Use of hearing aids in infancy

Congenital sensorineural hearing loss often remains undetected until the second or third year of a child’s life. With recent improvements in screening techniques and the advent of neonatal screening programmes we expect to detect infants with severe and profound hearing loss within the first year of life and to see a significant number under the age of 6 months. It is widely accepted that the earlier the habilitation of a child with a severe or profound hearing loss starts, the better the outcome is likely to be. Markides has demonstrated better speech intelligibility in children who were fitted with amplification in their first six months of life compared with children fitted after this age. Selection and use of amplification is a part of this habilitative process.

The first problem in the selection of appropriate amplification lies in obtaining sufficient and accurate information about the child’s hearing sensitivity over the essential speech frequency range—that is, 500–4000 Hz. Once the infant reaches the age of 6 months or so and is sitting independently with good head control it is usually possible to obtain reliable information about hearing sensitivity using distraction or visual reinforcement audiometric techniques. In an infant whose developmental problems preclude this form of testing, and in infants under the age of 6 months, electric response audiometry is usually required in order to obtain reliable threshold information. The auditory brainstem response is usually the choice for threshold determination in infants. This gives threshold information about hearing sensitivity at frequencies of 500–4000 Hz. Whatever method of selection is used it is necessary to evaluate the hearing aid fitting and one method is to obtain aided sound field thresholds (using warble tone or narrow band noise stimuli) when the infant is wearing the hearing aids. This gives a measure of the amount of speech frequency information that is available to the child. It is important to avoid excessively high levels of amplification that will prove uncomfortable and lead to the child rejecting the hearing aid, but it is equally important to ensure that enough amplification is being used.

The potential of high levels of sound to damage hearing is well known. Naturally there is concern about the potential of high output levels produced by present day hearing aids to further damage the users residual hearing. This has been the subject of a number of surveys, but no conclusive evidence has been produced. Any possible risk must be weighed against the disadvantage to the child in not utilising residual hearing to the full.

Hearing aids

Hearing aids are generally relatively unsophisticated devices, although advanced signal processing systems are being developed. At present most are basically amplifiers with some facility to (i) manipulate the relative amount of amplification at different frequencies, (ii) control the maximum output, and (iii) selectively alter the gain in order to ‘compress’ a wide range of sounds to fit within the user’s dynamic range. A hearing aid basically consists of a microphone that converts the incoming sound to an electrical signal, an amplifier with a variable gain control, and a receiver that converts the amplified electrical signal back into an acoustic signal. The power supply is provided by a battery.

In postaural aids all these components are housed in one case, which is worn behind the ear. The aid is coupled to the earmould, which is individually made for the infant’s ear, via a small elbow or hook on the hearing aid. This is connected to the tubing that provides a channel through the earmould and delivers the amplified acoustic signal deep into the meatus of the ear.

In the ear aids, where all the components are mounted in an earmould that fits into the canal and concha of the external ear, are now available. These aids are generally not suitable for growing infants because of the cost of frequent replacement of the system caused by growing ears.

With body worn hearing aids, the microphone, amplifier, and batteries are contained in a unit that is mounted on the child’s chest, usually in some sort of harness. The receiver is external and is connected via a lead to the body worn unit. The receiver itself clips directly into the earmould and is held there by a retaining spring clip.

All of these types of aid described so far (postaural, in the ear, and body worn) deliver the acoustic signal via air conduction deep into the external meatus of the ear and the resulting acoustic signal is transmitted via the middle ear to the cochlea and beyond in the normal way. It is also possible to use a bone conduction hearing aid. In this case the
Ear moulds
The earmould is an integral part of the amplification system. Its function is to deliver the amplified sound from the hearing aid receiver into the ear canal. It also serves to retain a postaural aid in position behind the ear or the receiver of a body worn hearing aid in the ear. In order to do this an earmould must be manufactured from appropriate material so that it is comfortable to wear for all of a child’s waking hours and is capable of providing an extremely good acoustic seal. The need for the former is obvious if a child is to accept hearing aids; the latter requirement is particularly important when high levels of gain and output are required as in cases of severe and profound hearing loss. Failure to provide a good acoustic seal results in acoustic feedback—a characteristic high pitched whistle that arises when amplified sound escapes around a poorly fitting earmould and is picked up by the microphone of the hearing aid and reamplified. The better the acoustic seal provided by the earmould the less the likelihood of this type of feedback occurring. There are other causes of feedback that may also need to be considered.

The problems associated with the provision of good earmoulds for children are well known and have been the subject of a number of surveys. With a skilled impression taker using a standard technique, however, and the availability of suitable earmould materials, good earmoulds can be. Provided it is essential that earmoulds for children are made of soft materials—for example, soft acrylic, silicone, or molioplast in order to satisfy the requirements of comfort and a good acoustic seal. In the case of rapidly growing infants, who require extremely well fitting earmoulds in order to deliver the required gain levels, it may be necessary to renew earmoulds as frequently as every three or four weeks.

Management of the hearing impaired infant
This requires a team approach to deal with the needs of the infant and family. In addition to the audiological aspects involved in the measurement of hearing sensitivity and the selection, provision, and monitoring of amplification there are more specifically medical and educational needs. The infant will be seen by a consultant or in otolaryngology or audiological medicine to assess whether there is any possible medically or surgically correctable cause of the hearing loss, or part of it, and to authorise the fitting of hearing aids. In addition, the child should be seen for a full developmental assessment including assessment of visual problems and for investigations into the aetiology of the hearing loss with referral for genetic counselling where appropriate. Hearing impaired infants and their families also require educational and rehabilitative support. In most areas infants with a permanent hearing loss and fitted with hearing aids would expect to receive regular home visits from a specialist teacher of the deaf whose role is to provide guidance and support to the family as a whole, rather than having a very specific teaching role, as well as maintaining an overview of the child’s progress. Increasingly specialist speech therapists with additional qualifications in working with the hearing impaired are also involved in this area. Close liaison between all these professionals and the family is essential. It is also important to inform families about relevant voluntary organisations that can provide help and support.

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