Chapter 9: Management of the hearing impaired child

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Man is a social creature; he derives his livelihood and his pleasure from communication, through sight and hearing, with others and with his environment. Deafness will impair this communication and, if present from birth, may hinder or even prevent its development. Children born with a hearing loss - the prelingual deaf - have a much greater problem than those who acquire deafness after language development. Furthermore, children with mild or moderate degrees of hearing impairment do not usually present as many management problems as those born with a severe or profound loss.

The importance of early detection

Fisch (1983) published a fascinating review of the development and maturation of the hearing system in normal infants and in those with a hearing loss. The hearing impaired child will have difficulty with speech perception and may therefore have delayed or absent speech and language development. There is no doubt, however, that many severely hearing impaired children do learn to understand speech well in spite of the restricted function of the auditory channel. It is known that much of the information contained in speech is redundant, since it contains more information than is needed to understand the message. In a deaf child, much of this redundancy is eliminated since it is not heard, although sufficient auditory information does reach the higher centres to allow adequate speech discrimination. Fisch postulated that, for optimum development of speech and language, the auditory pathway must be stimulated from a very early age to allow it and the higher centres to mature properly. The effects of auditory deprivation and poor communication ability on the child's social, psychological and educational development are well recognized (Boothroyd, 1982).

The benefits of early detection and initiation of management of deafness have been known for many years (Ewing, 1957). A survey of the countries of the European Economic Community (EEC) demonstrated that achievements in these fields are far from adequate (Martin, 1982). Only one-quarter of the children in the survey were suspected of being deaf (usually by their parents) during the first year of life. Ninety per cent of children had not been diagnosed by their first birthday and as many as 50% had still not been detected until 3 years of age. In most cases, even after diagnosis, there was a delay in the provision of aids, with 60% waiting up to 12 months or more.

This study also demonstrated that more than one-half of the children were unable to carry on meaningful conversation with strangers.

The importance of mild degrees of deafness, either conductive or sensorineural is not yet fully understood. Acute otitis media and secretory otitis media are common and many otologists have long lists of children waiting for the insertion of ventilation tubes. Some authors have suggested that children with recurrent or chronic middle ear problems show evidence of delayed language development and educational achievement (Hamilton, 1972; Rapin, 1979; Bergstrom, 1980). Others have advocated caution in attributing language disorders and learning disabilities to middle ear problems (Leviton, 1980; Ventry, 1980).
Present detection policies

Deafness in children is discovered in one of the following ways:

1. the child fails a screening test of hearing
2. the child is known to be ‘at risk’ of having a hearing loss
3. parental suspicion
4. the child fails to develop speech and language in the normal way.

Screening tests of hearing

These are discussed in full in Chapter 6. They are performed in an attempt to identify those children in need of further investigation.

At risk children

A family history of deafness, exposure of the fetus to a known pathogen, or a difficult birth increase the possibility of a child having a hearing loss. It is generally accepted that most at risk registers are incomplete for many reasons and there is doubt as to the usefulness of such a register (Parving, 1984; Riko, Hyde and Alberti, 1985).

Parental suspicion

If parents suspect their child to be deaf they are rarely wrong. Parving (1984) found that, in more than one-half of the hearing impaired children in his study group, the parents were the first to suspect the hearing loss. Parving also found a profound sense of bitterness in parents towards the health personnel who did not believe them or take their suspicions seriously.

Children who fail to develop speech

Clinicians occasionally see a child who, by the age of 2 or 3 years, has no speech or very indistinct speech. Some of these children have a hearing loss, although others have specific language disorders, emotional problems or mental retardation. There may be complex combinations of these disorders. There is also no doubt that some of these children have been missed by the earlier screening test.

Future detection policies

At present, considerable research is directed towards improving the early detection of deafness. This must use objective electrophysiological methods, since reliable behavioural responses are not usually present until 6 months of age. Techniques described include the Crib-o-gram (Simmons, McFarland and Jones, 1979), the auditory response cradle (Bennett, 1979), and auditory brainstem responses (Alberti et al, 1983; Galambos, Hicks and Wilson, 1984; Durieux-Smith and Picton, 1985).
Management of the child referred for assessment

Children who fail screening tests or are otherwise suspected of having a hearing loss should be referred to an otolaryngologist or audiological physician for further assessment. The aims of this should be as follows:

(1) to determine if a hearing loss is present. Many children referred are found to have normal hearing

(2) to determine the severity of the hearing loss

(3) to decide on the type of deafness, whether conductive or sensorineural

(4) to determine, is possible, the age of onset of deafness. Prelingual deafness has more serious implications for the child

(5) to look for other relevant handicaps.

It is the author's practice to send the parents a questionnaire with the initial appointment. This asks the parents to state their main worry about the child and what they think of the child's hearing. There are sections dealing with the pregnancy, postnatal development, ear, nose and throat symptoms and family history. Questionnaires are a notoriously unreliable means of gathering information, although they do give parents forewarning of the type of questions that will be asked during the visit to the clinic.

The first part of the assessment must be spent taking a brief, relevant history about the child's hearing. The author feels that it is better to move quickly on to the audiological assessment since children become restless and anxious very quickly in unfamiliar surroundings. If necessary a full history, including family history, exposure to pathogens and speech development may be obtained later.

The diagnostic test used depends on the child's chronological and developmental age. The tests are discussed in full in Chapter 6, and include:

(1) distraction test, children 6-18 months
(2) cooperative test, children 8-30 months
(3) performance test (conditioning), children older than 30 months
(4) pure-tone audiometry.

It is usually possible with these techniques to establish reliable hearing thresholds at different frequencies. Evoked (electric) response audiometry is useful in children under the age of 6 months or in those who are handicapped and will not or cannot respond to auditory stimuli in the usual way.

All children should have impedance audiometry (tympanometry), especially if free-field tests of hearing are used since the free-field test may not detect mild conductive hearing loss. Free-field speech discrimination tests are used with children under the age of 5 years. Older children will cooperate for more sophisticated tests of speech discrimination.
The greatest number of children with hearing impairment tested in outpatient clinics have conductive deafness, usually caused by otitis media with effusion. The management of these children is discussed in Chapter 12. It is sometimes necessary to fit children with a conductive loss with hearing aids, particularly if there is a middle or outer ear problem not immediately amenable to surgical or medical treatment (Bergstrom, 1980).

Children with sensorineural hearing impairments present much greater management problems. Modern techniques including evoked response audiometry, tympanometry and radiology, make possible a reliable identification of sites of lesions and hearing thresholds (Parving, 1983, 1985). Accurate identification of hearing thresholds is particularly important when deciding which type of hearing aid to fit.

The investigation of the cause of deafness, while not having immediate implications with respect to management of the child's hearing loss, is important. Parents want to know about the risk of subsequent children being born with a hearing loss, and also the risk to future generations. This investigation involves a multidisciplinary approach.

**Serological investigations**

Deafness as a result of maternal rubella may be diagnosed from the history and also the presence of specific antibodies, IgM or IgG, dependent on the child's age. It must not be forgotten that rubella antibodies may be present as a result of a postnatal infection in 5-10% of children under 4 years of age.

Sero logical tests for cytomegalovirus, toxoplasmosis and syphilis should be routinely performed.

**Other laboratory tests**

The urine of children under the age of 6 months may be examined for cytomegalovirus. Renal disease is sometimes associated with sensorineural deafness. It is therefore useful to screen the urine for blood cells, protein or sugar. Congenital hypothyroidism and Pendred's syndrome are associated with hearing loss. Fisch (1981) pointed out that effective screening of neonates for congenital hypothyroidism could virtually eliminate this as a cause of deafness. A simple means of doing this would be to check the serum thyroxine, although this test is not performed routinely in most centres.

**Radiology**

 Intracranial calcification is sometimes found on skull X-rays in children with toxoplasmosis.

Tomography and computerized tomographic (CT) scanning techniques have limited usefulness in the identification of aetiology in sensorineural deafness, but can help to localize the lesion and demonstrate structural abnormalities. Lund, Phelps and Beagley (1982) found that a combination of evoked response audiometry and tomography of the ear were useful with reference to surgical reconstruction of the middle ear.
Frazer et al (1986) discussed the role of hypocycloidal tomography in assessing the suitability of patients for cochlear implants. Most of their patients had a radiologically normal cochlea, although a few had 'cochlear otosclerosis' or labyrinthitis obliterans which precluded insertion of a cochlear implant.

Electrocardiography

In some disorders, such as the rare Jervell and Lange-Nielsen syndrome, there are characteristic electrocardiographic findings with prolongation of the QT interval and abnormal T waves (Fisch, 1981). Beighton and Sellars (1982) pointed out that this investigation had only a very limited place in the assessment of deaf children.

Assessment by other specialists

Ophthalmological examination is essential in children with sensorineural deafness. The fundus changes in rubella retinopathy are characteristic and have been described as a 'pepper and salt' appearance. They may be located in the macular area or at the periphery of the fundus (Wolff, 1973). Parving (1985) stated that combined serological and ophthalmological examination is necessary for the assessment of rubella deafness.

Fisch (1981) summarized the ocular findings in Usher's, Cockaynes, Laurence-Moon-Biedl and Refsum's syndromes.

Assessment of visual acuity may also be important when considering the education and management of the hearing impaired child.

The hearing impaired child may be referred for further assessment either to a pediatrician or paediatric neurologist, especially if there is evidence of head and neck abnormalities or of delayed growth and development in any sphere.

If the hearing loss is not caused by an obvious environmental factor, it should be assumed, until proven otherwise, that it has a genetic basis. These children and the parents should be referred to a medical geneticist, although all medical personnel dealing with these children should have a working knowledge of genetically transmitted deafness. The genetic basis of deafness is discussed in Chapter 3.

Parents' reactions to the diagnosis

Much has been written about parents' responses to the diagnosis (Boothroyd, 1982; Tucker and Nolan, 1984). The impact is usually devastating and the sequence of reactions is sometimes similar to that in mourning.

Shock

This is a natural defence mechanism and protects the individual from information which he or she does not want to hear. There is a profound sense of loss - the child is handicapped and abnormal. There is very little point in giving detailed information to parents in this state. They cannot take any of it in. It is important that the parents are shown that
there is a team of professional people immediately available to help and support them through this difficult time. In Belfast this is achieved by having a peripatetic teacher and a social worker with the deaf at the diagnostic clinic.

**Denial**

The protective effects of shock wear off. Parents question the diagnosis and produce 'evidence' that their child can hear. Some parents seek second, third, or even fourth opinions, taking the child to many different clinics in the hope that someone will say that the child's hearing is normal.

**Anger**

Parents sometimes ask why this disaster should have happened to them. Tucker and Nolan (1984) cited an example in which the mother blamed her husband for the child's hearing impairment. Some parents become hostile and bitter and their anger may be directed at the clinician. Patient support and willingness to listen often helps parents through this stage.

**Acceptance and constructive action**

Eventually the parents acknowledge the child's hearing loss and accept that the child, although handicapped, must and can be helped. This involves the parents learning about deafness and how it affects the child's development and education.

**Other reactions**

The author would agree with Tucker and Nolan's observation that parent adaptation does not always follow a predictable sequence of events as outlined above. Most parents do eventually adapt to the child's deafness. Some continue to deny the existence of the handicap and others remain angry and bitter.

Other parental responses are observed. Parents may have suspected for some time that the child is deaf and with the diagnosis comes a sense of relief that at last their suspicions are believed and action will be taken to help their child. There is also relief that the child does not have brain damage.

Parents of deaf children often feel isolated and inadequate. This can be lessened by immediate contact with counselling and supporting services who should provide ready access for help and information as required. Local parent support groups allow the parents of newly diagnosed children to discuss their problems with others who have been through the initial traumas. Branches of various organizations such as the Royal National Institute for the Deaf and the National Deaf Children's Society have regular educational meetings for parents, and act as a forum for exchange of information and ideas.

Tucker and Nolan (1984) discussed the theory and practice of counselling and pointed out that the counsellor's professional background is unimportant. The essential quality in any person undertaking this task is that they be knowledgeable in all aspects pertaining to the child's management. Parents come into contact with many different professionals - otologists,
audiological physicians, peripatetic teachers, audiological scientists, physiological measurement technicians, social workers with the deaf, hearing therapists, speech therapists and educational psychologists. Each has expertise in some aspects of management of the hearing impaired child and often this expertise overlaps. It is important that each understands their own role and also the role of the others. Parents must be given sufficient information which is intelligible and relevant. Enright and O'Connor (1982) emphasized the importance of peripatetic teacher counselling families of preschool children. Good relationships between teachers and parents may contribute significantly towards making more effective the educational guidance provided. This relationship allows the parents to exercise a central role in their child's progress.

Parents, unfortunately, are often given conflicting advice, especially about forms of education, whether oral or total communication. Some professionals have fixed ideas about which type of hearing aid is best and refuse to have anything to do with the others. Such conflicts should be avoided since they merely add to the parents' sense of insecurity and may cause a lack of confidence in the professionals involved.

The medical profession have, in general, a reputation for being abrupt and of having little time to spare to discuss problems with parents. Tucker and Nolan pointed out that medical people are usually trained to an action-orientated approach and sometimes lack the skills in other essential areas such as giving information and support.

There is a need for a team approach and there must be a flexible interchange of ideas and information. It is essential that the parents are seen as part of the team and that management decisions are not made without full consultation and explanation. Once the parents' confidence has been lost it is difficult to regain.

Having a deaf child causes enormous stress within the family. Other children may feel that they are being ignored, and sometimes one parent may feel neglected. Worries about the child's education are very real since there may not be a suitable local school. There is no doubt that having a deaf child throws a considerable financial burden on the family. These parents need good counselling and support throughout the child's development.

Concern has been expressed about interference with parent-child bonding, especially in neonates and young babies. Taylor (1985) emphasized the fine balance between the need to have parental awareness when hearing loss is suspected and a fear of interference with bonding. He reported the results of a questionnaire sent out to families of hearing impaired children. About 20% of parents who replied would rather not have known about the child's hearing loss within the first week of life. The most common reason given was that parents would have preferred to establish a bond with the baby before undertaking the task of managing a deaf child. Some parents felt that they would rather not know because they thought that nothing could be done for the child at such an early age. There is clearly a need for improved awareness and better education of both parents and professionals if deafness is to be detected early.
Subsequent management of the deaf child

The mainstays of management of the child with sensorineural deafness are:

1. appropriate hearing aid selection
2. promotion of the development of language and communication skills.

It is rare for a child to be born totally deaf and every attempt should be made to reach any residual hearing by the use of the high powered hearing aids which are currently available. Commonly, the only residual hearing is for low frequency sounds and hearing aids with extended low frequency responses can be used.

Every effort must be made to encourage the child to develop intelligible speech. The term auditory training has been used to describe techniques by which the child is taught to listen and hopefully to copy speech. This will be discussed later in this chapter.

Hearing aids

Sensorineural hearing loss in children cannot be corrected by any form of medical or surgical treatment. The role of cochlear implants will be discussed later. Similarly, some conductive losses caused by congenital abnormalities of the external or middle ear are not suitable for surgical treatment. These children should be considered for the fitting of hearing aids.

A full discussion of hearing aids is to be found in Volume 2. The following is limited to the particular problems found with children.

Types of hearing aids

Two types of hearing aids are currently available - personal aids and hearing aid systems (Tucker and Nolan, 1984).

Personal hearing aids

A variety of different personal hearing aids can be bought from several commercial firms. In the UK, the National Health Service (NHS) supplies a wide range of such aids free of charge. It is, however, possible for an NHS consultant to prescribe certain aids outside this range if it is considered that there is no NHS aid sufficient to meet the child's needs. There are two groups of NHS aids, the body worn (BW) aids and the behind the ear (BE) aids.

Body worn aids
   BW 60 series - low/medium power
   BW 80 series - high power

Behind the ear aids
   BE 10 series - low power
   BE 30 series - medium power
   BE 50 series - high power.
The range of aids is such that a suitable aid can be found to fit most children's requirements. However, it must not be forgotten that the NHS range has been designed chiefly for adults and the powerful BE aids are too big for most small children's ears.

Bone conduction hearing aids are available for children with deformed external ears or severe, recurrent ear infections which prohibit the insertion of ear moulds. The bone conductor can be used in conjunction with a conventional body worn aid, although a better cosmetic result is achieved by using a postaural aid on a head band with the output receiver wired to the bone conductor.

Hearing aid systems

The greatest disadvantage of conventional hearing aids is their inability to distinguish between speech sounds and the unwanted background noise which tends to mask speech. This is referred to as the signal-to-noise ratio of the system. The problem is made worse by reverberation caused by sound reflections of walls, ceilings, floors and furnishings and will cause the relatively strong vowel sounds to persist and mask the weaker consonants which contain most of the information in speech (John, 1957).

With most hearing aids the signal-to-noise ratio is a function of the distance between the signal source and the listener. Classrooms tend to be very noisy so that children seated away from the teacher will be at a disadvantage in that the background noise will mask the teacher's voice. This problem can be overcome in a variety of ways by using aids primarily supplied by education authorities.

Speech trainer

The child wears headphones connected to an amplifier, and controls on the amplifier allow adjustment of gain and frequency response. The teacher or parent uses a microphone connected directly to the amplifier. This useful device has a low signal-to-noise ratio since the microphone is close to the speaker's mouth. In addition, since feedback is reduced because of the distance between microphone and headphone, it is possible to achieve high levels of amplification with profoundly deaf children. It is most useful for short periods of intensive speech and language teaching.

Group hearing aid

The principle is very similar to that of the speech trainer except that several children are connected to one teacher and to each other. Each child's 'station' has an amplifier which allows individual adjustment of output and frequency response. Tucker and Nolan (1984) described this system's benefits and drawbacks, the chief drawback being lack of mobility of both children and teacher.

Radio hearing aids

Frequency modulated (FM) radio systems allow the child to be fully mobile within a fairly large area while retaining the good signal-to-noise ratio of group aids. The teacher or parent wears a microphone transmitter and the child a receiver so that no matter where the
child is in a room the person using the microphone will seem to be speaking almost directly into the child's ears.

There are two types of radio aid (Nolan, 1983a):

(a) the body worn receiver/hearing aid. This can be used either as an ordinary body worn aid or as an FM system

(b) the audio-input system, used in conjunction with the child's personal hearing aids. This type of FM system can be plugged into the child's personal BW or BE aids as required. The advantage of this system is that the child need only wear one set of aids and will not have to change between the body worn receiver/aid and personal aids.

The chief drawback of both types of FM system is that only the teacher has a radio transmitter and therefore interaction between pupils is limited. In the UK one-third of these radio aids are supplied by charitable sources or paid for by parents (McCormick, Bamford and Martin, 1986). The NHS has no policy of central provision for radio aids, although a recent circular (C331) does allow an otologist or audiological physician to supply these aids if money is available locally within the health system.

Infra-red hearing aid systems

The FM radio signals from the teacher's transmitter pass easily through walls and doors into adjacent areas. This gives rise to problems if children in a nearby classrooms are using a system on the same frequency. The infra-red system overcomes this difficulty since the infra-red waves are contained by the boundaries of any room in which the system is used. Problems do occur in bright sunlight which can produce noise in the system.

Loop system

Input from the teacher's microphone is amplified and transmitted either directly around an electromagnetic loop installed on the classroom walls, or by means of an FM system to a loop worn around the child's neck. Tucker and Nolan (1984) listed the drawbacks of the loop system, including spill-over into adjacent classrooms, unpredictable frequency response and weak or dead spots with the classroom loop. These authors pointed out that most of the drawbacks are eliminated by using the personal neck loop with an FM receiver.

Problems with hearing aid selection in children

There are two main areas of difficulty with hearing aid fitting:

(1) there is often limited information about the extent of the child's hearing loss

(2) young children cannot say which aid, or settings on the aid, they prefer.

Young children present particular problems with respect to information about the hearing loss. Standard free-field distraction test stimuli give a reasonable estimate of thresholds at different frequencies. These stimuli can be supplemented by using warble tones
or narrow band noise. Information about children too young for distraction testing can be obtained by evoked response audiometry, although it is usually difficult to obtain measurements of low frequency thresholds by this technique.

It is important to estimate the dynamic range of the residual hearing. This is the difference between threshold and loudness discomfort level. If the child receives frequent aided stimulation greater than the loudness discomfort level, there is a risk that the aids might be rejected. One means of estimating loudness discomfort level is to examine the stapedial reflex, although in many cases this is not present because of the severity of the deafness. Tucker and Nolan (1984) described an electroacoustical method of estimating loudness discomfort using an earmould receiver and watching the child's responses to increasing stimulation at different frequencies.

Most profoundly deaf children do have some residual hearing, usually for the low frequencies. In the newly diagnosed child there is no way of predicting how useful this will be, if at all, in helping speech discrimination. Every effort, however, must be made to use this residual hearing in an attempt to obtain communication.

Having obtained as much information as possible about the child's hearing it is then essential to select appropriate aids and to adjust their output and frequency responses as necessary to suit the child's needs. As with adults there are two main ways of choosing an aid.

**The empirical (selective) method**

The child is given several different aids in turn for trial. The problem with this method is that young children cannot say which aid is best. It is possible, by carrying out free-field tests including speech if the child is old enough, to gain a partly subjective impression of the relative merits of each aid.

**The theoretical (prescriptive) method**

Information about various parameters such as the child's thresholds at each frequency, most comfortable listening level and speech discrimination scores, allows a prediction of the best amplification characteristics for that child. This allows a suitable hearing aid to be chosen. Many different formulae are available which calculate theoretical settings for the frequency response and gain of the aids. It must not be forgotten that the hearing aid performance in a test box with a 2 mL coupler is not an accurate reflection of the aid's performance in the human ear. Modifications to the frequency response occur as a result of variations in earmould parameters and the resonance effect of the ear canal.

As the child becomes older the hearing aids, or the settings of the controls may need to be changed as more information about the child's hearing becomes available. There are also children, particularly those with hereditary deafness, in whom the hearing may deteriorate.

Hearing aids are usually fitted to each ear, except when low and middle frequency hearing are normal or only slightly impaired. Amplification of these frequencies may introduce distortion of the perceived speech signal.
There are many advantages to binaural fitting:

1. Improved localization of the sound source
2. Improved hearing in background noise
3. A binaural summation effect giving better amplification.

There has been some controversy over the relative merits of behind the ear and body worn aids. The power outputs of both types are equivalent. It is generally agreed that BE aids give a more natural sound environment because sound reception is at ear level. In addition, they are free from rubbing of clothes, give improved localization over the BW aids, and are cosmetically more acceptable. It has been argued that they are more easily removed and thrown away by young children. This can be avoided by taping the aid to the back of the ear or by using double-sided sticky tape. Children with a body worn aid can pull the cord and displace the receiver from the ear. The body baffle effect with BW aids improves the frequency response below 600 Hz by 5 dB (Wald, 1976). This may be useful in children with residual low frequency hearing only, but can be a disadvantage in a child with a flat loss. In these children the masking effects of the powerful low frequency vowel sounds on the weaker consonants will be enhanced by the body baffle effect.

The most significant limitation of all types of powerful hearing aids is acoustic feedback (Nolan, 1983b). This is most likely to occur when the microphone of the hearing aid is close to the receiver or earmould. Body worn aids are therefore less susceptible to this problem since they are worn on the chest. Good fitting earmoulds are essential if powerful BE aids are to be used. The impression should be obtained by the syringe technique after putting a small sponge tamp into the child's external ear. Children need to have their earmoulds renewed at regular intervals as the external auditory canal grows.

It is important that parents and teachers check the child's hearing aids daily. This is most easily carried out using a stethoclip. The hearing aid is attached either by hollow plastic tubing (BE aid) or by plugging the receiver into the stethoclip (BW aid). This permits detection of low battery power and other faults in the aid. Many schools and peripatetic teachers of the deaf have access to a hearing aid test box and can more accurately assess the aid's performance.

**Cochlear implants**

Considerable interest has been focused on the possibility of directly stimulating the cochlea or auditory nerve to help speech discrimination in the profoundly deaf. In the UK children are not, at present, considered for implantation (Frazer et al, 1986). There are ethical problems with informed consent. In addition, there is a risk of further damage to the ear with subsequent limitation of hearing aid benefit. Extracochlear implants are not without risk since middle ear infection is common in children.

**The education of hearing impaired children**

The ideal outcome is a child with good speech who can progress normally through the education system and integrate fully into a society which communicates mainly by the oral-
aural channel. In the author's experience, this is possible, even with profoundly deaf children, although with this group it is the exception rather than the rule.

Conrad (1980) investigated the reading, lip reading, speech intelligibility and 'inner speech' in a large group of 15-16.5 year olds with either partial or severe hearing losses. He found that 50% of children with a severe loss and 25% of the partially hearing had not reading comprehension at all. In addition, the severely deaf had poor lip reading ability, poor speech and poor 'inner speech'. A survey of children in the European Economic Community with an average loss of greater than 50 dB showed that more than one-half of these children were unable to carry on meaningful conversation with strangers (Martin, 1982).

A child's ability to acquire normal, or intelligible speech depends on several factors.

1. The extent of the hearing loss. This must take into account the pattern of the hearing loss, whether flat or ski-slope shaped.

2. The child's ability to use the residual hearing. In some cases the residual hearing, even with amplification, is insufficient for speech discrimination.

3. The time of onset of the hearing loss, whether present at birth, or developing later in childhood.

4. The child's personality and motivation.

5. The child's intelligence.

6. Sufficient exposure to communication systems, especially speech. This requires considerable motivation on the part of the parents.

**Preschool children**

Enright and O'Connor (1982) examined the role of peripatetic teachers of the deaf in preschool education of hearing impaired children. A major part of their task involves giving information, support and encouragement to parents, in addition to teaching language skills to the child. Parents are shown how to develop these skills and how best to use the child's residual hearing.

Kernohan, Lucas and Muter (1981) listed the information that should be given to parents:

1. an explanation of the child's hearing loss, with special reference to the frequencies involved

2. the differences between vowels and consonants and the importance of each to speech

3. the effects of amplification on speech and which parts of speech the child is likely to receive
(4) the effects of background noise

(5) how to look after the hearing aids

(6) the importance of talking normally to the child.

Much of the information in speech is contained in transitions between phonemes, speech rhythm and intonation patterns. In the hearing impaired child this information is vital and is lost if the child is spoken to in an artificial or exaggerated manner.

School-age children

There is a move towards integrating hearing impaired children into ordinary schools. At present hearing impaired children may be placed in one of several types of school situation:

(1) ordinary classroom, using hearing aids

(2) ordinary classroom, with hearing aids and regular help from a peripatetic teacher of the deaf

(3) ordinary classroom for part of the day, the remainder of the time being spent in an attached partially-hearing unit

(4) partially-hearing unit only, staffed by specialist teachers of the deaf

(5) school for the profoundly deaf

(6) other schools, such as speech and language units, for children with additional handicaps.

Legislation in the UK

The Education Act of 1976 amended the Act of 1944. It required local education authorities to make provision for the education of handicapped pupils in ordinary county or voluntary schools as well as in special schools. The trend towards integration was further encouraged by a report from the Department of Education and Science (The Warnock Report, 1978). This provided an overview of the then existing provisions and made proposals for future policy. It highlighted the importance of parental involvement in the general management of the hearing impaired child, especially in the preschool years.

The Education Act (1981) is based largely on the proposals of the Warnock Report. The Act abolished the use of existing categories of handicap (educationally subnormal, maladjusted, partially hearing, and deaf) and replaced them with a 'statement'. A statement is produced for each affected child and details the child's needs. It also lists the facilities and resources, including school placement, necessary to meet these needs. The statement is prepared from evidence submitted by the various people in contact with the child, including the parents, teachers of the deaf, educational psychologists, clinical medical officers, otologists
and audiological physicians. The Act encourages the trend towards integration of the handicapped into ordinary schools.

The 1981 Act has been criticized by many. It introduces complex referral, assessment and appeal procedures which increase administrative time and costs. With resources already stretched this reduces the amount of time spent in educating these children (Reeves, 1983).

**Communication methods in the education of deaf children**

Arguments about which method of education is best for severely hearing impaired children have been continuing for many years. Llewellyn-Jones (1986) gave a brief account of the history. In the early 1800s the predominant method of communication was the combined system using speech, finger-spelling and signing simultaneously. By the 1870s, oralism was being used increasingly in Europe and, at the International Congress on the Education of the Deaf in Milan in 1880, oralism was endorsed as the method of choice. In Britain in 1889 a Royal Commission recommended that every child should have the full opportunity of being educated in the oral system. The move towards oralism in schools was resisted by the British Deaf and Dumb Association (now the British Deaf Association) who fought to retain the combined system in schools.

The Lewis Report in 1968 found that, although British schools claimed to prefer pure oralism, over three-quarters of them used some form of signs or manual communication. As a result of this report some schools in the late 1960s and early 1970s began to use a variety of sign systems as educational aids. This move towards a combined system has continued.

Recent figures published by the National Deaf Children's Society shows that, in the UK, 47% of special schools and 13% of partially hearing units now nominally use a combined speech and signing system.

**Oralism**

Children educated in this system use only speech and lip reading as a means of communication. Signing of any sort is strongly discouraged or even prevented. Listening and speaking require considerable effort and concentration by the severely hearing impaired child, signing is much easier. Oralists argue that the ability of a child to develop speech is inhibited if the child is allowed to communicate by signing. The normal hearing child is thought to understand a significant amount of language at about the age of 12 months and 80% of his language development has occurred by 3 years of age. Oralism assumes that the brain of the hearing impaired child remains capable of learning speech and language at least to puberty, and perhaps beyond (Lenneberg, 1967). Many others subscribe to the view that there is a 'critical period' for most children during the first few years of life during which language development is at a premium. If these children are not taught communication skills within this period they may never acquire them.

**Finger spelling**

This, on its own, is a slow means of communication.
Cued speech

Some speech sounds, such as M, P, B or K, D, L, cannot be distinguished by lip reading alone. Cued speech uses eight different hand shapes in four different positions close to the speaker's mouth to enable the child to discriminate the lip movement. It was developed as an aid to teaching English to deaf children, and not as an exclusive signing system.

Signing systems (manualism)

British sign language

This is the communication system favoured by most profoundly deaf adults. It is a completely separate language since it does not follow the rules of English grammar.

Paget-Gorman sign system

This was developed as a means of accurately reflecting spoken and written English. It has a large vocabulary of inverted signs with provision for indicating grammatical structures such as word endings and tenses. It is rarely used in schools for the deaf.

Signed English

True (exact) signed English uses signs taken from British sign language with artificially developed 'sign markers' to indicate tense, word endings, etc. Another more popular version, Signs Supported English, uses signings in English word order, without sign markers, together with speech.

Makaton

This signing system, based largely on gestures and simple signs, is used with mentally handicapped patients.

Total communication

Total communication involves using a combination of speech, gestures, formal signing, finger spelling, speech reading (lip reading), reading and writing. Conrad (1980) postulated that, in very deaf children, exclusive use of spoken language fails to provide sufficient linguistic stimulation to the child's brain, parts of which may then undergo functional and perhaps even physical atrophy.

Supporters of total communication argue that providing sensory input through different channels - auditory and visual - enhances the possibility of language development. This must be understood as being language in its widest sense, since language may be thought of as a system of symbols and rules for communication.

Speech is one mode of language. It has been argued that total communication impairs speech development. Taylor (1985), in a survey of different schools, produced evidence that oral-only schools are more likely to succeed in developing the most normal speech aspects
of language. Nix (1983) reviewed various studies of communication systems and suggested that simultaneous oral/manual communication is beneficial, but that stimulation of the two channels together did not produce such good results as oralism alone. On the other hand, Dee, Rapin and Ruben (1982) demonstrated that total communication facilitated speech development and did not inhibit it.

There are problems in comparing results claimed for oralism and total communication. It is often difficult to know which parameters are being assessed, since intelligible speech is not always a measure of language development. There is no standardization of teaching practice. In many schools total communication is not total, but sacrifices speech in the interests of signing. One of the difficulties encountered with total communication is that total synchrony of speech and signing is impossible. It is difficult to sign quickly enough so as not to interrupt normal speech flow. Normal speech patterns contain information which is highly redundant to the normal hearing person, but essential to those with a hearing aid.

Total communication aims not only to stimulate language development, but also to provide a reliable system by which the child can communicate with teachers, parents, classmates and an increasing number of the population who are learning to sign. The child is hopefully 'bilingual' and has a flexible means of communication for use in different situations.

Arnold (1982), in a reply to Conrad's paper, pointed out that there was no evidence that any approach yet devised has successfully been used to educate the majority of severely deaf children.

Recent legislation gives parents a central role in the education of their hearing impaired child. Parents must therefore be given a balanced and informed view of the different communication methods available. Professionals must not force their opinions on parents.

There are many problems in the management of the deaf child. There is a need for more information about the extent of the child's hearing loss and the implications of this in the selection of suitable amplification. It is obvious that no single type of education system meets the needs of all deaf children. How can the decision be made about which type is best for a particular child? Is it reasonable to insist that oralism be used until it becomes obvious that the child cannot develop useful speech? Does total communication impair speech development? Objective research may answer some of these questions.