

Screening Children 3 – 5 Years of Age for Permanent Hearing Loss: Factors to Consider with Pure Tone and Otoacoustic Emissions Screening Methods



In determining an optimal hearing screening strategy for children 3 – 5 years of age, providers are advised to work with a local audiologist to determine the screening method(s) best suited to their setting and population. Since the mid-1960's, pure tone (PT) screening has been used widely to screen school-aged children for permanent hearing loss (PHL) and employed on a more limited scale with preschool children. In the mid-1990's, otoacoustic emissions (OAE) technology began to be used extensively in hospital-based universal newborn screening efforts and since that time has become the recommended method for screening children 0 – 3 years of age in early care and education settings.



Pure Tone Screening

Many audiologists regard PT screening as the “gold standard.” Others assert that OAE technology is equally effective in identifying the most common types of PHL and see it as the most practical and objective tool that lay screeners can use in school, home and healthcare settings to reliably screen preschool children.

The American Academy of Audiology specifically recommends:

- OAE screening for children 0 - 3 years of age.
- PT screening for children 3 - 5 years of age with OAE screening for the subset who cannot complete PT screening.



Otoacoustic Emissions Screening

Approximately 20% of children 3 – 5 years of age are typically unable to complete PT screening because the procedure requires them to consistently raise a hand or complete a simple task in response to sound. To ensure that all children are screened, providers conducting PT screening will therefore need to either purchase additional OAE screening equipment and provide training to screeners on both procedures or make provisions for this subset of children unable to complete PT screening to be referred to a pediatric audiologist.

Some audiologists point out that formal guidelines are slow to reflect current research and contextual considerations. They suggest OAE screening as a more practical primary screening tool because it is objective, can be used on children 0 – 5 years of age, and eliminates the need to purchase two types of equipment and train lay screeners to become proficient on both. The American Speech-Language Hearing Association Practice Portal proposes that the implementation of hearing screening protocols and equipment should be guided by the specific goals, target population, available personnel and the program-specific needs and/or limitations of the individual hearing screening program.

When determining which screening method(s) would be optimal for children in a specific setting, it is important for administrators and decision-makers to check state regulations and consult with a local audiologist, keeping in mind that: 1) the selected procedure needs to be simple enough to be performed reliably by lay screeners; 2) screening is not diagnostic—it is intended to identify children who need further audiologic evaluation to determine whether a permanent sensory or conductive hearing loss is present; and 3) neither PT nor OAE screening will identify all children with every type/degree of hearing disorder (very mild loss, auditory neuropathy spectrum disorder, central auditory processing disorder, etc.)

Audiologists and other professionals serving preschool children are advised to consider the following issues when choosing or recommending the most appropriate screening tool:

OAE and PT Screening Consideration Comparison

Considerations	Otoacoustic Emissions Screening	Pure Tone Screening
Portion of the auditory system assessed for permanent hearing loss (PHL)	<ul style="list-style-type: none"> Provides measure of cochlear (inner ear) outer hair cell function (most common site of PHL) while also providing information on pathway from the outer to inner ear 	<ul style="list-style-type: none"> Provides information about the entire auditory system including the child's ability to both listen and respond
Sensitivity* Specificity**	<ul style="list-style-type: none"> 55% to 100% 71% to 91% 	<ul style="list-style-type: none"> 50% - 98% 78% - 92%
Temporary/ fluctuating hearing loss	<ul style="list-style-type: none"> Screening more likely to refer children with temporary/ fluctuating hearing loss in outer/middle ear 	<ul style="list-style-type: none"> Screening less affected by temporary/fluctuating hearing loss in outer/middle ear
Age range	<ul style="list-style-type: none"> Can be used with all ages 	<ul style="list-style-type: none"> Cannot be used reliably with children under 3 years of age or approximately 20% of children 3 - 5 years of age who cannot be conditioned to respond
Child engagement & cognitive requirements	<ul style="list-style-type: none"> Child must tolerate probe in ear No task for child to learn Child can be quietly playing, attending to a quiet distractor or sleeping 	<ul style="list-style-type: none"> Child must tolerate headphones Child must be able to consistently "listen" for the sound stimulus and reliably perform a task (such as raise a hand or put a block in a bin) in response to sound
Efficiency	<ul style="list-style-type: none"> 1 to 3 minutes 	<ul style="list-style-type: none"> 4 - 7 minutes for screening; plus 4 -5 minutes to condition child prior to screening
Objectivity	<ul style="list-style-type: none"> Objective physiological measure (independent of screener observation) 	<ul style="list-style-type: none"> Subjective measure (dependent on screener observation)
Language	<ul style="list-style-type: none"> No language barriers since no instruction by screener required 	<ul style="list-style-type: none"> Language differences between screener and child may present a barrier in conditioning a child to perform a task in response to sound
Screening settings/ locations	<ul style="list-style-type: none"> Can be conducted in varied settings (classroom where other children are present, home, clinic, etc.) 	<ul style="list-style-type: none"> Must be conducted in a room with minimal distractions
Ambient noise level	<ul style="list-style-type: none"> Can be completed where there is a moderate level of background noise 	<ul style="list-style-type: none"> Noise level must be carefully controlled
Equipment cost	<ul style="list-style-type: none"> Approximately \$3,600 per machine \$100 - \$400 annual calibration Disposable probe covers .30- \$1.00 ea. 	<ul style="list-style-type: none"> \$900 to \$1,500 per machine \$100 - \$400 annual calibration Cleaning cloths for earphones
Equipment manipulation	<ul style="list-style-type: none"> Automated screening stimulus and protocol 	<ul style="list-style-type: none"> Screener must manually present a series of stimulus tones at specific frequency (pitch) and intensity (loudness) levels
Interpretation of results	<ul style="list-style-type: none"> Automated, objective, pass/fail outcome calculated by the equipment--no screener interpretation required 	<ul style="list-style-type: none"> Screener must make repeated, subjective judgments of the child's response to the screening stimuli and "tally" the responses to determine an overall pass/fail outcome
Scope of Screener Training	<ul style="list-style-type: none"> Screener must be able to select a probe cover of the correct size, insert the probe firmly in the ear canal, manage the child's behavior, start the screening unit and record or print the pass/fail outcome provided by the screening unit 	<ul style="list-style-type: none"> Screener must be able to teach each child to listen for tones and provide the desired response, evaluate child readiness to be screened, manually vary the frequency (pitch) and intensity (loudness) of screening stimuli in a set protocol, assess and record the child's response at each level, and determine whether overall pass criteria were met

*Sensitivity is a test's ability to identify a person who has a condition (PHL).

**Specificity is a test's ability to identify a person who does not have a condition (PHL).

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