Hearing Loss, Unilateral: Speech Therapy

Indexing Metadata/Description

› Title/condition: Hearing Loss, Unilateral: Speech Therapy
› Synonyms: Hard-of-hearing; mild hearing impairment; unilateral hearing impairment; unilateral congenital hearing loss; unilateral acquired hearing loss; single-sided deafness (SSD); monaural deafness; individuals with minimal hearing loss
› Anatomical location/body part affected: Conductive hearing loss: external or middle ear. Sensorineural hearing loss: inner ear. Central (neural) hearing loss: central auditory nervous system pathways
› Area(s) of specialty: Hearing Impairment
› ICD-9 codes
  • 389.05 conductive hearing loss, unilateral
  • 389.13 neural hearing loss, unilateral
  • 389.17 sensory hearing loss, unilateral
  • 389.21 mixed hearing loss, unilateral
  • 315.34 speech and language developmental delay due to hearing loss
› ICD-10 codes
  • H90.11 conductive hearing loss, unilateral, right ear, with unrestricted hearing on the contralateral side
  • H90.12 conductive hearing loss, unilateral, left ear, with unrestricted hearing on the contralateral side
  • H90.41 sensorineural hearing loss, unilateral, right ear, with unrestricted hearing on the contralateral side
  • H90.42 sensorineural hearing loss, unilateral, left ear, with unrestricted hearing on the contralateral side
  • H90.71 mixed conductive and sensorineural hearing loss, unilateral, right ear, with unrestricted hearing on the contralateral side
  • H90.72 mixed conductive and sensorineural hearing loss, unilateral, left ear, with unrestricted hearing on the contralateral side

(IDC codes are provided for the readers’ reference, not for billing purposes)

› G-Codes
  • Spoken Language Comprehension G-code set
    – G9159, Spoken language comprehension functional limitation, current status at time of initial therapy treatment/episode outset and reporting intervals
    – G9160, Spoken language comprehension functional limitation, projected goal status at initial therapy treatment/outset and at discharge from therapy
    – G9161, Spoken language comprehension functional limitation, discharge status at discharge from therapy/end of reporting on limitation
  • Spoken Language Expressive G-code set
    – G9162, Spoken language expression functional limitation, current status at time of initial therapy treatment/episode outset and reporting intervals
    – G9163, Spoken language expression functional limitation, projected goal status at initial therapy treatment/outset and at discharge from therapy
G9164, Spoken language expression functional limitation, discharge status at discharge from therapy/end of reporting on limitation

- **Other Speech Language Pathology G-code set**
  - G9174, Other speech language pathology functional limitation, current status at time of initial therapy treatment/episode outset and reporting intervals
  - G9175, Other speech language pathology functional limitation, projected goal status at initial therapy treatment/outset and at discharge from therapy
  - G9176, Other speech language pathology functional limitation, discharge status at discharge from therapy/end of reporting on limitation

<table>
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<th>G-code Modifier</th>
<th>Impairment Limitation Restriction</th>
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<td>CH</td>
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<tr>
<td>CI</td>
<td>At least 1 percent but less than 20 percent impaired, limited or restricted</td>
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<td>CJ</td>
<td>At least 20 percent but less than 40 percent impaired, limited or restricted</td>
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<td>CM</td>
<td>At least 80 percent but less than 100 percent impaired, limited or restricted</td>
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<tr>
<td>CN</td>
<td>100 percent impaired, limited or restricted</td>
</tr>
</tbody>
</table>


- **Reimbursement**: Reimbursement for therapy will depend on insurance contract coverage. No specific issues or information regarding reimbursement have been identified. In the United States, eligibility for publicly funded services for unilateral hearing loss (UHL) varies among states.\(^2\)

- **Presentation/signs and symptoms**
  - Patient presents with hearing loss in one ear of any degree (mild to profound). Possible symptoms include difficulty localizing sound (understanding where the sound is coming from), difficulty understanding speech when it is directed to the impaired side, and difficulty understanding spoken language in noisy environments.\(^2\) Depending on age and developmental level, the patient might also exhibit a speech delay, language delay, and/or lower academic performance associated with the UHL.\(^28,29\)

### Causes, Pathogenesis, & Risk Factors

- **Causes**
  - The incidence of UHL in newborns has been cited as .83 in 1,000, but the prevalence in school-aged children has been found to be as high as 3-5%.\(^3,4\) The etiology varies with the nature of the hearing loss (conductive or sensorineural)
    - Chronic otitis media with effusion (OME, “glue ear”) is the most common cause of acquired conductive hearing loss in children.\(^1\) Congenital causes of conductive loss include anomalies of the pinna, external ear canal, tympanic membrane (eardrum), and ossicles
    - Sensorineural hearing loss can be congenital or acquired. Cytomegalovirus infection is the most common cause of unilateral congenital sensorineural loss.\(^5\) Many cases are of unknown etiology.\(^6\)
    - Results of a study in the United States on the etiology of severe-to-profound pediatric UHL indicated that the cause of hearing loss was identifiable in 40% of patients (N = 84).\(^22\)

- **Pathogenesis**
  - The pathogenesis will vary depending on the cause of the hearing loss
Risk factors
• Factors associated with UHL
  – Family history of hereditary sensorineural hearing loss(22)
  – In utero infection(1)
  – Maternal infections, including cytomegalovirus (CMV) and herpes(32)
  – Premature birth(32)
  – Exposure to drugs or alcohol in utero(32)
  – Maternal diabetes(32)
  – Low birth weight(1)
  – Ototoxic medications(1)
  – Presence of a syndrome known to include sensorineural hearing loss(1) Syndromes include neurofibromatosis, osteopetrosis, Usher syndrome, Waardenburg syndrome, Alport syndrome, Pendred syndrome, and Jervell and Lange-Nielsen syndrome(2)
  – Acute otitis media(1)
  – Viral or bacterial infection of the middle ear can cause temporary conductive hearing loss(1)
• Factors associated with speech-language difficulties due to UHL
  – Early age of UHL onset(8)
  – High degree of hearing loss (severe to profound)(8)
  – Perinatal or postnatal medical complications that may lead to global or cognitive delays(8)
  – A right ear UHL(8)
  – Lack of family support(6)
  – Lower socioeconomic status(6)

Overall Contraindications/Precautions
› Protect residual hearing in impaired ear and hearing in good ear
  • Monitor hearing in both ears to ensure that hearing ability does not decrease
  • Contact a physician as soon as there is evidence of an ear infection
  • Protect both ears from noise-induced hearing loss (e.g., avoid listening to loud music for long periods of time)
 › See specific Contraindications/precautions under Assessment/Plan of Care

Examination
› History
  • History of present illness/injury
    – Mechanism of injury or etiology of illness
      - Is the UHL stable or progressive?(8)
      - What was the age of onset of hearing loss?
      - At what age was the hearing loss identified?
      - What was the age of amplification (or implant)?
      - What is the extent of hearing loss (e.g., mild, moderate, severe, profound)?
      - What is the primary indication for the speech-language evaluation (e.g., speech sound disorder, language delay)?
      - Does the patient experience any frustration with communication or learning?
      - Does the patient experience difficulty listening or paying attention in certain situations?
      - What are the situations in which the patient is experiencing the most difficulty communicating?
    – Course of treatment
      - Medications for current illness/injury: Determine what medications physician has prescribed, if any; are they being taken?
- **Diagnostic tests completed**
  - An audiologist will complete standardized and objective assessments of hearing abilities to determine the extent of UHL; review full audiology report

- **Home remedies/alternative therapies**: Document any use of home remedies or alternative therapies (e.g., acupuncture) and whether or not they help

- **Previous therapy**: Document whether patient has had speech, occupational, or physical therapy for this or other conditions and what specific treatments were helpful or not helpful

  - **Aggravating/easing factors**: Are there situations in which the patient has more difficulty hearing?

  - **Nature of symptoms**: Document nature of symptoms. Many, but not all, children with UHL have speech or language difficulties
    - Possible speech-language symptoms
      - Articulation delay or disorder
      - Language delay or disorder
      - Educational difficulties related to language
    - Difficulty perceiving and understanding speech in noise, even when the better ear is directed toward speech source
    - Difficulty perceiving speech from the affected side
    - Other symptoms
      - Poor sound localization ability
      - Overall increased listening effort
      - “Sound shadow” effect: the impaired ear hinders the ability of the functional ear, making it less sensitive to auditory signals, thereby enhancing the audiometric loss

  - **Other symptoms**: Document other symptoms patient is experiencing that could exacerbate the condition and/or symptoms that could be indicative of a need to refer to physician

  - **Barriers to learning**
    - Are there any barriers to learning? Yes__ No__
    - If Yes, describe _________________________

- **Medical history**
  - **Past medical history**: Questions regarding medical history are intended to identify 1) the type of previous and present audiological management, 2) the etiology of the hearing loss, and 3) any medical factors that might have affected speech and language development
  - **Comorbid diagnoses**: Ask patient/caregiver about other problems, including diabetes, cancer, heart disease, psychiatric disorders, orthopedic disorders, sensory problems, and hyperactivity
  - **Medications previously prescribed**: Obtain a comprehensive list of medications prescribed and/or being taken (including over-the-counter drugs)
  - **Other symptoms**: Ask patient and family about other symptoms the patient is experiencing

- **Social/occupational history**
  - **Patient’s goals**: Document what the patient and family (and teachers) hope to accomplish with therapy and in general
  - **Vocation/avocation and associated repetitive behaviors, if any**: Does the patient participate in recreational or competitive sports? Does the patient participate in any language-based recreational activities? Does patient participate in any recreational activities that may put his or her hearing at risk? Does the patient’s hearing ability influence his or her participation in activities?
  - Researchers in the United States conducted a pilot study to investigate quality of life in children with UHL aged 6-17 years using focus study groups and a pediatric quality of life measure. They concluded that children with UHL experienced some barriers due to hearing loss but learned to adapt. Scores on a measure of quality of life were not statistically different from children with normal hearing. The researchers found that children with UHL had larger variance on the Social Functioning score than their typical hearing peers, but they caution that the finding could be spurious due to small sample size
  - **Functional limitations/assistance with ADLs/adaptive equipment**: Is the patient experiencing any difficulties at work/school? Does the patient use any assistive/adaptive systems (e.g., FM system)?
– **Living environment**: To determine the quality and quantity of the patient’s opportunities to communicate, obtain information regarding the patient’s living environment.

- **Children**
  - What language is primarily used at home?
  - How many siblings does the child have?
  - Does the child receive support at school?

- **Adults**
  - Does the patient work?
  - What kind of noise is experienced at work?
  - What kind of daily communication does the patient have with colleagues/friends/family?

› **Relevant tests and measures**

- **Arousal, attention, cognition (including memory, problem solving)**: Has the patient received cognitive testing by a psychologist or psychiatrist? Document results of any cognitive evaluation.

  – Researchers in the United States conducted a pilot study of cognition in children with UHL by comparing cognitive functions of 7 children with severe-to-profound sensorineural UHL to 7 sibling controls with normal hearing and found that children with UHL had 1) reduced accuracy and efficiency of phonological processing and 2) impaired executive control function when maintaining verbal information while processing incoming irrelevant verbal information. They hypothesized that these deficits in may explain the educational difficulties experienced by some children with UHL.

  – In a study conducted in the United States, researchers compared the psychoeducational outcomes on assessments of language, reading, behavior, speech recognition in noise, and cognition in 27 children with minimal hearing loss (15 with UHL) and 26 children with normal hearing. Researchers found that levels of performance on most psychoeducational assessments were not significantly different when individuals were matched by age and level of maternal education. Significant differences on the Attention subscale of the Screening Inventory for Targeting Educational Risk (SIFTER) were found with children with minimal hearing loss described by their teachers as having greater attention problems than their normal hearing peers. Researchers hypothesized that the students struggled with selective attention. Within the group of children with minimal hearing loss, psychoeducational difficulty was associated with delays in identification of hearing loss, low maternal education, and use of amplification.

- **Specific tests and measures**

  – **Screening**: The advent of universal hearing screenings in the United States and in other developed countries has led to increased identification of children with UHL at an early age. Evaluations by specialists in otolaryngology, ophthalmology, genetics, speech-language pathology, and early intervention are recommended when sensorineural hearing loss has been detected. When retrocochlear hearing loss is suspected, a neurologic evaluation is recommended. Children with UHL sometimes exhibit subtle problems in the classroom that might go undetected by a traditional speech-language screening tool, and it is important to supplement screening information.

  - Researchers in Canada reported 20-year data on children with mild hearing loss in one Canadian region before and after the implementation of a universal newborn hearing screening program. They found that after program implementation, children with UHL were identified an average of 4 years earlier than they had been before the program; however, over half of the children who received recommendation for amplification experienced a considerable delay between identification and amplification (up to a 6-year delay).

  – **Audiological evaluation**: A comprehensive audiological assessment is performed by an audiologist and includes air and bone conduction threshold assessment, speech reception thresholds, measures of word recognition ability, tympanometry, ipsilateral and contralateral acoustic middle ear muscle reflex threshold assessment, and evoked otoacoustic emission testing.

  – **Functional auditory assessment**: Because the behavioral effects of UHL are often more subtle than those of bilateral hearing loss, functional assessment by an audiologist is recommended. Teachers can complete the SIFTER to determine if the student is educationally at risk.

  – **Oral language**: Not all individuals with UHL will exhibit problems with language; however, the prevalence of language impairment is higher among those with UHL as compared to those with normal hearing abilities. If receptive and/or expressive language difficulties are suspected, a comprehensive language assessment (language sample and standardized tests) should be performed to assess expressive and receptive vocabulary and morphosyntactic language. There are no tests of language abilities that have been standardized on individuals with UHL; hence, results must be interpreted with
caution. Recorded and transcribed language samples can also provide information on language pragmatics, mean length of utterance, vocabulary diversity, and syntax.

- In a case-control study conducted in the United States, researchers compared the language skills of 74 children with UHL and their sibling matched pairs (ages 6-12). The children with UHL had significantly worse scores than their siblings in language comprehension, oral expression, and oral composite on the Oral and Written Language Scales (OWLS). They also found that poverty was associated with similar decreases in speech-language scores. They advocate reconsideration of the common practice of withholding accommodations for children with UHL.

- Researchers in the United States compared language skills of 20 adolescents with UHL with 13 sibling controls. They found that adolescents with UHL demonstrated worse overall expressive language scores on standardized language measures than the controls. They recommended early speech-language intervention for children with UHL.

- The need for early intervention and use of amplification devices for children with UHL was advocated in a review of articles on UHL and academic performance published between 1986 and 2012. The authors of the review emphasized that UHL can lead to poorer listening in noise, poorer academic performance, and lower self-esteem.

–**Speech**

- Oral mechanism: Assess the structure and function of the oral mechanism to determine if there are any abnormalities that may interfere with speech production.

- Phonetic inventory: Using a 100-word sample (e.g., picture naming) and/or a conversational sample, take a consonant and vowel inventory to assess the distribution of sounds across word positions, syllable and word shape inventories, and word level stress patterns. A minimum of two productions of a sound is required before the sound can be credited to the phonetic inventory.

- Speech error analysis: Standardized tests or an informal (nonstandardized) analysis can be used to determine speech errors that have a high frequency of occurrence, are early developing, and are functionally important for that child and child’s family. For specific sounds, the number of omissions, substitutions, distortions, and additions can be completed. A conversational sample can be used to record any difficulties in prosody, fluency, or resonance (e.g., hypernasality).

- Phonological processes: Standardized tests can be used to classify and quantify phonological processes (patterns relating to sound errors). Children with hearing impairment often produce predictable error sound patterns (e.g., final consonant deletion).

- Sounds for treatment targets/stimulability: Methods to assess production capacity at the word level can include imitation, key positions (phonetic environment in which the target sound is successfully pronounced), keywords (a word or a limited number of words in which a sound is successfully pronounced), and phonetic placement and shaping (techniques that physically direct a person to the correct production of a target sound).

–**Phonological awareness:** If the child is at risk for reading difficulties and is at the appropriate age, assess phonological awareness (knowledge about the sound structure of language at the syllabic, intrasyllabic, and phonemic level) by use of a standardized test.

–**Academics:** Standardized and criterion-referenced tests can be used to assess reading and writing levels.

- Authors of a meta-analysis that included 4 studies (all high quality) comparing performance on intelligent quotient (IQ) tests between children with UHL and children with normal hearing reported that the children with UHL had significantly lower scores on full-scale and performance IQ tests.

- Forty-six children with UHL in the United States (ages 6-12 years) were studied over a 3-year period to determine changes in cognitive ability, academic achievement, and language. The children demonstrated improvement in oral language (from low average to average) and verbal intelligence; however, they did not exhibit improvements in academic performance. Academic weakness and behavioral problems remained areas of concern in about 25% of the children. The researchers concluded that Individual Educational Plans (IEPs) might be necessary for these children.

### Assessment/Plan of Care

› **Contraindications/precautions**

- Clinicians should follow the guidelines of their clinic/hospital/school and what is ordered by the patient’s physician or authorized by the child's school. The summary below is meant to serve as a guide, not to replace orders from a physician or a clinic's/school's specific protocols.

- Some amplification systems (e.g., BAHA [bone-anchored hearing aid]) are only approved for children above a certain age.

- Given the heterogeneity of individuals with UHL, individualization of treatment is warranted.
Diagnosis/need for treatment: If the child’s communication development is delayed for his or her age, a speech-language evaluation and treatment are warranted. A team approach is recommended to determine the developmental impact of hearing loss. At present, there are minimal studies concerning the exact effects of UHL on speech and language development.

Rule out: Bilateral loss, auditory processing disorder

Prognosis
- There is variability of academic and linguistic profiles of children with UHL, and some children do not experience educational or language problems. Prognostic factors include:
  - Age of onset of hearing loss
  - Age of identification of hearing loss
  - Level of hearing ability
  - Number of speech errors
  - Cognitive abilities
  - Etiology of hearing loss
  - Level of family support
  - Level of the family’s socioeconomic status
  - Availability of services
  - Child motivation and attention

Referral to other disciplines: Evaluations by specialists in otolaryngology, ophthalmology, genetics, speech-language pathology, and early intervention are recommended when sensorineural hearing loss has been detected. When retrocochlear hearing loss is suspected (a sensorineural hearing impairment in which the lesion is proximal to the cochlea), a neurologic evaluation is recommended.

Treatment summary
- Research studies on children with UHL are lacking and intervention recommendations are based primarily on clinical guidelines and focused on increasing the child’s school performance. At present, there are no intervention studies that have examined the effects of speech-language intervention on children with UHL. While speech and language goals are often provided by the speech-language pathologist (SLP), it is important to address the needs of children with UHL and speech-language delays within a team framework that includes, at the very minimum, an SLP, caregivers, and an audiologist.
- Early Intervention: While best practice guidelines have not yet been identified for infants and toddlers with UHL, recommendations have been made based on evidence from older children. Parents should be counseled by the audiologist or SLP on (1) amplification options, (2) the importance of a good acoustic environment, (3) the importance of creating a rich language atmosphere at home, and (4) safety issues related to poor localization ability.

- Amplification
  - The use of hearing aids and FM systems for children with UHL has evidenced some success, but little research exists to guide the audiologist in the selection and fitting of hearing aids for children with UHL. Parents should be informed by the audiologist about all possible amplification options for when their child is of eligible age.

- Acoustic environment
  - When the caregiver holds a baby or infant, the normal ear should be facing the speaker.
  - The parent should avoid allowing the normal ear to be facing a noise source (e.g., dishwasher)
  - The parent should be encouraged to make eye contact, use facial expressions and ensure that the infant can see the speaker’s face (e.g., good lighting) during communication interactions.
  - The speaker should obtain child’s attention before speaking.

- Language-rich environment
  - To encourage and stimulate language, the parents can talk to the child about daily routines, use repetition, play listening games, read books aloud, start conversations, and take turns talking.

- Localization ability
  - The parents can assist the child to localize sound by providing visual cues.
• Amplification for Children: In a study conducted in Canada in which researchers described clinical practices following universal newborn hearing screening, it was reported that amplification was recommended for over 90% of children who had UHL or mild bilateral hearing loss; however, only 63.3% used the amplification consistently or at school only. For the children with UHL, there was no relationship between degree of loss and use of amplification. The researchers recommended further research into the potential benefits of amplification and determinants of its use for these children.\(^\text{(27)}\)

The device should be tailored to the needs of the individual child, and caregivers/teachers should be trained on how to care for and use the system\(^\text{(13)}\).

– In a repeated measures design study (N = 6) conducted in the United States, researchers compared three types of audiological recommendations for school-aged children with UHL in different simulated classroom listening conditions (unaided, Contralateral Routing of the Signal [CROS] amplification, FM system). The CROS amplification system amplifies the signal from the poorer side by routing the signal to the better ear (wired or wireless). The FM system was the only system to produce uniformly high speech recognition scores across various listening conditions\(^\text{(14)}\). SDS scores were measured at a distance of 3, 4, 6, 8, and 10 meters to determine optimal seating distance from the speaker for a student with UHL. Researchers found that the group with UHL needed to be seated at 6.27 meters from the speaker to have equivalent scores of the normal-hearing group at 10 meters from the speaker. The researchers concluded that students with UHL require seating ranging from 4.35 meters to no further than 6.27 meters away from the teacher.

– In another study conducted in the United States, researchers compared the effectiveness of FM auditory trainers, conventional hearing aids, and CROS aids in children (N = 6) with varying degrees of UHL. Word recognition with each of the forms of amplification was evaluated both in quiet and in noise in a classroom. All 6 children in the study experienced significantly better performance in word recognition with the FM trainer. The children with the most loss derived the greatest benefit\(^\text{(16)}\).

– Bone-anchored hearing aids have been used with success in adults with UHL, but their effectiveness in children has not yet been determined. The U.S. Food and Drug Administration (FDA) restricts the use of surgically implanted bone-conduction devices in children\(^\text{(12)}\).

– Survey data suggests that some parents of children are satisfied with the use of conventional hearing aids (to poorer ear), but there is limited direct and empirical evidence to support the use of traditional hearing aids for the impaired ear in children with UHL\(^\text{(12)}\).

– In a study of 12 children with UHL in the United States, researchers investigated how age of amplification, early intervention, and degree of hearing loss affected localization ability\(^\text{(9)}\). The researchers found that a hearing aid in the impaired ear improved localization ability in children who received hearing aids and intervention at an earlier age (by the age of 5 years); however, children who received intervention at age 9 or older showed bilateral interference (localization ability decreased when the hearing aid was worn).

• Environmental modifications

– In a study conducted in Seoul, South Korea, researchers compared the speech discrimination scores (SDS) of adults, normal hearing students, and students with UHL in a simulated classroom environment\(^\text{(17)}\). SDS scores were measured at a distance of 3, 4, 6, 8, and 10 meters to determine optimal seating distance from the speaker for a student with UHL. Researchers found that the group with UHL needed to be seated at 6.27 meters from the speaker to have equivalent scores of the normal-hearing group at 10 meters from the speaker. The researchers concluded that students with UHL require seating ranging from 4.35 meters to no further than 6.27 meters away from the teacher.

• Amplification for adults: Adult patients with UHL often have difficulty localizing speech or sound, understanding speech in the poorer ear, and understanding speech in background noise. Audiological management is the main course of intervention with adults and includes counseling related to communication problems and providing amplification recommendations\(^\text{(18)}\). The following are possible amplification options for adults:

– CROS amplification to the better ear (wired or wireless). Published clinical guidelines have reported that few patients with normal hearing in the better ear report that any benefit attained using CROS amplification is outweighed by the harshness or tinniness of the amplified sound heard in the better ear. Thus, conventional CROS amplification has been found to be more successful with adults who have a mild hearing loss in the better ear\(^\text{(18)}\).
In a study conducted in Brazil with 30 adults with moderate to severe UHL, researchers found that use of programmable, behind-the-ear hearing aids resulted in significantly improved speech perception in noise. Baseline measures were taken prior to the hearing aid fitting and outcome measures were taken after the patients had worn the hearing aids regularly (8+ hours per day) for 3 months\(^{(36)}\).

Bone-conduction aids (eyeglass): A microphone, amplifier, volume control, and bone conduction receiver are mounted in the eyeglass arm with a vibrating pad projecting slightly toward the mastoid process on the side of the impaired ear. It delivers sound from that ear, routing it transcranially via bone conduction to the cochlea of the normal ear. A bone conduction aid might allow better awareness of sound arriving on the side of the poorer ear. Published clinical guidelines have suggested that bone conduction aids do not appear to improve localization significantly or the recognition of speech dramatically in high levels of background noise for most patients, but despite these drawbacks, many patients prefer this type of amplification to the CROS\(^{(18)}\).

BAHA: A BAHA is another type of bone-conduction hearing aid for which the patient undergoes outpatient surgery in which a titanium screw and abutment are implanted into the mastoid process on the side of the poorer ear. The advantage of the BAHA is that it transmits amplified sound directly through the skull without interference from the intermediate tissue. The patient might be a BAHA candidate if he/she:
- Is at least 5 years old
- Has better air conduction pure-tone average (ACPTA) at 500, 1000, 2000, and 3000 that is 20 dB HL or better
- Is free from a disease that may prevent good wound healing
- Is unable to use conventional air or bone conduction hearing aids
- Is strongly motivated toward this surgical procedure
- Is able to understand the objectives of this amplification
- Is able to maintain the hygiene of the percutaneous abutment\(^{(18)}\).

In a study conducted in the United States involving 23 children with unilateral deafness who received BAHAs over a 3-year period concluded that a BAHA can improve hearing in noise and in listening difficulties in children with profound UHL\(^{(19)}\). The complication rate among the subjects was 17% (n = 4).

In a study conducted in India with 24 adults with unilateral hearing loss, researchers found that digitally programmable BAHAs provided a significant hearing benefit in both quiet and noise; speech identification scores improved 20-40% after implantation of the BAHA\(^{(33)}\). Authors of a retrospective study conducted in the United Kingdom with 90 adults with unilateral sensorineural hearing loss, researchers found that almost half of the patients who were considered candidates for implantation of a BAHA declined the procedure because they did not perceive any benefit in pre-implantation trials\(^{(34)}\).

Cochlear implants:
- Authors of a systematic review published in 2016 that included 17 articles investigating the effectiveness of cochlear implants in patients with UHL reported that there were no high-quality studies (i.e., randomized controlled trials) and there was a high degree of heterogeneity among the patients included in the studies. For these reasons, it was difficult for the authors to make firm conclusions about the effectiveness of cochlear implantation for UHL. In general, the results of the studies included in this review indicate that cochlear implantation does tend to improve sound localization, speech perception, and tinnitus in individuals with UHL\(^{(35)}\).
- Authors of a systematic review published in 2016 that included 5 studies on cochlear implantation on children with unilateral hearing loss concluded that although speech perception in noise, sound localization ability, speech and language abilities, and quality of life were each reported to improve in at least one study in the review, the overall level of evidence was low. The review authors could not make any conclusions on the efficacy of cochlear implants for children with UHL due to small sample sizes, heterogeneity of study populations, and low quality studies\(^{(38)}\).

Sound localization training
- In a study conducted in the United States with 11 adults with severe to profound UHL, researchers investigated the effectiveness of a sound localization training program. For the pretraining, training, and posttraining assessment, participants sat facing an arc of 15 loudspeakers, each placed 10° apart. In pre- and posttraining assessments, a monosyllabic word was played from one of the loudspeakers at 60 dB SPL and the participants were asked to identify which loudspeaker played the word. During the 5 hour-long training sessions, participants were given visual and verbal cues about where the sounds were coming from and feedback was provided after each trial. Average group scores in the posttraining session were significantly improved in terms of sound localization as compared to the pretraining session.
Due to the small study size, researchers could not make firm conclusions about efficacy; however, they recommended further research on sound localization training for individuals with UHL using larger sample sizes\(^{40}\).

<table>
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<th>Problem</th>
<th>Goal</th>
<th>Intervention</th>
<th>Expected Progression</th>
<th>Home Program</th>
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<tr>
<th>Condition</th>
<th>Overview</th>
<th>Referral</th>
<th>Progress each patient as appropriate and indicated</th>
<th>Appropriate home activities and educational material may be provided to the patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language delay or disorder</td>
<td>Resolve language or speech delay or disorder</td>
<td>An audiologist should be consulted regarding amplification. The device should be tailored to the needs of the individual child and caregivers/teachers should be trained on how to care for and use the system.</td>
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<td>Speech (articulation) delay or disorder</td>
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<tr>
<td>Localization difficulties</td>
<td>Improve phonological awareness</td>
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<td>Poor phonological awareness</td>
<td>Speech-language goals will depend on assessment outcomes and can include increasing speech intelligibility by reducing error sounds, increasing language ability (e.g., vocabulary, syntax, narrative ability), or targeting academic needs such as phonological awareness and text comprehension</td>
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<td></td>
<td>Language intervention</td>
<td>The primary purpose of language intervention is to increase communication skills, including vocabulary and syntax. Long-term effects on language development are minimal in children with UHL, and there are no present studies on language intervention in this population. Goals should be formed on the basis of a thorough language assessment and tailored to their communicative needs</td>
<td></td>
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<tr>
<td></td>
<td>Speech/articulation intervention</td>
<td>The primary purpose of speech/articulation invention is to improve speech intelligibility. Possible goals include increasing phonetic and phonemic repertoires and correcting error sounds. There are no present studies on speech intervention with children with UHL. Guidelines can be taken from studies on children who have a hearing impairment or phonological difficulties</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please see Treatment summary, above
| Difficulty understanding speech in noise (speech discrimination)\(^{(6)}\) | Reduce adverse acoustic conditions | **Comprehension/listening**  
Children with UHL benefit from environmental conditions that have reduced noise | N/A | Appropriate home activities and educational material may be provided to the patient |
|---|---|---|---|---|
| **Therapeutic strategies**  
Classroom modifications that might help to enhance listening include the use of: | | | | |
| Barrier walls for small group activities\(^{(2)}\) | | | | |
| Sound absorbing materials like carpet and draperies\(^{(2)}\) | | | | |
| Tennis balls on chair legs in rooms without carpet\(^{(2)}\) | | | | |
| Seating away from noise (e.g., air conditioners, overhead projectors, doorways, windows)\(^{(2)}\) | | | | |
| Provide preferential seating for the child (e.g., front of class with seating positioned with normal ear towards teacher)\(^{(2)}\) | | | | |
| Please see *Treatment summary*, above | | | | |
Educational difficulties\(^{(5)}\)

Attention difficulties

Social-emotional/behavioral difficulties\(^{(8)}\)

<table>
<thead>
<tr>
<th>Therapeutic strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher strategies include:</td>
</tr>
<tr>
<td>Visual cues (e.g., pointing to the person who speaks next) to assist the child in turning towards the speaker(^{(2)})</td>
</tr>
<tr>
<td>Calling the child’s name before giving instructions(^{(2)})</td>
</tr>
<tr>
<td>Facing the child while speaking(^{(2)})</td>
</tr>
<tr>
<td>Please see Treatment summary, above</td>
</tr>
</tbody>
</table>

Desired Outcomes/Outcome Measures

› Resolved language or speech delay or disorder
› Improved sound localization
› Improved phonological awareness
› Reduced adverse acoustic conditions
› Resolved educational, attentional, and social-emotional/behavioral difficulties
› Improved quality of life

Maintenance or Prevention

› Regular screening of children with UHL should be performed to determine if hearing sensitivity remains stable in both ears.\(^{(8)}\) Audiograms are recommended every 3 to 4 months in the first year after the hearing loss is identified to monitor any progression of hearing loss. In some cases, UHL has been found to be an initial manifestation of bilateral auditory dysfunction and it is important to monitor hearing in both ears.\(^{(21)}\) After hearing is determined to be stable, annual audiograms are recommended. Management of recurrent otitis media and chronic otitis media with effusion will minimize the effects of a conductive loss\(^{(8)}\)

Patient/Family Education


Note

› Recent review of the literature has found no updated research evidence on this topic since previous publication on April 3, 2015
### Coding Matrix

References are rated using the following codes, listed in order of strength:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFR</td>
<td>Published research (randomized controlled trial)</td>
</tr>
<tr>
<td>RV</td>
<td>Published review of the literature</td>
</tr>
<tr>
<td>RU</td>
<td>Published research utilization report</td>
</tr>
<tr>
<td>QI</td>
<td>Published quality improvement report</td>
</tr>
<tr>
<td>L</td>
<td>Legislation</td>
</tr>
<tr>
<td>PDR</td>
<td>Published government report</td>
</tr>
<tr>
<td>PFR</td>
<td>Published funded report</td>
</tr>
<tr>
<td>X</td>
<td>Practice exemplars, stories, opinions</td>
</tr>
<tr>
<td>GI</td>
<td>General or background information/texts/reports</td>
</tr>
<tr>
<td>PU</td>
<td>Unpublished research, poster presentations or other such materials</td>
</tr>
<tr>
<td>CP</td>
<td>Conference proceedings, abstracts, presentation</td>
</tr>
</tbody>
</table>

### References
