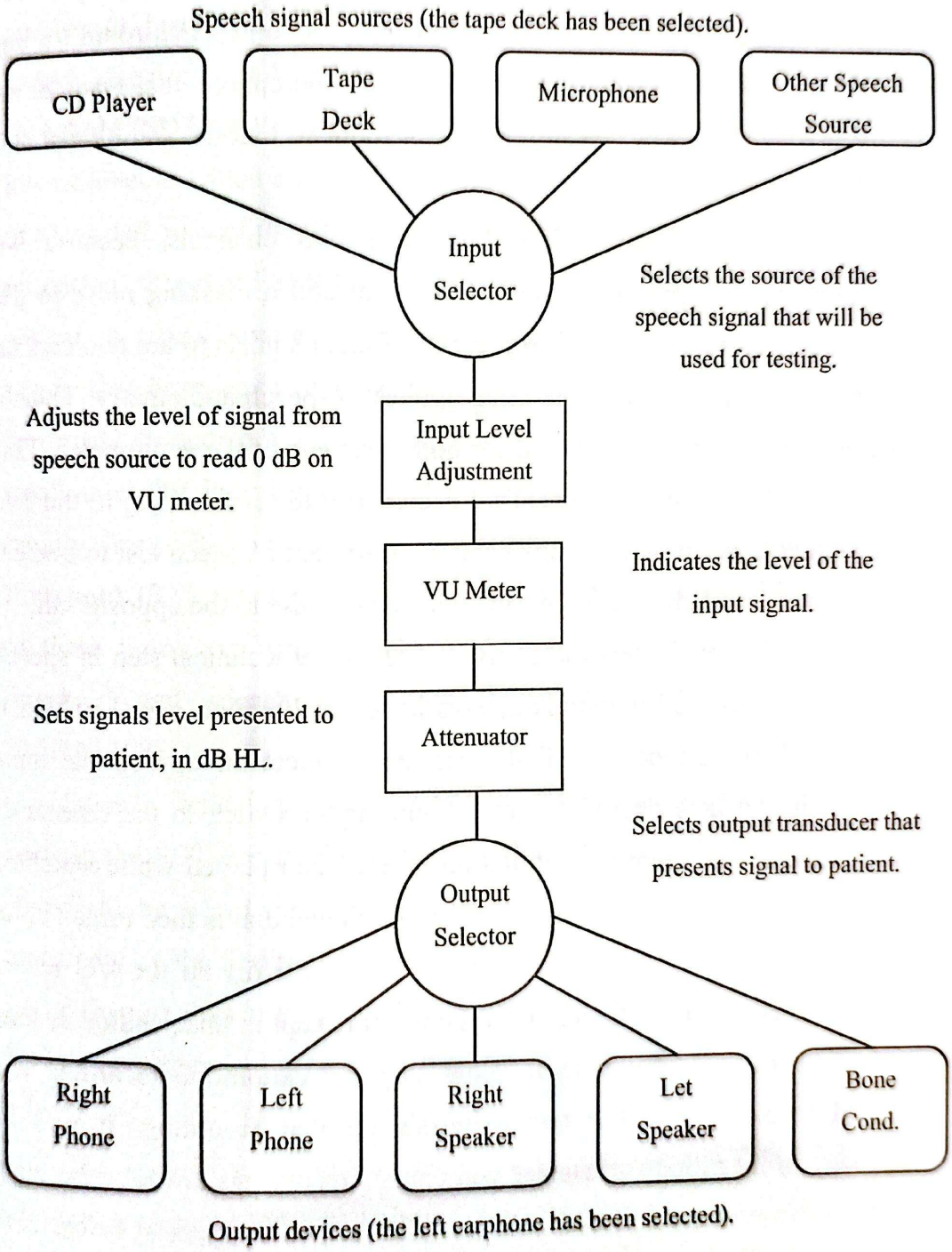


Figure 6-1. Block diagram of the speech mode (channel) of a clinical audiometer. In this example the audiologist is using recorded speech from the tape deck and is presenting that signal to the patient via the left earphone.

is a monitor earphone and/or loudspeaker (and level adjustment) to enable the audiologist to hear the speech signals that are being presented to the patient. Because speech audiometry is generally done in a two-room testing environment, there is also a patient (response) microphone that leads to an earphone and/or loudspeaker in the control room so that the audiologist can hear the patient's responses.

Recall that clinical audiometers have two channels, because we sometimes need to present a signal to one ear and a masking noise to the opposite ear, or we might need to present different signals to the two ears on certain kinds of tests. The same thing applies to speech audiometry. Thus, a separate speech mode is provided for both channels of the audiometer. This allows us to send speech signals (not necessarily the same ones) to the two ears. Similarly, we might use one channel to present a speech test to one ear and use the second channel to present a masking noise to the opposite ear.

Calibration of the test materials is a necessary technical step in speech audiometry. Recorded materials always have a calibration signal, which is usually a 1000-Hz tone. The first steps are to select the appropriate input device (e.g. the tape deck) and set the interrupter switch to the constantly "on" position. The recorded calibration tone is then played while watching the level indicated on the VU meter. The input level dial is then turned up or down until the level of the calibration tone is at 0 dB on the VU meter. That's all there is to it. The input level control is kept in this position as long as this recording is being used. Now stop the calibration recording and proceed to administer the test materials on that recording. It will be necessary to recalibrate whenever you change recordings or move the input level dial. In practice it is desirable to calibrate the test material before each use.

Thresholds for Speech

The threshold of a nonspeech signal such as a tone has a clear meaning; it is

the level at which the presence of the sound is just audible. However, the threshold for speech can mean the lowest level at which speech is either just audible or just intelligible. The lowest level at which the presence of a speech signal can be heard 50% of the time is called the **speech detection threshold (SDT)** or the **speech awareness threshold (SAT)**. In contrast, the lowest level at which a speech signal is intelligible enough to be recognized or identified 50% of the time is the **speech recognition threshold** or **speech reception threshold (SRT)**. The SRT is usually obtained by asking the patient to repeat **spondee (or spondaic) words**, which are two-syllable words that have equal emphasis on both syllables such as "baseball" or "railroad." Spondaic words lend themselves well to this use, because a very small intensity increase causes the recognition of spondees to rise very rapidly from 0% to 100%. The SRT has also been called the **spondee threshold (ST)** when measured with spondaic words (ASHA, 1979). All of these terms are readily understood in the field, but speech detection threshold and speech recognition threshold are the preferred usage (ASHA, 1988).

Speech detection and recognition thresholds should be different, because the SDT depends on audibility alone, whereas the SRT requires the stimuli to be heard and identified. This expectation has been borne out repeatedly by the finding that the average SDT tends to be roughly 7 to 9 dB lower (better) than the mean SRT. Cambron et al. (1991) found the mean SDT-SRT difference to be 8 dB for a male talker and 8.2 dB for a female talker.

The speech reception threshold has several clinical functions: (1) to serve as a measure for corroborating pure-tone thresholds, (2) to serve as a reference point for deciding on appropriate levels at which to administer supra-threshold speech recognition tests, (3) to determine hearing aid needs and performance, (4) to ascertain the need for aural (re)habilitation and progress in the management process, and (5) to determine hearing sensitivity

for young children and others who are difficult to test. The speech detection threshold is generally used when an SRT is not obtainable.

Gelfand (2001)

Part I. Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

..... 1. The pure-tone audiogram provides direct information about the patient's ability to hear and understand speech.

..... 2. Speech audiometry is used to find out how a patient hears speech.

..... 3. Both clinical audiometers and speech audiometers have two channels.

..... 4. Calibration of the test materials is an arbitrarily technical step in speech audiometry.

..... 5. It is a must to calibrate the test material before each use.

..... 6. The lowest level at which speech is audible or intelligible is called the threshold for the speech.

..... 7. When the SRT is used for measuring spondaic words, it is called the "ST".

..... 8. The mean SDT-SRT difference is the same for male and female talkers.

..... 9. Speech detection and recognition thresholds may be different.

..... 10. When an SRT is not obtainable, the SDT is usually used.

B. Choose a, b, c, or d which best completes each item.

1. In paragraph 1 the writer mostly talks about ..... .

a. the role of speech in human interactions

b. the main way of reaching a desired result in human communication

c. how an individual hears speech

d. the role of the pure-tone audiogram in depicting a patient's auditory status

2. 'It' in paragraph 1, line 4 refers to ..... .

a. the patient's auditory status
b. some direct information
c. a partial picture
d. the pure-tone audiogram

3. In paragraph 2 the ..... are mostly explained.

a. procedures for performing the clinical audiometers

b. components of the speech mode of the clinical audiometer

c. best places for performing speech audiometry

d. best methods used by an audiologist for hearing the patient's responses

4. The best topic for paragraph 4 is '.....' .

a. Calibrating the Test Signal(s)

b. How to Use the VU Meter

c. When to Calibrate the Test Material

d. Technical Steps in Speech Audiometry

5. The ..... is the level at which the presence of the sound is just audible.

a. speech detection threshold
b. speech awareness threshold
c. threshold for speech
d. threshold of a tone

6. When a patient repeats two-syllable words having the same emphasis on both syllables, the ..... is usually obtained.

a. threshold of a nonspeech signal
b. speech detection threshold
c. speech reception threshold
d. speech awareness threshold

7. Paragraph 6 mainly deals with the ..... .

a. definition of the SRT

b. definition of the SDT

c. differences between the SDT and SRT

d. similarities between the SDT and SRT

8. The best topic for the last paragraph is '.....' .
   a. Clinical Functions of the SDT
   b. Clinical Functions of the SRT
   c. How Can an SRT Be Used Instead of the SDT?
   d. When the SDT Can Be Used Instead of an SRT?

C. Answer the following questions orally.

1. What does the pure-tone audiogram provide?
2. What is the process of speech audiometry?
3. What are the components of the speech mode of the clinical audiometer?
4. What does the audiologist use to record the speech signals in Figure 6-1?
5. Why do clinical audiometers have two channels?
6. What is 'the threshold for speech'?
7. What are the differences between the SDT and SRT?
8. How can the SRT be obtained?
9. When is the SRT referred to as the ST?
10. Why should the SDT and SRT be different?
11. What are the main clinical functions of the SRT?
12. When is an SDT used instead of an SRT?

Part II. Language Practice

A. Choose a, b, c, or d which best completes each item.

1. A sociologist has studied the complex way in which people ..... each other at parties.
   a. recognize
   b. substantiate
   c. interact with
   d. adjust to
2. Many of your suggestions have been ..... in the new plans designed by experts.
   a. interested
   b. concerned
   c. engaged
   d. incorporated

3. Recent researches and experiments have ..... her predictions and increased the validity of her theories.

a. corroborated b. deteriorated

c. attenuated d. degraded

4. When all witnesses ..... what she had said, her innocence was proved.

a. identified b. dealt with

c. bore out d. manifested

5. Her voice was scarcely ..... above the noise of the wind, so I could not understand what she was talking about.

a. intensified b. aural

c. audible d. recalled

6. The two-syllable words having equal emphasis on both syllables are called ..... used for measuring the threshold for speech in some tests.

a. attenuators b. transducers

c. signals d. spondees

7. This hearing aid costs ..... $ 100; really I don't know its exact price.

a. readily b. roughly

c. originally d. specifically

8. This lecture would be ..... only to an expert in computing.

a. intelligible b. responsive

c. zealous d. irritable

9. They explored every ..... but could not find a solution for this financial problem.

a. loudspeaker b. transducer

c. vibrator d. avenue

B. Fill in the blanks with the appropriate forms of the words given.

1. apply

a. There were 250 ..... for this job.

b. Have you filled in the ..... form for a new passport?

c. Scientific advances are often ..... to industrial processes.

d. The questions in the second part of the form ..... only to married women.

2. aware

a. He is well ..... how risky this operation is.

b. He has always been a politically ..... person.

c. The speech ..... threshold is the lowest level at which the presence of a speech signal can be heard 50% of the time.

3. calibrate

a. This work is of a very high ..... .

b. Recorded materials always have a ..... signal.

c. Once ....., protect the tips of needles against dropping on the floor, sink, or bottom of bottles.

4. corroborate

a. Someone who saw the accident ..... the driver's statement.

b. To prove his innocence, his lawyer should offer some ..... evidence to the court.

c. The ..... of pure-tone thresholds can be provided when the speech reception threshold serves as a measure in our test.

5. interrupt

a. The calm of the night was ..... by a loud bang.

b. I am studying for a lecture tomorrow, so don't ..... me.

c. A lot of ..... have prevented me from finishing my job.

d. To calibrate the test materials in speech audiometry, the first steps are to select the appropriate input device and set the ..... switch to the constantly "on" position.

6. obtain

a. He said the police had ..... this information by illegal means.

b. Those conditions no longer ..... .

c. I am sorry sir, that type of car is no longer ..... .

7. repeat

a. History seems to be ..... itself.

b. I wish we could see more new movies on television, not ..... all the time.

c. His ..... speech bothers me.

d. This accident is a ..... of one that happened here three weeks ago.

8. refer

a. Let me just ..... to my notes to find the exact synonym of this word.

b. A list of ..... are written at the end of the article.

c. He introduced his ex-employer as his ..... .

d. The teacher often acts as a ..... for his pupils.

C. Fill in the blanks with the following words.

acceptable	children	level	live-voice
patients	presenting	recorded	time
typical	standardization		

Spondaic words may be presented to the patient using readily available recorded materials or by **monitored live voice,** which means the words are spoken into a microphone by the audiologist who monitors his/her voice level on the audiometer's VU meter. Recorded material is preferred for SRT testing, but ..... the stimuli by monitored live voice is also ..... . Compared to monitored live voice testing, ... materials provide much better control over the ..... and quality of the speech signals being

presented to the patient, as well as the obvious benefits of greater ..... On the other hand, the flexibility afforded by monitored ..... testing is often desirable or essential when testing ..... who require any kind of modification of the test procedure. ..... examples are elderly patients who might need more ..... to respond than is provided on the recording, ... or others with restricted vocabularies, etc. The need for flexibility is not limited to patients who have special needs.

D. Put the following sentences in the right order to form a paragraph. Write the corresponding letters in the boxes provided.

a. To express in other way, an open-set item is much like a fill-in question and a closed-set item is much the same as a multiple-choice question.

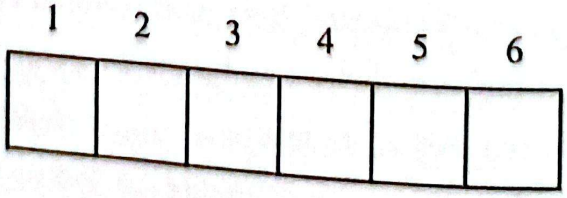
b. An open-set format means the patient must respond without any prior knowledge of what the possible alternatives might be.

c. In contrast, a closed-set format means the patient is provided with a choice of several possible response alternatives.

d. So, various different kinds of speech material were used for this purpose.

e. The most commonly used materials for clinical speech recognition testing are monosyllabic words that are presented in an open-set format.

f. Speech recognition tests were originally devised to assess the effectiveness of telephone and radio communication systems.



Comfortable and Uncomfortable Listening Levels for Speech

The **most comfortable loudness level (MCL)** for speech is the hearing level at which the patient experiences speech material to be most comfortable, that is, where he/she prefers to listen to speech material. The basic method used in MCL testing involves adjusting the hearing level of speech until the patient indicates that it is comfortably loud. "Continuous discourse" speech material is often used for obtaining the MCL, although spondees and sentences are also usable. The "continuous discourse" is usually a recorded selection of some prose material. Relatively uninteresting selections are used so that the patient can concentrate on the perceived level of the material without being distracted by its content. Continuous discourse material is also known as "cold running speech" for this reason.

As they try to find the MCL, new clinicians learn rather quickly that many patients seem "unreliable" or even "uncooperative" because they report comfortable loudness at several hearing levels. This experience is not an example of patients trying to give the audiologist a hard time. On the contrary, it demonstrates the important concept that the MCL is really *a range of levels* instead of *a level.*

The **uncomfortable loudness level (UCL)** for speech is the hearing level at which the patient considers speech material to be uncomfortably loud. The same kinds of materials used for measuring the MCL for speech are also applicable to the UCL. When testing for the UCL, it is important for the patient to understand that he/she should indicate when the experience of loudness becomes uncomfortable. This is an important distinction because we are interested in when the sound becomes uncomfortably loud rather than

the patient's capacity to endure pain. In other words, we are concerned with sound levels that begin to produce an uncomfortable *auditory* experience, as opposed to the *tactile* sensations (e.g. tickle, feeling, pain) associated with the highest tolerable sound intensities. For this reason, "uncomfortable loudness level" is preferred over other terms that include words like *discomfort* and *tolerance* such as *loudness discomfort level, tolerance level,* or *threshold of discomfort.*

The range in decibels between the patient's SRT and UCL is called the **dynamic range**. It is, in effect, the patient's usable listening range. For example, if a patient has an SRT of 15 dB HL and a UCL of 100 dB HL, then his/her dynamic range would be 100 – 15 = 85 dB wide. This means that the patient's hearing can accommodate a range of sound intensities that is 85 dB wide. One of the major problems faced by many patients with sensorineural hearing loss is that their thresholds are elevated but their UCLs remain essentially unchanged, which results in a constricted dynamic range. For example, a patient's SRT might be elevated to 65 dB HL, but his/her UCL might still be 100 dB HL so that her dynamic range would be 100 – 65 = 35 dB wide. Notice the difference between this situation and the prior example. There would be no problem "fitting" the wide range of intensities in the real world into a usable (dynamic) listening range that is 85 dB wide. However, the patient in the second example has a usable listening range that is only 35 dB wide, which is too narrow to accommodate the range of intensities found in the real world of sound. Imagine the implications of a restricted dynamic range for hearing aid use. Amplifying sound levels so they become audible (which is desirable) will also cause many sounds to exceed the patient's UCL (which is undesirable). Consequently, in addition to amplifying them, we must also try to "squeeze" the wide range of real-world sounds into the patient's narrower dynamic range.

Gelfand (2001)

Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

..... 1. To test the MCL, the hearing level of speech should be adjusted until the patient states that it is comfortably loud.

..... 2. Cold running speech is often used for getting the MCL.

..... 3. If interesting "continuous discourse" is used for obtaining the MCL, the patient cannot focus on the perceived level of the material.

..... 4. Uncooperative patients are those who try to give their audiologist a hard time.

..... 5. Different procedures and materials are used for measuring the MCL and UCL for speech.

..... 6. An audiologist is usually concerned with tactile sensations related to the highest tolerable sound intensities when he/she is testing for the UCL.

..... 7. The patient's usable listening range is called the 'dynamic range'.

..... 8. A restricted dynamic range occurs when the patient's SRT increases but his/her UCLs remains unchanged.

..... 9. When testing for the UCL, the audiologist is interested in the patient's capacity to tolerate pain.

B. Choose a, b, c, or d which best completes each item.

1. All of the following materials are usually applicable in testing for MCL except ..... .

a. a recorded selection of some poems

b. "continuous discourse" speech material

c. spondaic words

d. "cold running speech" selections

2. 'It' in paragraph 2, line 5 refers to ..... .
   a. the important concept
   b. a range of level
   c. the experience gained from unreliable patients
   d. an example of patients trying to give their audiologist a hard time
3. In paragraph 2 the writer attempts to demonstrate that ..... .
   a. the MCL is, in effect, a comfortable loudness level
   b. the MCL for speech is actually a range of hearing levels
   c. new clinicians have used new methods in MCL testing
   d. unreliable patients usually attempt to bother their audiologist
4. When testing for the UCL, clinicians ..... .
   a. are interested in sound levels beginning to produce an uncomfortable auditory experience
   b. are concerned with the highest tolerable sound intensities
   c. pay much attention to the threshold of comfort
   d. are concerned with the patients' tactile sensations
5. All of the following materials can be used for measuring the UCL except ..... .
   a. boring "continuous discourse" proses
   b. two-syllable words having equal emphasis on both syllables
   c. "cold running speech"
   d. monosyllabic words presented in an open-set format
6. One of the most important problems of many patients with sensorineural hearing loss is that their ..... .
   a. speech recognition threshold remains unchanged
   b. uncomfortable loudness levels usually increase
   c. most comfortable loudness levels remain constricted
   d. dynamic range is too restricted to harmonize with the range of intensities found in real-world sounds

7. The best title for the last paragraph could be '.....' .

a. The Range of Sound Intensities

b. How to Amplify the Sound Levels

c. Dynamic Range for Speech

d. The Range between the Patients' SDT and UCL

9. 'Them' in the last paragraph, line 20 refers to ..... .

a. audible sounds

b. sound levels

c. real-world sounds

d. implications of a restricted dynamic range for using hearing aids

C. Write answers to the following questions.

1. What is the most comfortable loudness level?
2. Why should uninteresting proses be used for obtaining the MCL?
3. Why do many patients seem unreliable to clinicians trying to find the MCL?
4. Can you define uncomfortable loudness level?
5. What is an uncomfortable auditory experience?
6. What is the dynamic range?
7. How can the dynamic range be calculated?
8. What causes a major problem for many patients suffering from sensorineural hearing loss?
9. How can an audiologist help the patient mentioned in the second example?

* * *

A. Translate the following passage into Persian.

Assessing Speech Recognition

There is a readily understandable distinction between the threshold for speech and the ability to understand the speech that is heard. Consider the following complaints expressed by a variety of hearing-impaired patients: "I can hear speech but I can't understand it"; "words aren't clear"; "speech sounds muffled [or distorted]"; or "I mistake one word for another". The common theme here is that the speech heard by the patient is lacking in intelligibility. This problem is experienced in terms of inaccurately-received messages and/or reduced clarity. Speech recognition measures have been used in every phase of audiology such as (1) to describe the extent of hearing impairment in terms of how it affects speech understanding, (2) in the differential diagnosis of auditory disorders, (3) for determining the needs for amplification and other forms of audiologic rehabilitation, (4) for making comparisons between various hearing aids and amplification approaches, (5) for verifying the benefits of hearing aid use and other forms of audiologic rehabilitation, and (6) for monitoring patient performance over time for either diagnostic or rehabilitative purposes.

B. Find the Persian equivalents of the following items and write them in the spaces provided.

1. amplifying sound levels .....
2. audiologic rehabilitation .....
3. bone vibrator .....
4. dynamic range .....

5. interrupter switch .....
6. most comfortable loudness level (MCL) .....
7. pure-tone audiogram .....
8. speech audiometer .....
9. speech audiometry .....
10. speech awareness .....
11. speech detection threshold .....
12. speech discrimination score .....
13. speech intelligibility .....
14. speech mood .....
15. speech recognition score .....
16. speech recognition threshold .....
17. spondee threshold .....
18. tactile sensations .....
19. uncomfortable loudness level (UCL) .....
20. VU meter .....
21. word recognition score .....

Unit 7

Section One: Reading Comprehension

Hearing Screening in Children

Screening is the process of applying certain rapid and simple tests, examinations, or other procedures to generally large numbers of persons which will identify those persons with a high probability of a disorder from those who probably do not have the disorder. A criterion measurement cutoff point is always involved, below or above which the disorder is suspect. Screening is not intended as a diagnostic procedure; screening merely surveys large populations of undiagnosed and typically asymptomatic persons to identify those who are suspected of having the disorder and who require more elaborate diagnostic procedures. Persons identified with positive or suspicious findings are referred to their physician for diagnosis and, if necessary, appropriate treatment.

Because hearing impairment is relatively invisible, hearing screening tests have been in use for at least 60 years to identify children for further auditory evaluation. Screening for hearing loss in U.S. public schools has been in practice since the 1930s, and nearly every state has some sort of mandated hearing screening program to identify children with educationally handicapping hearing impairments. The literature of audiology abounds with descriptions of various group and individual hearing tests designed for use in schools, dating from the introduction in 1927 of the Western Electric 4-C group speech test. Currently, either by order of legislative mandate or through some type of coordinated statewide program, hearing screening of

school-aged children is conducted in nearly all U.S. states.

Screening for disease as early as possible in a child's life is now an accepted public health mandate. In a separate focus of hearing screening, the past 35 years has seen hearing screening programs for newborns developed to identify those newborns with hearing loss so that habilitative measures can be instituted. The historical development of hearing tests for infants has evolved from early behavioral observation techniques to today's sophisticated physiologic hearing screening technologies. Out of approximately 4,000,000 live births in the United States each year, it is estimated that 10% are at risk for congenital hearing loss. Of these infants, 30-50 of every 1000 are hearing impaired.

A more difficult problem has been the development of simple, efficient, and valid hearing screening techniques for young children between 2 and 4 years of age. The effect of mild to moderate hearing impairment in this age group has been shown to be detrimental in speech/language development, but no hearing screening technique has gained universal acceptance for use in Head Start Programs, primary care physician offices, or public or private preschool grades.

Inasmuch as a wide variety of material relative to all aspects of hearing screening in children is presented, it is useful to look at the philosophy of screening from the vantage point of all the health sciences. A great deal of effort has been expended by public health agencies and epidemiologists to analyze the performance characteristics of all types of screening procedures.

The following two aspects of screening philosophy are relevant to the current discussion of screening theories and how they relate to hearing conservation programs: (1) the selection of the disorder or disease, and (2) the evaluation of the screening procedures. The first question that must be asked is whether there should be a screen for a certain disease. If the answer is yes, then specific criteria described below should be applied to the selection of disorders.

Occurrence Frequent Enough or Consequence Serious Enough to Warrant Mass Screening. How prevalent is the disease in the population to be screened? Some balancing of cost with the number of children who have the disease must be made. Cunningham (1970) stated, "From the point of view of a public health program, in order to justify a mass screening program, the condition must be reasonably frequent or if rare it must have serious consequences if not detected." In the case of hearing, screening neonates for congenital deafness can be justified on the basis of its severity and resultant disastrous consequences; the screening of the young child can be justified on the basis of numbers alone and on consequences. Table 7-1 illustrates the relative status of hearing screening compared with other commonly screened newborn diseases. Hearing screening not only yields the highest returns among these diseases, but also is more productive of results once the problem is identified.

Table 7-1. Matrix analysis for test performance characteristics.

Test Results	Impaired	Normal	Total
Positive	TP	FP	TP+FP
Negative	FN	TN	FN+TN
Totals	TP+FN	FP+TN	TP+FP+FN+TN

TP, true positive; *TN*, true negative; *FN*, false negative; *FP*, false positive.

From Jacobson, J. & Jacobson, C. (1987). "Application of test performance characteristics in newborn auditory screening." *Seminars in Hearing,* 8(2), 133.

Cost of Screening Reasonably Commensurate with Benefits to the Individual. Is the screening equipment costly to purchase and to maintain? Do the personnel administering the screening tests require expensive training or high-level salaries? It is very difficult to designate any costs as excessive when the health and welfare of many individuals are at stake, but there are limitations to the funds available in any area. Some equipment can continue to be used for long periods and for many thousands of tests before any repair

or calibration is required. In addition, as the trend toward the use of nonprofessional aides continues, the cost of screening continues to decrease. The cost-analysis of screening the infant and preschool population also varies, but in no case would it be considered exorbitant when compared with the benefits accrued.

Northern & Downs (2002)

Part I. Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

..... 1. Screening surveys large populations and is a diagnostic procedure.

..... 2. For appropriate treatment, people with positive results are referred to physicians.

..... 3. A hearing screening program is necessary to identify children with educationally handicapping hearing impairment.

..... 4. Hearing impairment is always invisible.

..... 5. It is over fifty years now that hearing screening tests have been in use.

..... 6. Screening tests are applied in public schools to separate hearing-impaired students from normal ones.

..... 7. It is estimated that 10% of the live births in the U.S.A. are at risk for congenital hearing loss.

..... 8. Since congenital hearing loss can have serious consequences if not detected, screening of neonates can be justified.

..... 9. When the health of many individuals is concerned, no program in this regard is considered as excessive.

.....10. The selection of the disorder is one of the principles of hearing screening.

B. Choose a, b, c, or d which best completes each item.

1. Screening is a process in which we can ..... .
   a. distinguish a large number of people who are not suspected of having a disorder
   b. apply certain tests to large numbers of people with a high probability of a disorder
   c. distinguish individuals who are suspected of having a disorder from those who are not
   d. apply rapid examinations to those individuals with a high probability of a disorder
2. In screening programs, people with positive findings ..... .
   a. are considered as undiagnosed
   b. should be followed up
   c. are considered handicapped and should be treated
   d. have to be separated from those with suspicious findings
3. All of the following statements are stated in the text except ..... .
   a. hearing impairment in the age of 2 to 4 is harmful to speech development
   b. in hearing screening programs for infants, early behavioral observation techniques are used
   c. students with educationally handicapping hearing impairment are identified through screening programs in U.S. schools
   d. hearing screening programs for newborns started over three decades ago
4. The screening program for a selected disorder can be based on the ..... .
   a. prevalence of the disease and its consequences
   b. prevention procedure of the selected disorder
   c. point of view of the public health program
   d. kind of treatment applied for the disorder

5. The cost of any screening program ..... .
   a. is difficult to designate due to the use of nonprofessional aides
   b. is limited to the funds available to the area
   c. will be lower when performed by an audiologist
   d. cannot be regarded as excessive when the health of individuals is considered
6. The main idea in the first paragraph is to ..... .
   a. state the reason for applying screening programs
   b. describe the screening procedures
   c. emphasize the importance of screening programs
   d. introduce the criterion measurement cutoff point
7. In the U.S.A. hearing screening tests are applied to students in order to ..... .
   a. have further auditory evaluation
   b. find some sort of mandated hearing screening program
   c. identify those with educationally handicapping hearing impairments
   d. use various group and individual tests designed for use in schools
8. "In a separate focus of hearing screening, ... so that habilitative measures can be instituted" (paragraph 3, line 2). In which of the following sentences does the word 'measure' have the same meaning?
   a. A measure of technical knowledge is desirable in this job.
   b. Is this test a good measure of reading comprehension?
   c. Which measure of weight do pharmacists use?
   d. We must take a preventive measure to reduce crimes in this area.

C. Answer the following questions orally.

1. What is the main purpose of screening?
2. Why is it necessary to identify neonates and children with hearing impairment as soon as possible?
3. What is the estimate of the incidence of congenital hearing loss in the United States?

4. What are the principles of hearing screening?
5. How can a mass screening program be justified?
6. How can screening neonates and young children be justified?
7. When did the hearing screening programs for newborns start?
8. What degree of hearing impairment has a great impact on children between 2 and 4 years of age?
9. Why is it difficult to consider the cost of screening programs as excessive?
10. Why does the cost of screening programs continue to decrease?

Part II. Language Practice

A. Choose a, b, c, or d which best completes each item.

1. In screening programs some ..... that constitute pass or failure should be taken into consideration.
   a. impairments
   b. behaviors
   c. criteria
   d. equipments
2. In hearing evaluation the ..... of the hearing loss is determined.
   a. variety
   b. severity
   c. philosophy
   d. difficulty
3. We have to ..... the limitations caused by this disease.
   a. designate
   b. maintain
   c. purchase
   d. repair
4. Not many people realize the ..... of screening neonates for congenital deafness.
   a. maintenance
   b. chance
   c. performance
   d. significance
5. Health-care centers have taken ..... to stop water contamination.
   a. intentions
   b. measures
   c. apart
   d. requirements

6. A(An) ..... new method of treatment was introduced by some physicians.

a. excessive b. historical

c. equivalent d. efficient

7. ..... of the treatment approach was the most important part of the program.

a. Selection b. Condition

c. Discussion d. Production

8. They were very surprised by the ..... of the disease in that area.

a. competence b. analysis

c. prevalence d. significance

B. Fill in the blanks with the appropriate forms of the words given.

1. administer

a. He is responsible for the ..... of justice.

b. We have got ..... duties.

c. She is an excellent ..... who is able to manage everything well.

d. They ..... relief to famine victims.

2. necessary

a. He felt a great ..... to talk about his problems.

b. Your proposal will ..... hard work and effort.

c. She doesn't ..... have to undergo assessment.

d. She hasn't the experience ..... for the job.

3. justify

a. It was such a ..... explanation that convinced everybody.

b. You can ..... such action on the ground of greater efficiency.

c. I can see no ..... for ignoring the value of that test.

d. He is ..... cautious about the subject.

4. legislative

a. New ..... is to be introduced to help hearing-handicapped individuals.

b. It is impossible to ..... for all possible contingencies.

c. Everyone is expecting a ..... reform.

d. A group of people who have the power to make and change laws are called ..... .

5. apply

a. Tuning fork tests are ..... in situations where formal audiometric testing would be cumbersome.

b. The ..... of heat may relieve muscle pain.

c. The results of this research can be ..... to new developments in technology.

d. As the wages were low, there were few ..... for the jobs.

6. description

a. He ..... his illness as a handicapping one.

b. The report was quite .....; everything we needed was included.

c. The patient gave us a ..... of his disease.

d. ..... how this instrument worked was difficult for me.

7. compare

a. His work is ..... with the very best; it's great.

b. A ..... study of the social systems of the two countries was conducted by a well-known sociologist.

c. They are going to ..... the two test results and make the final decision.

d. Nowadays there are more complicated audiometers in ..... with two decades ago.

8. objective

a. The only ..... to the program is that it is not cost-effective.

b. The child was the ..... of attention while he was sick.

c. A jury's decision in a court case must be absolutely ..... .

d. The judge had a reputation for complete ..... .

C. Fill in the blanks with the following words.

discussion	disorder	results	without
current	critical	material	identify
screening	attempt	evaluate	effectiveness

The success of a screening program depends on the ..... of the measures used to ..... those who are likely to have the target ..... and to pass over those who do not have the target disorder. It is no longer sufficient to ..... a test procedure critically by simply reporting the percentage of positive ..... in patients with the disease and the percentage of negative results in patients ..... the disease. More rigid and ..... performance characteristics must be applied to each ..... test to evaluate fully its effectiveness in the overall ..... to identify infants and children with hearing problems. Jacobson and Jacobson (1987) provided an excellent ..... of screening test performance characteristics, and the ..... authors are grateful for their permission to use their ..... as the basis of their discussion.

D. Put the following sentences in the right order to form a paragraph. Write the corresponding letters in the boxes provided.

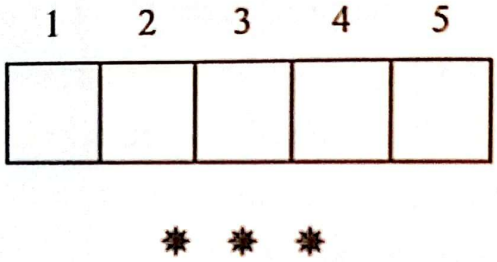
a. The rate of prevalence is calculated by dividing the number of diseased patients in the population at a specified time by the number of individuals in the population at that specified time.

b. To calculate incidence rate, two variables must be defined: (1) the beginning and end of the time period under study, and (2) the population at risk for developing the disorder under study.

c. Prevalence rate is a census measure that expresses the presence of diseased patients per 100,000 population at the time of investigation.

d. In contrast, incidence rate is the frequency of new outbreak of a disease condition in a population for a given period.

e. Incidence rate is calculated by dividing the number of new diseased patients in a population during a specified period by the number of persons exposed to the risk of developing the disease during that same period.



Section Two: Further Reading

Prevalence of Newborn Hearing Loss

Stein (1999) asked the critical question concerning how many newborns might be expected to be found with significant hearing loss in the annual U.S. population of 4 million births. The prevalence of newborns with hearing loss is currently under re-examination, with new data being generated from universal infant hearing screening programs underway in more than 20 states. For many years, it was widely held that the prevalence of hearing loss in the newborn population is approximately 1 in 1000 live births, or 4000 infants per year. It was argued by many that this estimate was understated as it was based only on congenital, profound bilateral hearing loss. Further, early surveys failed to include newborns at risk for developmental disabilities in whom the prevalence of hearing loss is now known to be significantly

greater than the well-birth infant population. Hearing loss of mild, moderate, or severe degree or unilateral hearing loss were not taken into account simply because of the difficulty in accurately assessing hearing in infants before the advent of otoacoustic emission (OAE) and auditory brainstem response (ABR) screening.

It has been long known that the number of babies with hearing loss identified in the newborn intensive care unit (NICU) is considerably higher than in the general well-baby population. Several studies estimated the incidence of hearing loss in this NICU targeted population at 20-50 times greater than in the newborn nursery, or at least 1 in 150 babies. Although more and more research studies are underway to establish the true prevalence of hearing impairment in newborns and children, as this information is crucial for long-term planning and funding of intervention and special education programs, it is clear that the answer to the question is complex. In each study, consideration must be given to the specific description of the target population; the definition of hearing loss in terms of degree, type (sensorineural and/or conductive), and unilateral or bilateral presence; technique of identification and protocol followed; criteria for what degree of hearing loss constitutes pass or failure; and the success of follow-up and diagnostic confirmation of each hearing loss.

The incidence of congenital hearing loss in the general newborn population is high and is a relatively common occurrence. Mehl and Thomson (1998) compared the incidence of bilateral hearing loss in newborns in Colorado against other existing disease screening programs as shown in Table 7-2. They reported that congenital bilateral hearing loss is present in 200 of 100,000 newborns. For comparison, the incidence in galactosemia is 2 per 100,000 births; phenylketonuria, 10 per 100,000 births; and hypothyroidism, 25 per 100,000 births. The prevalence of newborn and infant hearing loss has been estimated in other studies from 1.5 to 6.0 per 1000 live births. Risk factor screening identifies only 50% of infants with

significant hearing loss, and failure to identify the remaining 50% of children with hearing loss results in diagnosis and intervention at an unacceptably late age.

Table 7-2. Yield in infant health-care screening tests.

Disease Screened	Yield
Phenylketonuria	7 in 100,000 births
Combined immunodeficiency disease	25 in 3 million births
Maple syrup urine disease	1 in 300,000 births
Neonatal hyperthyroidism	25 in 100,000 births
Cystic fibrosis	50 in 100,000 births
Hemoglobinopathy	13 in 100,000 births
Bilateral sensorineural hearing loss	260 in 100,000 births

From Mehl, A. & Thomson, V. (1998). "Newborn hearing screening: The great omission." *Pediatrics*. 101(1), e4.

Review of the literature of the past 35 years confirms that substantial data exist to support irrefutable facts delineated by Northern and Hayes (1994) about hearing impairment in early childhood:

- Sensorineural hearing impairment in infants and young children is a serious condition that results in life-long disability.
- Continued dependence on the high-risk registry approach to screening infants will identify less than 50% of infants with significant hearing loss.
- Valid techniques, with proven acceptable sensitivity and specificity, are currently available to detect moderate, severe, and profound hearing loss in infants.
- Early intervention is essential for facilitating speech, language, and cognitive skills; social-emotional development; and academic achievement.

Early identification and habilitation of all infants with hearing impairment must continue to be a major goal for health-care systems.

Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

..... 1. The prevalence of hearing loss in newborns at risk for developmental disabilities is approximately equal to the well-birth infants.

..... 2. The advent of OAE and ABR made it difficult to assess hearing in infants accurately.

..... 3. The incidence of hearing loss in babies in the NICU is higher than in the well-baby population.

..... 4. The incidence of congenital hearing loss in newborns is an unusual occurrence.

..... 5. Not all infants with significant hearing loss can be identified through risk factor screening.

..... 6. Screening on the basis of risk factor may result in delayed diagnosis in some children.

..... 7. Different degrees of hearing loss in children cannot be detected due to lack of enough techniques.

..... 8. The main goal of health-care systems is to identify and habilitate all infants with hearing impairment as soon as possible.

B. Choose a, b, c, or d which best completes each item.

1. The main idea in the first paragraph is ..... .

a. Stein's point of view about significant hearing loss in the U.S.A.

b. new data generated from universal infant hearing screening programs

c. prevalence of newborn hearing loss

d. newborns at risk for developmental disabilities

2. OAE and ABR tests ..... .

a. do not take into account mild, moderate or severe hearing loss

b. are helpful in assessing different degrees of hearing loss

c. are not used in screening tests because of the difficulty in accuracy

d. were invented before the infant hearing screening programs started

3. 'The question' in paragraph 2, line 9 refers to the ..... .

a. number of babies with hearing loss in the NICU

b. criteria for what degree of hearing loss constitutes pass or failure

c. number of babies with hearing loss in the general well-baby population

d. true prevalence of hearing impairment in newborns and children

4. "... as this information is crucial ..." (paragraph 2, line 7). In which of the following sentences does the word 'as' have the same meaning?

a. As she grew older, she gained more confidence.

b. As she is a newcomer, she may need some help.

c. As you know, they are going to give us some more information.

d. As a colleague, I respect him a lot.

5. According to the passage, ...

a. failure to identify children with hearing loss is a common incidence

b. the prevalence of hearing loss in newborns is higher in comparison with other diseases

c. all infants with hearing loss can be identified by risk factor screening

d. the incidence of bilateral hearing loss is two times greater than that of other diseases

6. Focus on high-risk factors in infants ..... .

a. causes delayed diagnosis and intervention in nearly half of the infants with hearing impairment

b. results in identifying all infants with significant hearing loss

c. is not accepted as a good method in screening programs

d. fails to identify infants with significant hearing loss

7. One of the main goals of health-care programs is to ..... .

a. estimate the prevalence of newborn hearing loss

b. determine the degree of hearing loss in infants

c. identify the risk factors in infants with significant hearing loss

d. identify of all infants with hearing impairment and their habilitation as soon as possible

C. Write answers to the following questions.

1. How is it possible to estimate the prevalence of hearing loss among newborns?
2. What is the importance of OAE and ABR screening tests?
3. What criteria should be considered when the prevalence of hearing impairment in newborns is under study?
4. What is the consequence of dependence on the high-risk registry approach in screening?
5. How can we facilitate speech, language and cognitive skills?
6. What is the main goal of neonate screening programs in health-care systems?
7. What is the level of the incidence of hearing loss in the NICU population?
8. Why was the estimation of the prevalence of hearing loss in 4000 infants per year understated?

A. Translate the following passage into Persian.

Joint Committee on Infant Hearing Screening

In 1969, at the suggestion of Marion Downs, a national committee formed of representatives from the Academy of Pediatrics, the Academy of Ophthalmology and Otolaryngology, and the American Speech and Hearing Association met to make recommendations for newborn infant hearing screening. The Joint Committee at that time addressed itself to the use of behavioral observation hearing screening tests for use with infants which had been developed and described by Downs and Sterritt (1964) and Downs and Hemenway (1969). The Joint Committee developed *a high-risk register for deafness* that identified five major criteria that would put newborn infants at risk for having severe to profound hearing impairment. The five criteria were family history; intrauterine fetal infection; defects of the ear, nose, or throat; low birthweight; and high bilirubin level. These risk factors could be identified by interviewing the birth mother or by examining the medical records of each infant to see whether there was any history or physical finding that would give a high probability of hearing loss. The Downs and Sterritt project mass-screened 17,000 newborns in Denver, resulting in the identification of 17 infants with profound hearing loss. The high-risk register approach was an attempt to focus attention on those infants most likely to have significant hearing loss rather than screening every baby. The high-risk concept assumes that one can identify a small group of children whose history or physical condition results in a high chance of having the target handicap.

B. Find the Persian equivalents of the following items and write them in the spaces provided.

1. asymptomatic .....
2. bilateral hearing loss .....
3. congenital hearing loss .....
4. educationally handicapping hearing impairment .....
5. habilitative measures .....
6. high-risk registry approach .....
7. incidence .....
8. intervention .....
9. legislative mandate .....
10. nonprofessional aides .....
11. prevalence .....
12. screening procedure .....
13. significant hearing loss .....
14. sophisticated .....
15. unilateral hearing loss .....

Unit 10

Section One: Reading Comprehension

Presbycusis

A number of factors have been linked to hearing loss in older adults. These include age, metabolic disorders, vascular disorders, renal disease, medications, medical treatments, and noise exposure. Moscicki et al. (1985) speculated that some of the minor risk factors for hearing loss vary according to sex. The risk factors for women include history of Meniere's disease and family history of hearing loss. In contrast, the risk factor for men is history of noise exposure.

The aging process comes with some degree of deterioration at most and probably all levels of the auditory system, resulting in age-related auditory impairments that are collectively known as **presbycusis**. There is a general consensus that presbycusis is the result of various kinds of physiological degeneration due to the normal aging process (theoretically "pure presbycusis") *plus* the accumulated effects of noise exposure, ototoxicity, medical disorders and their treatment, as well as the possibility of hereditary susceptibilities.

Presbycusis is usually described in terms of how hearing thresholds change with increasing age. Differences exist among presbycusis curves, reflecting differences between the populations sampled, degrees of exposure to social and/or occupational noises, and the extent to which people with otological disorders were excluded from the samples. Representative curves are shown in Figure 10-1.

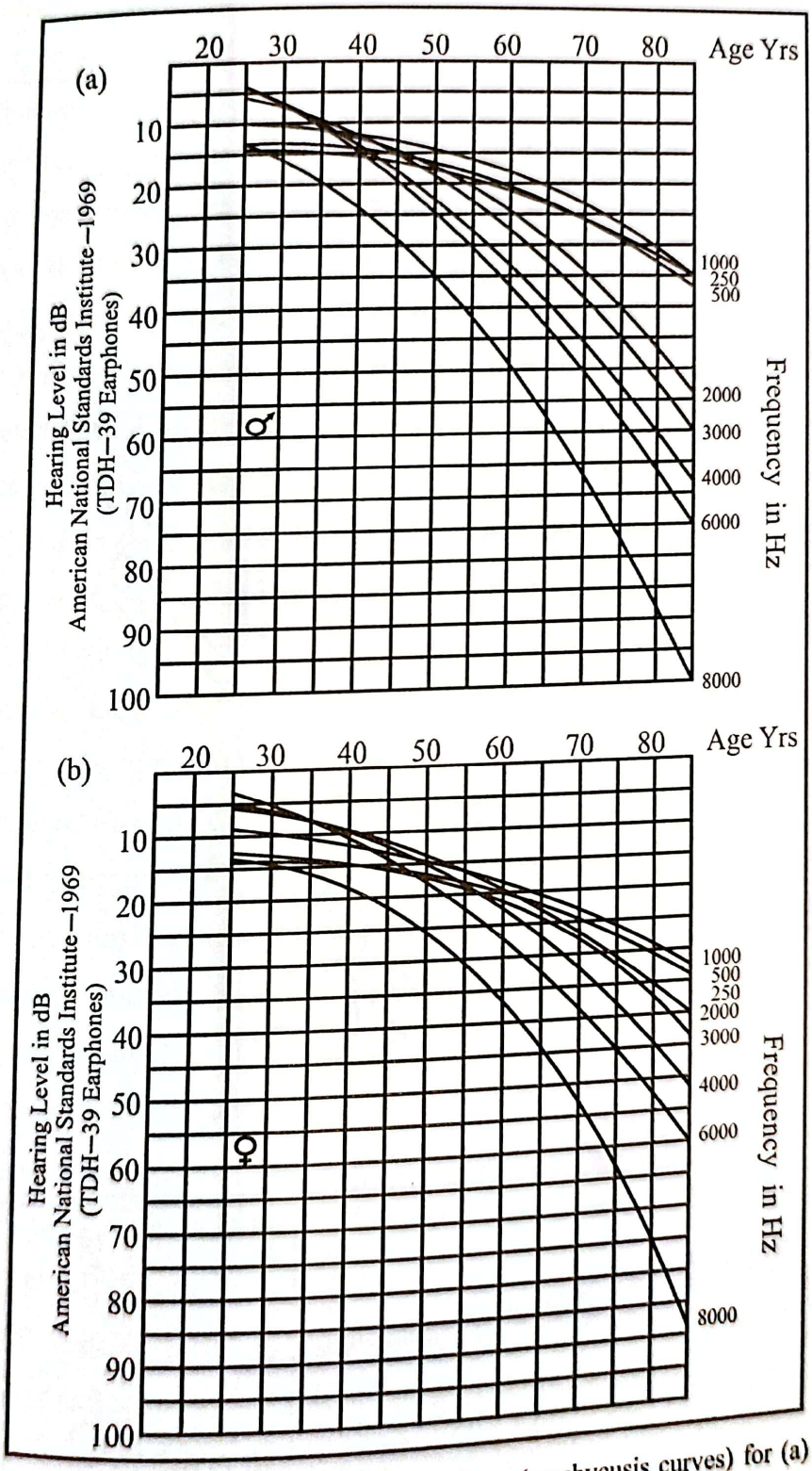


Figure 10-1. Hearing level as a function of age (presbycusis curves) for (a) males and (b) females (Data by Spoor, 1967. Adapted from Lebo C.P. & Reddell R.C. (1972). "The presbycusis component in occupational hearing loss." *Laryngoscope*, 82, 1399-1409, with permission).

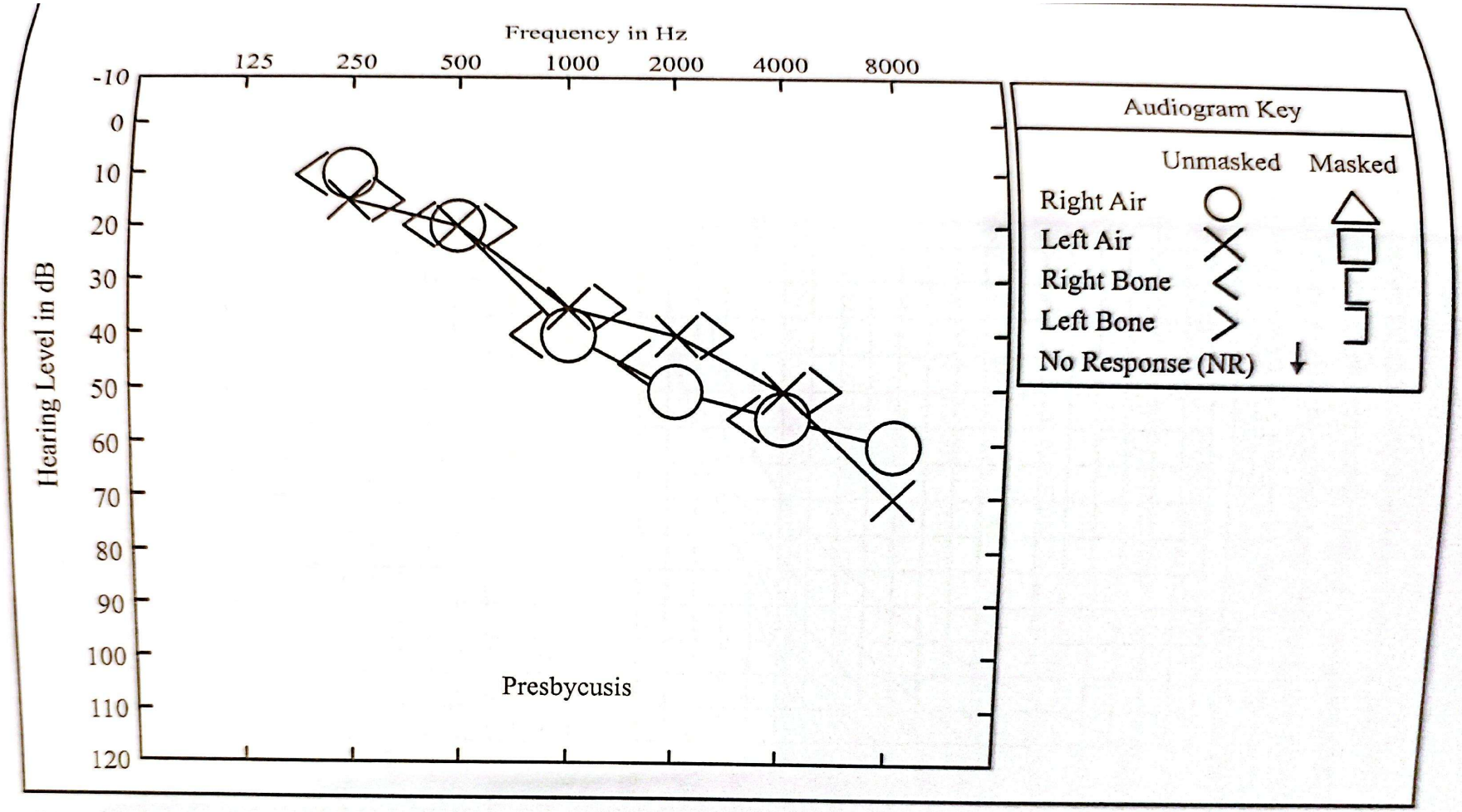


Figure 10-2. The audiogram of a typical patient with an essentially symmetrical bilateral sloping sensorineural hearing loss associated with presbycusis.

Figure 10-2 shows the audiogram of a typical patient with presbycusis, showing a sloping sensorineural hearing loss that is essentially symmetrical in both ears.

Difficulty with speech recognition is the most common complaint of presbycusics. There is a general trend for speech recognition scores in quiet to decrease with age, but there is also considerable variability, and it has been suggested that the performance of the elderly is comparable to that of young persons with similar audiograms when they are tested at adequate intensity levels. Gates et al. (1990) found that only 3 out of 1026 elderly subjects (0.3%) had disproportionately low speech recognition scores with respect to their audiograms. In contrast, it is clear that speech intelligibility decreases with aging for speech that is presented under *difficult listening conditions* (noise, time compression, reverberation, interruption, competition, etc) The presbycusic effect for degraded speech becomes evident as early as the fifth decade of life (years 40-49).

Various histological types of presbycusis have been described, as illustrated in Figure 10-3. However, the student should be aware that many patients have more than one kind of histological deterioration, and that not all of the idealized types of presbycusis have been observed by all investigators. The four classical types of presbycusis were based on a combination of clinical and histological findings by Schuknecht (1955, 1964, 1974). **Sensory presbycusis** is due to the degeneration of the sensory hair cells and supporting cells mainly toward the basal turn of the cochlea, and can also include atrophy of the associated neurons as a secondary effect. It is associated with a sloping (often steeply) high-frequency sensorineural hearing loss and speech recognition scores that are consistent with the nature of the audiogram. **Neural presbycusis** is related to primary degeneration of the auditory neurons. The reduced neuronal population is characterized clinically by speech recognition scores that are lower than what would be expected from the audiogram. A typically poor speech recognition in

presbycusis is sometimes called **phonemic regression**, but this phenomenon appears to be rare.

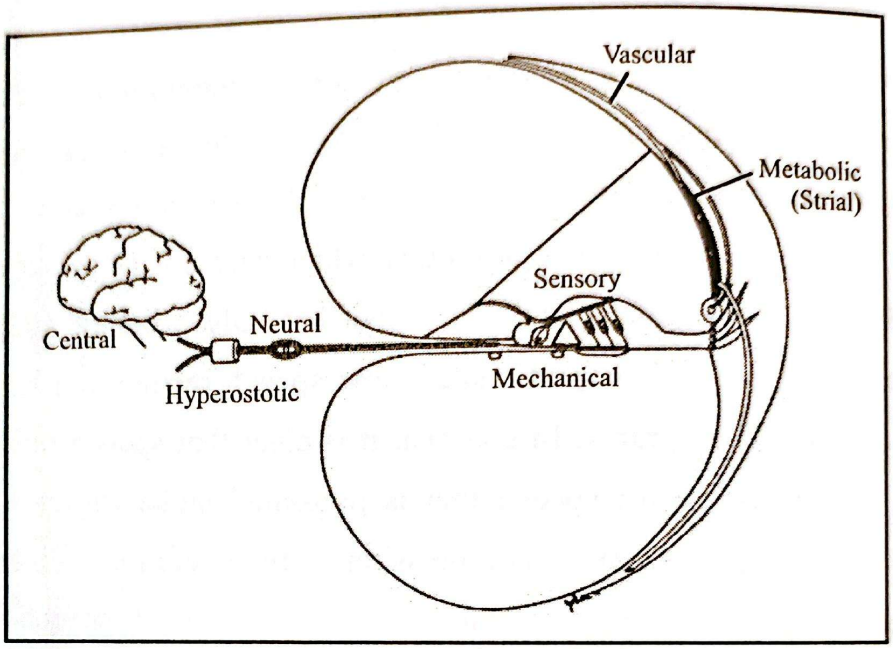


Figure 10-3. Adapted from Johnsson & Hawkins (1979). "Age-related degeneration of the inner ear", In Han, S. S. & Coons, D. H. (Eds.) *Special Senses in Aging.* Ann Arbor: Institute of Gerontology, University of Michigan, 119-135, with permission.

Metabolic or **strial presbycusis** is caused by degeneration of the strict vascularis, causing a relatively flat sensorineural hearing loss with speech recognition scores that are in line with the audiogram. **Mechanical** or **cochlear conductive presbycusis** is attributed to structural changes in the basilar membrane, affecting its mass and stiffness, which would in turn affect the mechanics of the cochlea and produce a sloping sensorineural hearing loss. This kind of presbycusis may be hypothetical.

Two additional forms of presbycusis have also been identified (Johnsson & Hawkins, 1979; Hawkins & Johnsson, 1985). **Vascular presbycusis** is associated with deterioration of the blood supply to the lateral wall of the cochlear duct and the spiral lamina, and may play a part in the

deterioration of the strict vascularis and spiral ligament. **Hyperostotic presbycusis** occurs when abnormal bone growth (hyperostosis) in the modiolus or internal auditory meatus compresses auditory nerve cells so that they degenerate.

Central presbycusis is due to deterioration at various levels of the auditory system up to and including the auditory cortex (CHABA, 1988), although the amount of anatomical evidence in this area has been disappointing. The central component of presbycusis is generally revealed by performance deficits on auditory tests associated with central auditory processing disorders. Central presbycusis does not appear to be based on cognitive deficits, and increases in prevalence with advancing age.

Gelfand (2001)

Part I. Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

..... 1. The number of females suffering from presbycusis is more than that of males.

..... 2. Primary degeneration of the auditory neurons leads to neural presbycusis.

..... 3. Age is a significant risk factor for hearing loss.

..... 4. The term 'phonemic regression' implies a disproportionate loss of speech understanding ability relative to the audiogram.

..... 5. The functional manifestation of strial presbycusis is a flat audiogram with equal hearing loss across frequencies.

..... 6. Neural presbycusis is characterized by hair cell loss and wearing away of the auditory neurons.

..... 7. Each of the four types of presbycusis, postulated by Schuknecht, is associated with a particular audiometric pattern.

..... 8. Central presbycusis is based on cognitive deficits.

..... 9. Some of the major risk factors for hearing loss vary according to sex.

B. Choose a, b, c, or d which best completes each item.

1. The best title for the first paragraph would be '.....' .
   a. Etiologies of Hearing Loss in Older Adults
   b. The Minor Risk Factors for Hearing Loss
   c. The Effects of Meniere's Disease in Hearing Loss
   d. The Influence of Noise Exposure on Older Adults
2. Generally the term 'presbycusis' refers to hearing loss .....
   a. related to the patient's family history
   b. associated with the aging process
   c. determined by the degrees of exposure to social noises
   d. caused by Meniere's disease
3. The representative curves shown in Figure 10-1 illustrate all of the following information associated with presbycusis except .....
   a. age-related threshold shifts are greater
   b. age-related threshold begins sooner for the higher frequencies
   c. females are affected more than males
   d. there is some greater involvement toward the base of the cochlea
4. In paragraph 2, it is suggested that presbycusis is the sum of hearing loss resulting from ..... types of physiological degeneration.
   a. pure
   b. aging
   c. four
   d. five
5. Presbycusis sufferers mostly complaint about .....
   a. difficult listening conditions
   b. occupational noises
   c. hereditary susceptibilities
   d. difficulty in recognizing speech

6. All of the following types of presbycusis are classified based on Schuknecht's clinical and histological findings except ..... presbycusis.

a. sensory
b. neural
c. hyperostotic
d. metabolic

7. The most common symptom of ..... presbycusis is the degeneration of the ..... .

a. central, auditory cortex
b. vascular, auditory nerve cells
c. metabolic, mechanics of the cochlea
d. neural, sensory hair cells

8. The speech recognition scores of those suffering from ..... presbycusis are ..... the audiogram.

a. strial, consistent with the nature of
b. neural, lower than what would be expected from
c. sensory, in line with
d. mechanical, disproportionately lower than

9. Figure 10-3 illustrates ..... .

a. a schematic representation of the various types of presbycusis
b. the functional correlations of the anatomical changes within the central auditory pathways
c. a schematic representation of the relationship between the brain and the auditory system
d. the sites of degeneration of the auditory system leading to central presbycusis

C. Answer the following questions orally.

1. What is 'presbycusis'?
2. What are the factors that have been linked to hearing loss in the old?
3. Why is the prevalence of hearing loss somewhat higher in men?

4. How are the degenerative changes of sensory presbycusis manifested?
5. What is the functional manifestation of metabolic presbycusis?
6. What are the two types of presbycusis identified by Hawkins and Johnsson?
7. How is the central component of presbycusis revealed?
8. What is 'phonemic regression'?
9. When does hyperostotic presbycusis occur?
10. Which types of presbycusis are hypothetical?

Part II. Language Practice

A. Choose a, b, c, or d which best completes each item.

1. Moscicki et al. ..... that some of the risk factors for hearing loss vary according to sex, but they were not certain.
   a. confirmed b. approved
   c. rejected d. speculated
2. This report would be ..... only to an expert in computing.
   a. variable b. irritable
   c. intelligible d. recreational
3. The two political parties have reached a(an) ..... on this issue and will enact it tomorrow.
   a. correlation b. consensus
   c. sequel d. disposition
4. First, I'll explain how it works ....., then I'll give you a practical demonstration.
   a. collectively b. recreationally
   c. theoretically d. steeply
5. People with auditory ..... receive special education in this hospital.
   a. disadvantages b. deficits
   c. diagnoses d. spasms

6. He has already collected some paintings, but he wants to ..... more.

a. investigate b. deteriorate

c. accumulate d. degrade

7. Audiologists have not ..... that his sudden hearing loss is due to the recent head trauma he had in the car accident.

a. excluded b. controlled

c. impacted d. expected

8. Dr. Smith ..... his success to working hard.

a. attitudes b. attends

c. attaches d. attributes

B. Fill in the blanks with the appropriate forms of the words given.

1. evident

a. I can't find any ..... to support my theory.

b. ....., no one has done research in this field before.

c. This room is so dirty that it is ..... that no one has cleaned it lately.

d. The police were in ..... whenever the President appeared in public.

2. hypothesis

a. If we accept these ....., they may provide some explanations for the recent changes in the weather.

b. He asked me how I would deal with this case if I were the judge, but that is a purely ..... situation.

c. He put forward the ..... that the bones belonged to mammoths living 3000 years ago.

d. It is ..... possible for him to overrule their decision, but highly unlikely.

3. idealize

a. She tends to ..... the time she spent in the Middle East.

b. His books give a rather ..... picture of life in 19th-century Italy.

c. That is my ..... of what a university should be like.

d. Kish is an ..... place for a holiday.

e. ....., we should have twice as much room space as we have now.

4. illustrate

a. He is going to compile a beautifully ..... book about the plants growing in this area.

b. The ..... of his book are better than the text.

c. Mr. Smith is the ..... of this book.

d. His story about Gharoon ..... his true generosity very clearly.

e. The teacher tried to provide some ..... examples to explain the deep meaning of Shakespeare's poems.

5. investigate

a. Dr. Miller is a famous ..... .

b. The police are ..... the crime.

c. He has been ..... and found blameless.

d. The ..... about his mysterious death has not been finished yet.

6. recognize

a. I ..... professor Tabesh the moment he walked in.

b. Mrs. Watson has a British accent, which is very ..... .

c. Her accent is ..... British.

d. My ..... of English words has increased greatly.

7. sense

a. I could ..... how sad she was feeling.

b. You should have had enough ..... to turn off the electricity supply before disconnecting the wires.

c. Don't be so .....; I was not criticizing you.

d. Your impolite manner really wounded her ..... .

e. She felt faint in the hot room, but going out and taking in the fresh air she quickly regained her ..... .

8. speculate

a. The police are ..... that this incident might be linked to a similar attack two weeks ago.

b. It is not a matter for ..... .

c. He has been ..... in oil shares and lost a lot of money.

d. Professor Miller is strongly opposed to ..... philosophy.

C. Fill in the blanks with the following words.

called	clarity	decrease	exists
hearing	lengthen	music	offending
produced	pressure	refer	time

Almost everybody has experienced temporary hearing difficulty (often with tinnitus) after being exposed to high sound levels of one kind or another, such as loud ....., construction noise, lawn mowers, subways, etc. This short-term ..... in hearing sensitivity is sensorineural in nature and is ..... a temporary threshold shift (TTS). In general, a TTS can be ..... by sound levels greater than about 80 dB sound ..... level (SPL). As the intensity and/or duration of the ..... sound increases, the size of the TTS gets bigger and the ..... it takes for recovery gets longer. A permanent threshold shift (PTS) ..... when the TTS does not recover completely, that is, when ..... sensitivity does not return to normal. Because PTS could ..... to just about any permanent hearing loss, we generally ..... the term to noise-induced permanent threshold shift (NIPTS) for ..... . The nature and severity of a NIPTS is determined by the intensity, spectrum, duration, and time course of the offending sounds; the overall duration of the exposures over the years; and the patient's individual susceptibility to the effects of noise.

D. Put the following sentences in the right order to form a paragraph. Write the corresponding letters in the boxes provided.

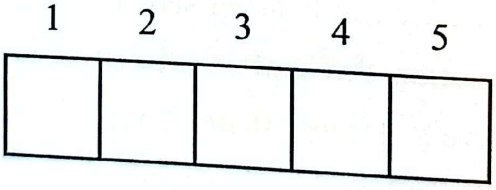
a. Accordingly, hearing status in each ear and the adequacy of a given amplification device should be closely monitored.

b. The prevalence of renal disease, diabetes mellitus, and hypertension are high in the elderly.

c. In addition, the hearing loss characterizing persons suffering from chronic renal failure and diabetes mellitus often fluctuates in severity depending on the individual's medical condition.

d. Although the incidence of hearing loss in persons suffering from these medical conditions is variable, the configuration and type of loss is consistently high-frequency bilateral and sensory-neural.

e. However, it is difficult to isolate the etiology of hearing loss in these individuals, because the drugs taken to control the conditions may be ototoxic.



Section Two: Further Reading

Sudden Hearing Loss

Sudden hearing loss means the rapid onset of a hearing loss, which might develop instantaneously, overnight, or over the course of a few days. The

hearing loss is usually unilateral, but it can be bilateral, and any degree of severity is possible. It is almost always accompanied by tinnitus, and a feeling of pressure or fullness in the affected ear(s) is also very common; vertigo may or may not be present.

The possible etiologies that must be considered as the cause of sudden hearing loss include a variety of viral infections; perilymphatic fistula; interference with the cochlear blood supply due to, for example, vascular disease, blood disorders (e.g. sickle cell), embolisms, and vascular spasms; perilymph hypertension; rupturing of Reissner's membrane; Meniere's disease; and acoustic tumor. Recent head trauma, acoustic trauma, and exposure to ototoxic drugs are often omitted from the list, but the author has come across cases of sudden hearing loss attributable to each of these. Finally, we cannot forget that impacted cerumen as well as acute Eustachian tube occlusion can also lead to sudden hearing loss. It is true that these conductive disorders are not what we have in mind here, but we do not know the cause until after the patient has been seen. No matter what the etiology eventually turns out to be, a current complaint of sudden hearing loss constitutes a medical emergency.

The expected course of sudden hearing loss is difficult to project, because it depends on the underlying cause of the symptoms. Sometimes the loss resolves spontaneously. Some cases are responsive to medical or surgical treatment, which may have to be initiated quickly to avert a permanent hearing loss. Others are permanent, and others still may be progressive. The treatment for sudden hearing loss is usually medical, and might consist of corticosteriods, vasodilators, anticoagulants, rebreathing of 95% oxygen/5% carbon dioxide, diuretics, and/or a low-sodium diet, depending on the diagnosis. Outcomes run the gamut from no effect to dramatic improvement. Unfortunately, controlled studies of treatment effectiveness for sudden hearing loss are distinguished by their absence. Byle (1984) found no better results for any treatment than what would have

been expected from spontaneous recovery. When specific underlying causes are identified (e.g. Meniere's disease, underlying systemic diseases, acoustic tumor), they are treated appropriately. Surgery may be indicated if there is evidence of a perilymphatic fistula.

Gelfand (2001)

Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

..... 1. The rapid onset of hearing loss, always developing during a few days, is called 'sudden hearing loss'.

..... 2. Sudden hearing loss is always accompanied by vertigo.

..... 3. Ototoxicities, recent head trauma and acoustic trauma can also be considered as etiologies of sudden hearing loss.

..... 4. Surgical interventions may be recommended when sudden hearing loss is attributable to acute Eustachian tube occlusion.

..... 5. As the onset of sudden hearing loss depends on the underlying cause of the symptoms, its expected course is difficult to project.

..... 6. Usually, the onset of sudden hearing loss affects just one ear.

..... 7. Both surgical and medical interventions can be used for treating sudden hearing loss.

..... 8. Surgical management is used for treating permanent hearing loss.

..... 9. Usually, medical interventions are used for treating sudden hearing loss.

..... 10. Unilateral hearing loss is almost always accompanied by tinnitus.

B. Choose a, b, c, or d which best completes each item.

1. The main idea of the first paragraph is to introduce the ..... of sudden hearing loss.

   a. management
   b. treatment
   c. etiologies
   d. symptoms

2. Which of the following symptoms always happens at the same time that sudden hearing loss occurs?

   a. bilateral hearing loss
   b. vertigo
   c. tinnitus
   d. a feeling of pressure in the affected ear(s)

3. 'Others' in paragraph 3, line 5 refers to other kinds of ..... .

   a. surgical treatment used for resolving sudden hearing loss
   b. sudden hearing loss
   c. the symptoms of sudden hearing loss
   d. medical interventions used for treating sudden hearing loss

4. In paragraph 2 the writer implies, but does not directly state, that ..... .

   a. the rapid onset of hearing loss can be due to exposure to ototoxic drugs, as well as acoustic and recent head traumas
   b. recent head trauma, acoustic trauma and ototoxicities cannot be considered as etiologies of sudden hearing loss
   c. impacted cerumen may not lead to sudden hearing loss
   d. acute Eustachian tube obstruction cannot be regarded as a cause of sudden hearing loss

5. All of the following etiologies are considered as factors leading to interference in the cochlear blood supply except ..... .

   a. vascular disorders
   b. perilymph hypertension
   c. emolisms
   d. blood disorders

6. In paragraph 2 the writer has broadly explained the ..... sudden hearing losses.

a. diagnostic bases of
b. symptoms and signs of
c. complications associated with
d. possible causes of

7. In paragraph 2 ..... possible etiologies causing sudden hearing loss are mentioned.

a. eleven
b. ten
c. twelve
d. nine

8. The word 'outcomes' in paragraph 3, line 9 refers to the results of the ..... hearing loss.

a. on-time diagnoses of sudden
b. medical interventions used for treating of sudden
c. surgical or medical interventions used for treating progressive
d. surgical treatments used for curing permanent

9. According to the last paragraph, when sudden hearing loss is attributable to ....., surgical intervention may be recommended.

a. rupturing of Reissner's membrane
b. a head trauma
c. a perilymphatic fistula
d. acute Eustachian tube occlusion

10. The best title for the last paragraph would be '.....' .

a. Underlying Causes of Sudden Hearing Loss Symptoms
b. Characteristics of Progressive Hearing Loss
c. Medical and Surgical Management of Sudden Hearing Loss
d. Complications Accompanying Sudden Hearing Loss

C. Write answers to the following questions.

1. What is 'sudden hearing loss'?
2. What are the symptoms of sudden hearing loss?
3. What are the etiologies of sudden hearing loss?

4. How can the expected course of sudden hearing loss be projected?
5. What kinds of treatment can be used for sudden hearing loss?
6. When should a surgical treatment be indicated for treating a patient suffering from sudden hearing loss?
7. What kind of medications can be prescribed for the treatment of sudden hearing loss?
8. How can the treatments's effectiveness for sudden hearing loss be determined?

Section Three: Translation Activities

A. Translate the following passage into Persian.

Auditory Neuropathy

The term **auditory neuropathy** refers to hearing disorders in which physiological tests show that the eighth cranial nerve or the lower auditory brainstem is functioning abnormally even though the outer hair cells are operating normally. Radiological tests do not show retrocochlear lesions of the types just described, such as tumors or multiple sclerosis. Auditory neuropathy occurs among all ages from infancy throughout adulthood. The hallmark of auditory neuropathy is (1) a *neural abnormality* demonstrated by an absent or very abnormal *auditory brainstem response (ABR)* in spite of (2) *normally functioning outer hair cells,* which may be shown by normal results for *otoacoustic emissions* or *cochlear microphonics*. Other tests of auditory neural integrity also shown abnormalities, such as absent *acoustic reflexes* and absent *masking level differences*. Patients with auditory

neuropathy can have sensorineural hearing loss of any degree from mild to severe, and their speech recognition performance is usually poorer than what would be expected on the basis of the pure-tone audiogram. In contrast to sensorineural hearing loss of cochlear origin, those with auditory neuropathy derive little if any benefits from the use of conventional hearing aids, and effective treatment approaches are still being sought for these patients.

B. Find the Persian equivalents of the following items and write them in the spaces provided.

1. acoustic trauma .....
2. acoustic tumor .....
3. anticoagulants .....
4. atrophy of neurons .....
5. auditory impairments .....
6. diuretics .....
7. hyperostosis .....
8. Meniere's disease .....
9. metabolic disorders .....
10. neural presbycusis .....
11. noise exposure .....
12. ototoxicity .....
13. perilymphatic fistula .....
14. phonemic regression .....
15. pure presbycusis .....
16. sensory presbycusis .....
17. spiral lamina .....
18. spiral ligament .....
19. vascular disorders .....
20. vasodilators .....
21. vertigo .....