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MANAGEMENT OF HEARING IMPAIRMENT IN CHILDREN

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Abstract

Hearing loss in children is often a silent and hidden handicap. Children with hearing loss frequently appear to be normal, and often their handicaps are not apparent. Hearing loss that is undetected and untreated can result in speech, language, and cognitive delays. Early identification and intervention with hearing inquired child improve language, communication, and cognitive skills. Sudden or progressive sensorineural hearing loss accompanied by dizziness following barotrauma should prompt consideration of traumatic perilymph fistula. Early surgical exploration is recommended to improve hearing and vestibular symptoms.

Key words: Children, Hearing loss, Identification, Treatment, Language, Communication, Cognitive skills, Mother, Nurse or Babysitter Checklist.

Review, Discussion and Comments

Treatment options for children with hearing loss depend upon the etiology. The underlying cause is addressed whenever possible. As examples, acute otitis media is treated with antibiotics, impacted cerumen is removed, and ototoxic drugs that cause reversible hearing loss are stopped if alternate therapy is available. Surgical intervention is necessary for some conditions (Watkin *et al*, 2007).

The amplification devices are recommended for children with bilateral sensorineural hearing loss or long-term conductive hearing loss. Cochlear implants are an option for children with profound bilateral hearing loss who do not benefit from traditional amplification (Vohr *et al*, 2008).

Multidisciplinary Team:

All the children with permanent hearing loss should be managed by a multidisciplinary team that includes audiologists, otolaryngologists, speech pathologists, geneticists, and educational specialists. In addition, because these children rely on sight for communication and learning, they should be referred to a pediatric ophthalmologist (Callison, 1999).

The hearing impaired child should also be referred to the appropriate educational agency. In some states, referral is mandatory within a limited time after identification. The local school district or early childhood intervention agency

is equipped to provide educational guidance for the special needs of hearing-impaired children. Educational options vary according to the degree of hearing loss and cognitive ability of the child. Improvement of communication skills is the basic goal of early education programs for hearing-impaired children. Most agencies work with the team of professionals to establish an individual treatment plan for each child.

Surgical Management:

Surgical intervention is indicated for some conditions associated with hearing loss. Tumors and cholesteatomas, for example, require surgical excision. Children with fluctuating or progressive sensorineural hearing loss may need surgical exploration for and repair of a perilymph fistula (Park *et al,* 2012).

Some of the conditions that cause conductive hearing loss can be treated with either surgery or amplification (Gaines and Jones, 2013). The otosclerosis or other ossicular chain abnormalities secretory otitis media without response to medical treatment, stenosis of the external auditory canal after penetrating trauma, and atresia of the external auditory canal if no associated abnormalities are documented on the temporal bone computed tomography (Jahrsdoerfer, 1980).

Hearing Aids and Assistive Devices:

The first step in providing successful hearing amplification is for the audiologist and the parents, child, and other family members to agree that the child has hearing loss and will benefit from a hearing aid. A second opinion is sometimes necessary. Parents should know that hearing aids do not necessarily restore hearing to normal, but can be expected to improve hearing. Amplification before the age of six months improves language outcome (Yoshinaga-Itano, 1995).

Hearing Aids:

1- Selection: A range of hearing aid styles, types, and costs is available. The choice of a hearing aid for each child is made on an individual basis in consultation with an audiologist and the parents.

2- Fitting: The results of the formal audiologic evaluation are used to determine the best hearing aid for the child based on age, level of hearing loss, and type of hearing loss.

In young children, it may be difficult to know whether a hearing aid is correctly fit or too loud. Measurement of sound intensity in the ear canal with a tiny microphone (Real Ear) can address this problem (Winter and Eisenberg, 1999). Computer programs are available that use real ear measurements or simulated real ear measurements to help the audiologist determine whether a particular device is appropriate for a given child. The desired sensation level (DSL) approach estimates a frequency gain target that amplifies speech to audible levels across a broad frequency range and is beneficial in fitting hearing aids for very young children (Olsen, 2008).

3- Style: The styles of hearing aids available include bone conduction, behind-the-ear, in-the-ear, and completely-in-the-canal instruments. Bone conduction hearing aids are used for chil-

dren who have atretic ears or chronic otorrhea (Jaber *et al*, 2013).

Most hearing aids fit for children are behind-the-ear instruments because the earmold that is coupled to the ear is easily remade as the child grows. In-the-ear and in-the-canal instruments are more cosmetically appealing to teenagers; these devices are appropriate only for hearing loss less than 80 dB.

Electronic Features:

Electronic circuitry and signal processing options also must be considered when selecting a hearing aid. Circuitry can be analog, digital, or digitally programmable. The advantages of digital and programmable hearing aids over conventional analog hearing aids include better sound quality, increased precision, improved speech recognition (Kuk *et al*, 1999), and flexibility of settings; disadvantage is higher cost.

Assistive listening devices:

Assistive listening systems are designed to improve hearing perception, especially in noisy environments. They consist of a microphone for the speaker, an FM transmitter, and a receiver worn by the listener. These are available as stand-alone units, or the FM receiver can be attached to a hearing aid (Rizer and Burkey, 1999). Assistive listening systems provide gain (amplification) and improve signal-to-noise ratio by eliminating background noise. Most FM assistive devices are used for educational purposes, but they can help in any listening situation.

Counseling and Education:

Parents should be encouraged to purchase an extended warranty or insurance plan for hearing aids. Most manufacturers offer extended warranties at reasonable prices. Some insurance companies specialize in coverage for hearing aids.

The fitting of hearing aids and assistive devices can be a stressful time for parents of hearing-impaired children. They may need counseling and support in addition to written information on hearing loss, hearing aids, and troubleshooting tips. Regular follow-up sessions with the audiologist are necessary to establish aided benefit, to check the fit of the hearing aids and ear-mold, and to check in with the parents.

Bone Conduction Hearing Devices:

Certain patients who are unable to benefit from a standard air conduction device (a conventional hearing aid) may benefit from a device that transmits sound directly through the skull. Bone conduction hearing aids can be held against the skull with a steel-spring headband; however, this is typically uncomfortable, cumbersome, and does not achieve good quality hearing.

In contrast, an implantable bone conduction hearing aid has significant advantages. The main implantable system available is a bone-anchored implantable hearing aid system known as BAHA. A small titanium screw is inserted and osteointegrates with the bone of the skull over several months. An abutment is attached to the screw such that a small portion of the abutment sticks out through the skin and forms an attachment point for a removable bone conduction hearing aid. The sound quality is far superior to that of traditional bone conduction hearing aids.

The BAHA may be implanted either unilaterally or bilaterally. Because 3 to 4 mm of bone is needed to ensure osteointegration, children are typically about six years of age before BAHA is feasible.

Potential indications for such an implantable system include: Congenital atresia of the ear canal such that it does not exist or cannot accommodate a standard hearing aid (provided that the nerve is functional) Chronic infection of the middle or outer ear that is exacerbated by a standard hearing aid Allergic reactions to standard hearing aids Single-sided deafness as may occur after removal of a vestibular schwannoma (acoustic neuroma), from trauma, or from a viral or vascular insult

A significant number of patients with single-sided deafness who receive a BAHA implant (and thus are receiving sound from their deaf side transmitted via bone to the hearing side) are able to localize sounds.

Cochlear Implants:

Cochlear implants are surgically implanted prosthetic devices that electrically stimulate the cochlear nerve to provide hearing. The device consists of a battery-powered external processor (that looks like a hearing aid), a receiver coil implanted below the scalp, and an electrode inserted directly into the cochlea through a surgical opening. The criteria for selecting cochlear implantation include profound bilateral sensorineural hearing loss and little or no benefit from hearing aid use after six months (Rizer and Burkey, 1999).

All cochlear implant devices (Cochlear Corporation, Med-El, and Clarion) have been FDA approved for use in children younger than 18 months; the Cochlear Corporation device has been approved for use in children as young as 12 months. Despite excellent results in many children, cochlear implantation should be considered cautiously in children younger than two years, because placement of the implant generally destroys residual cochlear function.

As to early experience of structured inputs and complex sound features generate lasting changes in tonotopy and receptive field properties of primary auditory cortex, Ranasinghe *et al.* (2012) experimentally found that the speech sound processing is resistant to changes in simple neural response properties caused by manipulating early acoustic environment. The advantage of early auditory stimulation during the "critical period" of hearing development needs to be balanced against the risks of the procedure.

Children are now offered bilateral cochlear implants, which allow them to hear better in conditions with background noise (such as restaurants), localize sound, and hear sound coming from either side without having to turn one's head. If chosen, the implants may be performed simultaneously or sequentially. If sequentially, there is no length of time between surgeries beyond which patients fail to benefit (Zeitler *et al*, 2008).

Preoperative Evaluation:

Preoperative evaluation includes a CT scan of the temporal bone to evaluate the patency of the cochlea, identify congenital malformations, and assess

surgical anatomy (Demirpolat *et al*, 2003). , MRI for inner ear and auditory nerve was done to exclude nerve aplasia (Mlynski and Plontke, 2013). Other important prerequisites include access to an education program that stresses auditory and verbal skills and highly motivated parents who have realistic expectations.

Outcome:

Cochlear implantation in children provides auditory detection over much of the speech signal and results in improved auditory discrimination and speech production (Kveton and Balkany, 1991). The language achievement of 29 prelingually deaf children three or more years after cochlear implantation was compared with the achievement of 29 prelingually deaf children who were treated with hearing aids. The children with cochlear implants had better language comprehension and production skills (Tomblin *et al*, 1999).

Children whose deafness occurs after age two years and who are deaf for short periods of time have the best language outcome (Manrique *et al*, 2004). As an example, the speech perception and production skills of three groups of children were analyzed after cochlear implantation: 70 children who were congenitally deaf, 22 children who were deafened by meningitis before two years of age, and 14 children who were deafened by meningitis after two years of age (Mitchell *et al*, 2000). The speech perception skills of the groups of children who were deafened after age two were better than those of the other two groups; no difference was found in speech perception or production skills between the two groups of children whose deafness began before age two years.

Speech perception was measured three, four, and five years after cochlear implantation in forty children who were born deaf or who became deaf before three years of age and who had no measurable speech perception before implantation with the most powerful hearing aids. Speech perception improved with time (27, 35, and 45 mean words per minute at three, four, and five years of follow-up, respectively). Improvement in speech perception was greater for children who were younger at the time of implantation and who used oral rather than total communication, as, including signing (O'Donoghue *et al*, 2000).

Meningitis Risk:

Children with cochlear implants are at increased risk for meningitis, particularly the pneumococcal meningitis. O'Mahony *et al.* (2011) reported that cochlear implants have been associated with increased risks of bacterial meningitis in children, notably but not limited to implants with a sialastic accessory piece called a positioner. They added that a fully immunized 4-year-old child with a cochlear implant without a positioner who developed *Streptococcus pneumoniae* meningitis 3 years after implantation. The case highlights the increased risk for bacterial meningitis in the presence of cochlear implants regardless of device type, immunization status, or time after implantation especially in the context of

the middle- and inner-ear structural anomalies.

Families Supports:

Jackson (2011) examined family supports after identification of children's hearing loss. He found that the quality of support was rated higher by parents of children with cochlear implants than by parents of children with hearing aids. Top-ranked sources of support included individual professionals and service providers, other parents of children with hearing loss, family support organizations, and grandparents and extended-family members. Open-ended written responses indicated that parents desired additional opportunities to connect with mentors, role models, and other parents.

Hearing Loss Avoidance Complication?

There are two primary categories of hearing loss in children, congenital (present at birth) and acquired (occurring after birth). These hearing losses may be sensorineural, conductive or mixed.

Hearing loss can affect a child's ability to develop communication, language, and social skills. The earlier children with hearing loss start getting services, the more likely they are to reach their full potential.

Varying degrees of hearing loss affect 2% children under the age of 18months. Fortunately, there are very few hearing losses that cannot be helped with modern technology. The most effective treatment is achieved through early intervention. Early diagnosis, early fitting of hearing aids, and an early start on special education programs can help maximize a child's hearing.

Routinely, the nurse performs hearing tests for babies shortly after delivery. This assures early intervention in the event that the newborn exhibits any signs of hearing loss.

Mother, Nurse or Babysitter Advices:

Birth to 3 Months: Reacts to loud sounds, is soothed by mother voice, Turns head to mother when she speaks, is awakened by loud voices and sounds, Smiles when spoken to and seems to know mother voice, and quiets down if crying

3 to 6 Months: Looks up or turns toward a new sound, Responds to "no" and changes in mother tone of voice, Imitates his/her own voice, Enjoys rattles and other toys that make sounds, Begins to repeat sounds (such as "ma-ma", and "ba-ba"), Becomes scared by loud voices

6 to 10 Months: Responds to his/her own name, a telephone ringing, or someone's voice (even when sounds are not loud), Knows the words for common things (cup, shoe) and sayings ("bye-bye"), Makes babbling sounds, even when alone, Starts to respond to requests such as "Come here", Looks at things or pictures when someone talks about them

10 to 15 Months: Plays with own voice, enjoying sound and feel of it. Points to or looks at familiar objects or people when asked to do so, Imitates simple words and sounds; may use a few single words meaning fully enjoys games like peek-a-boo and pat-a-cake

15 to 18 Months: Follows simple directions, such as "Give me the ball", Uses words he/she has learned often, Uses 2-3 word sentences to talk about and ask for things, Knows 10-20 words

18 to 24 Months: Understands simple yes/no questions (Are you hungry?), Understands simple phrases ("in the cup", "on the table"), Enjoys being read to, Points to pictures when asked

24 to 36 months: Understands "not now" and "no more", Chooses things by size (big, little), Follows simple directions such as "Get your shoes" or "Drink your milk", Understands many action words (run, jump)

Talk to the family doctor if child has a hearing problem. The following are some common risk factors:

- Do others family members, including brothers and sisters, have a hearing problem?
- Did the child's mother have medical problems in pregnancy or delivery (serious illness or injury, drugs or medications)?
- Was baby born early (premature)?
- Did baby have physical problems at birth?
- Does child rub or pull on his/her ear (s) often?
- Has child had scarlet fever?
- Has child had meningitis?
- Has child had multiple ear infections in past year?
- Does the child have cold, allergies, and ear infections often?
- Keep in mind the auditory myiasis (Morsy, 2012).

One must keep in mind that the early hearing loss detection, the best treatment outcome.

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