Diagnostic Audiologic Testing

There are a variety of evaluative measures, which can be utilized to obtain information on the auditory status of infants and young children. Diagnostic audiologic evaluations for infants and children can be divided into two categories: electrophysiologic and behavioral testing.

a. Electrophysiologic testing includes any type of hearing test, which does not require the infant or child's participation in terms of a behavioral response. Electrophysiologic testing can be performed on patients ranging in age from infancy to adulthood.

Examples of electrophysiologic testing which yield information regarding auditory status include:

1. **Otoacoustic Emissions (OAE):** OAE measures assess auditory function up to and including the outer hair cells of the cochlea. OAE's are elicited by direct acoustic stimulation (via tonal stimuli used in Distortion Product Otoacoustic Emissions - DPOAE and click stimuli in Transient Evoked Otoacoustic Emission - TEOAE) and are recorded by a small microphone placed in the ear canal. The presence of an OAE is correlated with hearing thresholds of 30 dBHL or better. Administration of OAE screening can be adversely affected by the presence of debris in the ear canal or middle ear pathology.
2. **Diagnostic Auditory Brainstem Response (ABR) testing** : Diagnostic ABR measures assess auditory function up to and including the level of the brainstem. The auditory system is stimulated by a brief acoustic signal (clicks or tone bursts), which is presented to each ear via air or bone conduction. Surface electrodes placed on the vertex, forehead and mastoids (or earlobes) record the resulting neuro-electrical activity. ABR is assessed based on the identification of waveforms in both their morphology and measurement of absolute and interwave latencies. Diagnostic ABR provides ear specific information with some frequency specificity within 5-15dB of behavioral thresholds. In addition, ABR can be useful in detecting brainstem pathology. Infants should be asleep or in a quiet state in order to successfully undergo ABR testing. Infants under the age of 4 months can usually undergo the testing under natural sleep conditions, however older infants and children may require sedation for completion of this test.
3. **Tympanometry:** Tympanometry studies do not provide information regarding a child's hearing, but do offer diagnostic information regarding the integrity of the child's middle ear. The test is performed by placing a small test probe at the opening of the ear canal. The probe contains a microphone, a probe tone and an air-pressure device, which can gently alter the air pressure within the ear canal. The microphone measures the reflected tone from the tympanic membrane as the air pressure within the ear canal is manipulated. The tympanometer will generate a graph (called a tympanogram) which will provide information on the condition of the middle ear, aiding in the diagnosis of otitis media, tympanic membrane perforation, impacted cerumen, eustachian tube dysfunction as well as to assess the function of pressure equalization tubes.
4. **Acoustic Reflex testing:** Acoustic reflex testing measures the response of the stapedius muscle, which contracts when a loud sound is heard. The presence or absence of an acoustic reflex as well as the decibel level needed to elicit a reflex can provide important diagnostic information regarding the severity and type of hearing loss measured.
5. **Auditory Steady State Response (ASSR):** The auditory steady state response (ASSR), also called the steady state auditory evoked potential (SSEP) is an auditory evoked potential elicited through the use of modulated pure tones which can be used to predict hearing sensitivity of individuals of all ages. ASSR technology is particularly sensitive in differentiating between severe to profound hearing loss. In addition, ASSR can be recorded at intensities very near behavioral thresholds at the frequency under test in both normal and hearing-impaired ears.

b. Behavioral audiologic evaluation measures for children (6 months corrected age and older) include:

1. **Visual Reinforcement Audiometry (VRA):** The VRA technique typically utilizes a light or animated toy placed at a 90 degree angle to one side of the infant, which is flashed on and off to reinforce a head turn response to the sound stimulus. The sound stimuli may consist of frequency-

modulated pure tones, speech or narrow-band noise. During training trials, the audiologist will simultaneously present the sound stimuli concurrently with the visual reinforcer. Once the baby has become familiar with the paired presentations, the sound stimulus will be presented in isolation. When the baby's head turn response occurs, the visual reinforcement is activated. Stimulus intensity can then be decreased in order to determine the softest level where a head turn response can be obtained. The testing can be then be repeated using a variety of frequencies.

2. **Conditioned Orienting Response Audiometry (COR):** COR differs from VRA in that two separate visual reinforcers are used. Reinforcers are placed 90 degrees to either side of the infant's head with sound stimuli delivered either through matched soundfield speakers or via insert earphones. The task is for the infant to hear the stimulus and be able to localize to the source of the stimulus. Once the child correctly turns their head toward the sound source, the visual stimulus is presented on that side to reinforce their correct response.
3. **Conditioned Play Audiometry** : Children in the age range between 24 months and 5 years can undergo assessment of their hearing status through the use of conditioned play audiometry. Using this technique, the child is engaged in a game like activity whereby they are asked to perform a specific task (e.g., dropping a block in a bucket or putting a piece in a puzzle, etc.) every time a sound is heard. Sound stimuli can be presented via speakers in soundfield, through earphones, or through the use of a bone conduction oscillator.