Review Article

Auditory-Verbal Therapy for Children with Hearing Impairment

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Abstract

The new millennium has brought about great innovation and advancement in hearing technology, early detection and intervention. This in turn has altered expectations of what children with hearing impairment are really capable of in terms of listening, developing spoken language, and academic and social performance. In Singapore, with Universal Newborn Hearing Screening in place, babies with hearing impairment can be detected early and early intervention implemented by 6 months of age. To benefit from the "critical periods" of acoustic neurological and linguistic development, early identification of hearing impairment, medical intervention, use of appropriate amplification technology and effective habilitation are vital. Auditory-Verbal practice emphasises listening to access auditory information, so that these children have the opportunity to develop intelligible speech and spoken language. Auditory-Verbal practice supports ongoing individualised diagnostic therapy with parent participation, guidance, education and support by an Auditory-Verbal specialist. The goal of Auditory-Verbal therapy is to enable children with hearing loss to grow up in regular learning and living environments so that they can become independent, participating and contributing citizens in mainstream society.

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Introduction

In recent years, rapid technological advancement in the education of the hearing-impaired has taken place. Early intervention is now possible with the advent of diagnostic equipment capable of objectively and accurately screening and confirming hearing loss even in neonates. No baby is too young to be tested. The use of modern hearing technology, such as digital hearing aids and cochlear implants, has enabled children who are deaf or hard of hearing to obtain maximum acoustic neurological benefits. Never before in the history of education of the deaf have these children had such hearing potential. Through hearing, all the features of speech can be assessed. As a result, children who are deaf or hard of hearing have the opportunity to develop spoken language through listening. With early detection, early amplification and effective individualised Auditory-Verbal therapy with parent participation, up to 80% of children born deaf can potentially be successful in mainstream education and society.[1]

Degree of Hearing Impairment

In addition to being classified by aetiology and time of onset, hearing impairment can also be categorised by severity and by the degree to which the hearing impairment affects an infant's sound reception. Degree of hearing loss is indicated by an audiogram where the measurement is recorded in decibels in hearing levels (dB HL), a unit expressing the ratio between 2 sound pressures or 2 sound powers.[2,3]

Children with normal hearing sensitivity are able to perceive sound intensities of 20 dB HL to 25 dB HL or softer in a quiet room.[4-6] Table 1 summarises the various degrees of hearing impairment and their effects.[3]

Importance of Early Detection and Intervention

The longer the brain is deprived of auditory input, the greater the resulting sensory deprivation, causing a lack of sensory stimulation to the brain. Not only does sensory deprivation prevent auditory learning, deprivation also

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Table 1. Degrees of Hearing Impairment and its Effects*

Amount of hearing loss (dB)	Type	Effects
26-40 dB HL	Mild	May have difficulty in hearing faint or distant speech. Without audiological management, a child who experiences a 35-dB hearing impairment may miss 25% to 40% of the speech signal depending on the noise level in the room and the distance from the speaker. Without the use of hearing technology, the child who has a 35-dB to 40-dB hearing impairment may miss up to 50% of class discussions.
41-55 dB HL	Moderate	A child with hearing impairment at this level may miss 45% to 75% of speech signals and without the use of hearing aid technology and intervention, the child is likely to have limited vocabulary and imperfect speech production.
56-70 dB HL	Moderately Severe	If amplification technology is not used, spoken language must be very loud and the speaker is preferred to speak very close to the child. If the child does not receive appropriate early and continuing intervention, he/she will have marked difficulty in school and there will be evidence of speech intelligibility and delayed language development. The child may also have problems with social behaviours.
71-90 dB HL	Severe	Without hearing aid technology, it will prevent a child from hearing all conversational speech. One may still be able to hear vowels but it will be difficult to perceive consonants.
90 dB HL and above	Profound	A person with profound hearing loss cannot hear any sounds without amplification.

* Adapted from Flexer[3] and Hall & Mueller[6]

prevents neural growth. In the absence of normal stimulation, there is a sensitive period of about 3.5 years during which the human central auditory system remains maximally plastic; after age 7, plasticity is greatly reduced.[7] The longer the deprivation, the more "stunted" the auditory brain growth. In fact, not only do the auditory centres not grow, existing pre-wired auditory tracts can also degenerate.[8]

Moeller et al[9] examined the receptive language skills of a group of school-age children who were deaf or hard of hearing, ranging in age from 4.5 years to 20 years. These children demonstrated receptive vocabulary skills that were equivalent to those achieved by typically hearing children aged 5 to 7 years. This study, which postulated significant delays in receptive vocabulary development in comparison with normal hearing peers, is consistent with other studies of school-age children who are deaf or hard of hearing.[9,10] Hence, children with hearing loss have or potentially have problems accessing constant and consistent information through spoken language. This results in poor early learning experiences, which in turn create a weak foundation for developing language skills and accessing knowledge.[11]

The advent of modern hearing technology enables children with even profound deafness to use sound to access critical auditory brain centres, enabling the stimulation of neural growth. According to Flexer,[3] "It is critical to note that as human beings we are neurologically wired to develop spoken language and reading skills through the central auditory system. Most people think that reading is a visual skill, but recent research on brain mapping shows that primary reading centres of the brain are located in the auditory cortex—in the auditory portions of the brain.[12] That's why many children who are born with hearing loss and who do not have access to auditory input when they are very young tend to have a great deal of difficulty reading even though their vision is fine." Therefore, the earlier and more efficiently a child is allowed to have access to meaningful sound, with subsequent direction of the child's attention to sound, the better chance that child will have of developing spoken language, literacy, and academic skills.

Advances in technology, together with early detection of hearing loss in children born deaf, have resulted in dramatic changes in the lives of children with hearing impairment. Current standards of medical care dictate that hearing loss in children should be detected as soon as possible after birth and that intervention should be initiated by 6 months of age, for optimal speech and language development.[8] Such early detection has been facilitated by Universal Newborn Hearing Screening (UNHS) programmes, which are now available in many developed countries, including Singapore. This enables hearing loss to be detected at a very young age so that with effective intervention, a child with hearing impairment can develop age-appropriate language and attend regular schools with their hearing peers. These children would have acquired a sound language foundation, which is the stepping-stone to one's ability to access the curriculum. This requires early and appropriate amplification where children needing cochlear implants receive them as young as 1 year of age. However, in babies who develop hearing loss from meningitis, cochlear implant surgery may be performed even earlier, before cochlear ossification sets in.

A critical concept that pertains to the attainment of spoken language and literacy skills is the notion of hearing or listening age. A child's auditory-language development begins when amplification technology is first used.[13] If a

child is 2 years old when her hearing loss is identified, she is 1-day-old relative to listening and language learning when her hearing aids are first fitted or her cochlear implant is activated and mapped. When that child reaches a chronological age of 3 years, she is 1-year-old relative to her listening experience; linguistically, she may sound more like a 1-year-old than a 3-year-old. This anticipated gap between a child's chronological age and listening age decreases over time, provided that the child uses appropriate amplification technology during all waking hours, and has active family-centred auditory-based intervention. In essence, the earlier a child's hearing impairment is identified and managed, the smaller the gap will be from the outset and the longer the problem is left unidentified, the greater the sensory deprivation.

It is not sufficient just to provide early access to auditory stimulation to a hearing-impaired child. This must be followed by effective, meaningful habilitation, which is as important as the provision of adequate hearing.

Habilitative Approaches

There are currently 4 main approaches to teaching children who are deaf and hard of hearing. These approaches are classified as: 1) visual methods such as American Sign Language and Signing Exact English; 2) Total Communication, which combines approaches emphasising lip-reading, speech, natural gestures and a manually coded English sign system which has no written form; 3) auditory-based methods such as the Auditory-Oral approach where children are often educated within a school with other deaf children with an emphasis on auditory teaching and group instruction sessions;[14] 4) the Auditory-Verbal (A-V) approach, which utilises listening as a primary modality for the development of spoken language, where therapy sessions are individualised and diagnostic.[15] While there is no one system, approach or communication methodology designed to meet all of the individual needs of a child and his or her family, the A-V approach is one option. When a child begins using a cochlear implant, an A-V approach will optimise that new hearing potential to develop spoken language.

The Auditory-Verbal Approach

A-V practice is a model of communication and intervention for children with hearing impairment that incorporates the principles adapted from its pioneers, Doreen Pollack, Helen Beebe and Daniel Ling.[15-17] The A-V approach has been practised for more than 30 years, when Doreen Pollack started the Acoupedic Programme in Denver in 1969. In fact Pollack[18] recorded that as early as 1761, there were postulations that "total deafness" did not exist. The deaf could be trained to hear words. Dr Max Goldstein started his Acoustic Method, where one was trained to detect sounds, and it was stressed that the teacher would cover her mouth either with her hand or a piece of paper to encourage listening.[19] However, he did not have many children in his programme because at that time, it was believed that when one was deaf, one was also mute. Dr Goldstein's ideas were far ahead of his time.

Auditory-Verbal therapy (AVT) involves individualised, diagnostic sessions emphasising the use of hearing technology in optimal and meaningful conditions. The aim is to acquire listening as a primary modality to developing spoken language (personal communication – Goldberg DM & Lebahn C, 1990). The A-V approach is based on the notion that most children with mild to profound hearing loss can learn to communicate through spoken language if provided with appropriate amplification, and abundant listening and language stimulation to develop their hearing potential.

A-V practice supports ongoing individualised diagnostic therapy based on acoustic phonetics, with parent participation, and the guidance, teaching and support of an A-V specialist. It utilises a hierarchy of listening skills, an expectation by therapist and parents that a child with hearing impairment can learn to listen and speak, and educational, social, and emotional integration with hearing peers.[20] The goal of A-V practice is that children with hearing loss can grow up in regular learning and living environments that enable them to become independent, participating and contributing citizens in mainstream society.[21] The principles of A-V practice are listed in Table 2.

AVT is diagnostic, with each session being an ongoing evaluation of the individual child and the parent's progress in the 5 areas of audition, speech, language, cognition and communication.[20,22] Children learn to use their hearing amplification technology to listen to their own voices and the voices of others, and to the sounds in their environment in order to understand spoken language and develop meaningful communication. They learn through a natural sequence of language which is acoustically salient. Through interactions in play and everyday routines, parents, caregivers and therapist create a listening and language learning environment whereby listening becomes integrated into the total personality of the child.[18]

Outcome Studies in Auditory-Verbal Intervention

The following are studies related to the academic achievements in individuals who have participated in A-V therapy.

Rhoades and McCafferey (personal communication, 2002) conducted a 4-year longitudinal study with 40 children who learned through an A-V approach. They found that there is a significant language growth as a result of A-V

Table 2. The Principles of Auditory-Verbal Practice*

The system of principles of auditory-verbal practice are:

1. Supporting and promoting programmes for the early detection and identification of hearing loss and the auditory management of infants, toddlers and children so identified;
2. Providing the earliest and most appropriate use of medical and amplification technology to achieve the maximum benefits available;
3. Instructing primary caregivers in ways to provide maximal acoustics stimulation within meaningful contexts, and supporting the development of the most favourable auditory learning environments for the acquisition of spoken language;
4. Seeking to integrate listening into the child's total personality in response to the environment;
5. Supporting the view that communication is a social act, and seeking to improve spoken communicative interaction within the typical social dyad of infant/child with hearing loss and primary caregiver(s), including the use of the parents as primary models for spoken language development, and implementing one-to-one teaching;
6. Seeking to establish the child's integrated auditory system for the self-monitoring of emerging speech;
7. Using natural sequential patterns of auditory, perceptual, linguistic and cognitive stimulation to encourage the emergence of listening, speech, and language abilities;
8. Making ongoing evaluation and prognosis of the development of listening skills an integral part of the (re)habilitative process;
9. Supporting the concepts of mainstreaming and integration of children with hearing loss into regular education classes with appropriate support services and to the fullest extent possible.

*Adapted from Auditory-Verbal International[21]

teaching. The following assessment tools, which were standardised on normally hearing children were used: the Test Of Auditory Comprehension Of Language (TACL), (ages 3 to 10), the Peabody Picture Vocabulary Test–Revised (PPVT-R) (ages 2.5 to 90) and the Test for Expressive Emergent Morphology (TEEM) (ages 3 to 8). It was determined that the correlation between chronological age (CA) and language age (LA), for the assessment tools used, became stronger over time, especially during the last year of intervention. The gap between their chronological age and language age was closed and these children achieved high levels of linguistic competency, that is, the results for children with hearing impairment became closer to the standards of children with typical hearing.

Wray et al[23] found that 16 out of the 19 of children aged between 5 years and 15 years in the sample read "at" or "above" grade level, 44% of the 16 students were rated as reading "above average levels" and their teachers rated them as having strong skills in the areas of social behaviour, class participation, attention and academic skills. A similar study by Robertson and Flexer[24] surveyed 37 children, the majority having a severe to profound hearing loss, who read in the average range or higher as compared to normally hearing children.

While the above studies involved younger children, Goldberg and Flexer[25] conducted a survey of young adults who were severely to profoundly deaf and had received AVT for at least 3 years during their childhood. Of the 157 respondents, 72.7% perceived themselves as part of the "hearing world" and 95% had pursued post-secondary education. In research conducted by Durieux-Smith et al,[26] 65 adolescents aged 14 years and above who had received AVT as preschoolers were studied. The objectives were to: 1) examine functioning in the areas of communication, academic performance and self-perception of young people with hearing impairment; 2) identify factors that were facilitating and/or barriers to inclusion in mainstream education; and 3) develop recommendations to enhance integration. The results indicated that children who had received preschool A-V intervention could function effectively within the school and community environment, achieving scores within the average range on measures of communication, self-perception and academic skills.

Early Integration into Mainstream Education

Established centres overseas have shown that more than 80% of children detected and entered into effective early oral habilitation have been integrated early into mainstream schools with great success. Reasons for integrating students are as follows: 1) successfully habilitated deaf children of today have more similarities than differences in comparison with normal hearing children, with the same range of learning potential interests and goals; 2) having a child with hearing loss in a regular class creates a good educational and learning environment for typically hearing children. Classmates develop greater empathy with the exceptional child and they will learn how to communicate and feel comfortable with him/her, resulting in greater understanding and acceptance; 3) children with hearing impairment benefit from learning alongside typical children with normal hearing, speech and language who will serve as good role models in those areas; and 4) only through ongoing integration will society become more knowledgeable about those with hearing impairment, raise their expectations for these children and realise their talents and potential. This acceptance may assist in the employment potential of individuals with hearing impairment in future years.

A Model to Illustrate the Practice of Auditory-Verbal Therapy

The Listen & Talk Programme was established in July 2001 in the Department of Otorhinolaryngology of the Singapore General Hospital. The therapists were trained in an intensive course in A-V practice, a specialty combining the 3 professions of audiology, speech-language pathology and teaching of the deaf, using the standardised curriculum of the Auditory-Verbal International as a guide.

In the Listen & Talk Programme, in the same physical pod as the audiology and cochlear implant centre, children are fitted with appropriate amplification upon diagnosis of hearing impairment. Parents and caregivers are taught how to develop their child's listening and language skills by participating in weekly individualised parent guidance A-V sessions. Parents participate in therapy, learning to be the primary case managers for their child. During the course of therapy, parents/primary caregivers are provided with education, guidance and family support by the team of various professionals. A-V sessions are a diagnostic evaluation of a child and his/her parents' progress. Parents receive weekly targets in audition, speech, language, cognition and communication to integrate into daily routines and interactions with their child. These goals are based on the developmental stage and hearing age of the child and are incorporated into structured activities, in meaningful daily routines, and most importantly, in play. To facilitate parents' self-efficacy (i.e., the belief in one's ability to successfully perform a task[27]), therapists and parents also conduct sessions in the comfort of the family's home, focusing on family activities and interests. The main clients in an A-V programme are the parents/primary caregivers, who participate in sessions. The goals are to develop their confidence and skills in implementing techniques and strategies, and to play an integral role in habilitating their child to develop listening, spoken language and communication competence.

There are over 200 hearing-impaired children, ranging from 4 weeks to 16 years of age, in the Listen & Talk AVT programme. There are 4 therapy rooms, 3 of them replications of rooms of a house, i.e., a kitchen, a living room and a room especially for infants and toddlers. Parents and their family members may borrow books from a resource library that provides information on topics related to hearing impairment, parenting, mainstreaming and child development, and a video library where they may learn from other parents and programmes. A room conducive to counselling new parents is also available. The multidisciplinary team of professionals in the Listen & Talk Programme comprises medical professionals, audiologists, A-V therapists, a medical social worker and a psychologist. When warranted, therapists collaborate with physiotherapists, occupational therapists, speech therapists, and school educators in mainstream and/or in special schools. This collaboration forms an integrated educational team that further supports the diagnostic role in AVT to continuously assess each child on his/her progress and learning abilities. A-V therapists visit schools to guide and support classroom teachers who may be new to mainstreaming. In addition, parent education and support groups are held quarterly, where parents benefit from further knowledge but also, most importantly, from emotional and peer support.

Conclusion

The new millennium has brought about great technological advancements in the field of hearing disorders. Hearing loss can now be detected at birth, and in the majority of cases, children can develop fluent spoken language through audition. The principles of A-V practice are to fully develop a child's hearing potential, so that the child can successfully integrate into mainstream society, and have choices in his/her future education and employment. The Listen & Talk Programme of the Singapore General Hospital illustrates a successful model of A-V practice in diagnosing, intervening and providing a holistic approach for the management of children with hearing impairment.

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