

CHAPTER 1

ORIENTATION AND RATIONALE OF THE STUDY

”It is so exciting to discover that wherever in the world residual hearing is being used to the full, in an environment in which parents and professionals work as partners to motivate children to communicate, hearing impaired children are learning to listen and to develop spoken language of a quality that is functional for life in society at large.”

(Clark, 1997:271)

1.1 INTRODUCTION

Cochlear implantation is one of the fastest developing fields within audiology (Nikolopoulos, Dyar & Gibbin, 2003:127; Nikolopoulos, Archbold & O’Donoghue, 1999:189; O’Donoghue, Nikolopoulos, Archbold & Tait, 1999:419; Archbold, O’Donoghue & Nikolopoulos, 1998:328; Nikolopoulos & O’Donoghue, 1998:46; Waltzman, Cohen, Gomolin, Green, Shapiro, Hoffman & Roland, 1997:342). Furthermore, the performance of cochlear implant users differs drastically from hearing aid users. Large differences are seen in their capability to identify environmental sounds, differentiate between voices, use auditory and lip reading cues, and in the comprehension of speech without the assistance of visual cues. Persons with a hearing loss, who are able to receive these auditory signals through the use of a cochlear implant, experience an abrupt change from a ‘world of silence’ to a ‘world of sound’. In addition to the special characteristics mentioned above, cochlear implant users have similar problems and needs, which are comparable to hearing-impaired individuals who are fitted with conventional hearing aids. It is vital that both cochlear implant and hearing aid users become skilled at making use of their auditory cues, in combination with all other visual, kinaesthetic and tactile cues, as well as communication abilities in order to cope successfully in the everyday environment of the real world (Estabrooks, 1998:79; Eisenwort, Baumgartner, Willinger & Gstöttner, 1996:243). Therefore, paediatric implantation involves long-term financial implications as well as a commitment in terms of time (Archbold, 1994:57). Today it is widely recognised that experienced professionals are required to implement well-managed paediatric programmes to ensure future viability for all implanted children. Given

the indications of the long-term benefits which are emerging from implant programmes throughout the world; this is a field which deserves more research due to the expansion possibilities which exist in it.

This chapter will provide an overview and perspectives on cochlear implants. The importance of obtaining outcome measures will be discussed, as well as the challenges faced when assessing a heterogeneous population. The recommended areas of assessment will be outlined. This delineates the purpose of the study: to determine the clinical relevance of the assessment protocol proposed by the Pretoria Cochlear Implant Programme.

1.2 PERSPECTIVES ON COCHLEAR IMPLANTS, PROBLEM STATEMENT AND RATIONALE OF THE STUDY

Profound or severe hearing impairments in young children often result in poor speech perception and production skills (Mondain, Sillon, Vieu, Levi, Reuillard-Artieres, Deguine, Fraysse, Cochard, Truy & Uziel, 2002:91). However, an issue, which remains problematic, is that of children who receive little or no benefits from conventional hearing aids. Firstly, when a hearing loss is so severe, it results in little or no usable residual hearing, and no benefit can be derived from the hearing aids. Secondly, a certain percentage of these patients are unable to bear the vibrotactile sensations of the hearing aid, and lastly, severe recruitment makes the use of the hearing aid intolerable. Thus, “research involving cochlear implants originated in an attempt to provide these children with an alternative sensory device” (Cummings, 1993:1).

Therefore, cochlear implants are provided to severely and profoundly hearing impaired children on the hypothesis that short-term outcomes in auditory receptive skills will translate, via a cascade of medium-term outcomes, into greater social independence and richer quality of life. In order to measure the outcomes and progress achieved from cochlear implants, effective assessment protocols are vital (Sanderson & Nash, 2001:1).

Cochlear implants differ from hearing aids in that they bypass the damaged inner ear and directly stimulate the residual auditory nerve fibres in the cochlea. A cochlear implant system consists of two components: (a) an external part worn on the body or behind the ear, and (b)

an internal receiver that is surgically implanted into the cochlea. The speech processor, which is either worn on the body or behind the ear, converts sounds into electronic signals, and a transmitter coil sends these signals to the implanted receiver package. The receiver package then carries electronic signals along several electrodes that can selectively stimulate the auditory nerve fibres within the cochlea (O'Donoghue, Nikolopoulos & Archbold, 2000:466).

Since the clinical application of cochlear implants started in the 1970's, the number of stimulating electrodes within the implant has been increased to improve its performance and the design has shifted from a single channel to a multi-channel system, which improves speech perception abilities. Vast research also includes miniaturization of the electronic circuitry (Ertmer, 2002:218; Naito, Okazawa, Honjo, Hirano, Takahashi, Shiomi, Hoji, Kawano, Ishizu & Yonekura, 1995:207; Cummings, 1993:1). These advancements in technology resulted in cochlear implantation now being an established method of management for profound deafness (Nikolopoulos, et.al, 2003:127; Nikolopoulos, et.al, 1999:189; O'Donoghue, et.al, 1999:419; Archbold, et.al, 1998:328; Nikolopoulos & O'Donoghue, 1998:46; Waltzman, et.al, 1997:342).

The advent of cochlear implants has had a dramatic effect on the achievements of young profoundly deaf children. Children who receive an implant early on in life, followed by a period of appropriate intervention, can achieve speech and language skills that exceed levels observed in profoundly deaf children with hearing aids (Geers, Brenner, Nicholas, Tye-Murray & Tobey, 2003:307). Children who receive an implant early also become less dependant on lip-reading. In addition, improved speech perception skills and awareness of environmental sounds, and improvement of speech production and voice monitoring occurs (Calmels, Saliba, Wanna, Cochard, Fillaux, Deguine & Fraysse, 2003:1; Mondain et.al, 2002:91; Richter, Eibele, Laszig & Löhle, 2002:111; Cummings, 1993:2).

As with hearing aids, children who receive cochlear implants do not perform in a uniform fashion. This is not an unusual finding, given the heterogeneous nature of the hearing-impaired population. Factors which contribute to the success of cochlear implantation, include etiology of deafness, age of onset of deafness, duration of deafness, age at implantation, primary mode of communication, parental and educational settings, skills of professionals, as well as the child's learning style, intelligence, hearing and listening abilities (Estabrooks, 1998:79; Sheppard, 1993:423). There may be other contributing factors, which

may be physiological in nature, such as neural supply and central processing abilities. Product factors which may also affect the outcomes of cochlear implantation are the number of electrodes implanted, speech coding strategies used, comfort, cosmetics and the availability of clinical and service support (Geers et.al, 2003:307). Furthermore, research has verified that access to good quality auditory training or learning also results in improved performance (Nevins & Chute, 1996:173). Additionally, post-operative success is highly dependant on close collaboration with parents (Bertram, 1996:61).

Cochlear implantation is therefore a beginning, not an end. It is a process, which involves decision-making, irreversible surgery and highly demanding intervention (Most & Zaidman-Zait, 2003:99). As a result, cochlear implantation requires a team of professionals committed to the long-term care of the children who receive the device (Nevins & Chute, 1996:21). An involved family is another crucial element in the success of an implant, especially if one takes into consideration that a decision for cochlear implant surgery involves a long-term, and most likely also a life-long commitment to intervention, auditory training, acquisition of spoken language skills and follow-up appointments (NAD Position Statement, 2004; DesJardin, 2003:391; Nevins & Chute, 1996:21). Outcome measures are successfully used for counselling purposes in order to foster realistic expectations in parents and to ensure that they are fully committed to the rehabilitation programme if long-term intervention is indicated by the outcomes (Tye-Murray, 2004:735; Estabrooks, 1998:20). As the parents are one of the main members within the Cochlear Implant Programme, family-orientated intervention programmes are commonly utilized. Family-centred intervention proposes that when professionals provide information, guidance and support to parents, it should empower the parents to build collaborative partnerships, in order to develop competence and involvement in their child's speech, language and educational development. Research proves that increased effectiveness of intervention programmes is evident if a family-centred approach is followed (Most & Zaidman-Zait, 2003:100).

In order to facilitate a successful implantation and intervention process, it is important that all the professionals involved understand the range of progress implanted children will display, how their level of functioning may change over time, and how to make the most of the available support services. The most commonly occurring challenges, which exist when assessing the outcomes of children with cochlear implants, are the following (Dyar, 2003; Nevins & Chute, 1996:173):

- The measurement of outcomes in extremely young children.
- The assessment and monitoring of progress in hearing-impaired children with complex linguistic or learning needs.
- The effectiveness of the cochlear implant device, i.e. mapping procedures in young children with cochlear implants is often difficult. Mapping procedures entail establishing electrical thresholds and maximum comfort levels, as well as loudness balancing of the electrodes (Weinstein, 2000:596)

As mentioned above, there are many challenges which are present when working with young cochlear implant recipients. Considering cochlear implantation is provided to children who are younger than 18-months at some cochlear implant programmes, and it is highly likely that this trend will continue towards children being implanted closer to birth or diagnosis, it is essential to ensure that mapping procedures and progress monitoring procedures are adapted to accommodate children with little or no spoken language. Many of the traditional assessments for auditory, speech perception, expressive and receptive language are inappropriate, as young children often do not have the necessary baseline skills (Weinstein, 2000:596). Furthermore, traditional assessments are also inappropriate for children with additional handicaps (which is present in approximately 40% of children with cochlear implants), as they also do not comply with the necessary baseline skills of the assessments due to the presence of a general developmental delay (Young, 1994:522). The subjects in this research study were in the transitional stage of spoken language development. The specific challenges that were identified were that the children had minimal spoken language, which resulted in slight adaptations to the assessment procedures (e.g. visual cues), and a large amount of observational techniques were used. Although a section of a standardised assessment was included in the proposed protocol, standardised assessments at this linguistic level are still very limited, especially regarding formal expressive language assessments.

“The purposes of a communication assessment after cochlear implantation are (1) to monitor an individual child’s rate of progress in speech and language acquisition - with reference to other cochlear implant users, (2) to collect data on the range of linguistic benefits observed across cochlear implant users over time and (3) to investigate and amend diagnosed or unforeseen communication difficulties - especially in the case of children who seem to progress at a slower rate” (Dyar, 2003:2). Thus, outcome measures are vital and provide important information for the intervention programme. The information gained from an

assessment includes deviations from the expected pattern of development, which would involve adjustments to the device (also known as *mapping*) or changes to the intervention programme. Furthermore, accumulation of the assessment information over time, and as a function of age, provides the background to which future cochlear implant users can be compared. In summary, assessments provide information in order to monitor progress over time, to provide concrete feedback to the multidisciplinary team members, especially to the parents, and lastly to monitor any changes in performance. Outcome measures are also needed for the collection of prevalence data for research, which is crucial for funding purposes, and for collaborative research to occur across all Cochlear Implant Clinics in South Africa (Lutman, Archbold, Gibbin, McCormick & O'Donoghue, 1996:39).

Professionals working within cochlear implant programmes are still finding the best measures on how to assess and report changes in hearing-impaired children's communicative competence, following cochlear implantation, and how to overcome the barriers of measuring progress in young implanted children (Dyar, 2003). This challenge is increasing as a result of changes in the candidacy criteria and secondly one must bear in mind that children are being implanted when they are younger (Chester-Brown, 2004).

Currently, children's linguistic skills are divided into three categories, namely, preverbal, transitional and functional language. During the preverbal stage, "children are functioning at a pre-lexical stage of spoken language acquisition." Characteristics of the transitional stage are, "recognisable words and simple formulaic expressions" reported by caregivers or professionals (Allen & Dyar, 1997:127). "Some single words or phrase patterns may be elicited on a minimum of two occasions in an assessment context" (Allen & Dyar, 1997:127). By this stage, awareness of voice and sounds in meaningful situations is present, and there is an idea of the use of language, and of the fundamental rules of communication (Archbold & Tait, 1994:178). During the functional language stage, the hearing-impaired child, "demonstrates the ability to use language spontaneously and in a systematic way. Knowledge of meaning, morphological and syntactical rules of the language is apparent, and the child has started to 'self-generate' language patterns" (Allen & Dyar, 1997:127).

In order to obtain sufficient outcomes and a holistic overview regarding the speech perception, and the speech-, language and literacy development of children with cochlear

implants, certain areas need to be assessed. The following areas of assessment have been recommended as essential, and should be included in all assessment protocols (Dyar, 2003):

- *General development.* Approximately 40% of children with a hearing impairment have additional handicaps (i.e. mental retardation, learning disability, emotional or behavioural problem, uncorrected visual problem, cerebral palsy, orthopaedic problem, brain damage, heart disorder, legal blindness and epilepsy). Considering that additional handicaps are likely to interfere with the performance of a child with a cochlear implant, an assessment of general development is crucial (Young, 1994:522). Assessment of general development also provides an indication of the type and degree of support needed pre- and post-implant.
- *Parent-child interaction.* Parents demonstrate a wide range of strategies and behaviours that may serve to support and facilitate a child's communicative development, or in some cases hinder communicative development. For young children, the parents' style and degree of match or mismatch with the child's abilities are of primary importance. It is therefore crucial to document the strengths and weaknesses of parent-child interaction during observation of familiar daily living or play activities (Prizant & Wetherby, 1995:162).
- *General socialization.* Social integration into society is one of the long-term aims of cochlear implantation. Assessment of general socialisation is essential to determine if the child with a cochlear implant is displaying age- appropriate social behaviours, and if he/she is aware of the social language and conversational rules that govern verbal exchanges (Ross, Brackett & Maxon, 1991:148).
- *Emerging literacy skills.* It is important to promote literacy skills in children at the transitional stage of linguistic development, as the presence of a hearing loss may inadvertently limit the child's access to print. This places the child at risk for later reading and language-learning difficulties at school (Mahshie, Moseley, Lee & Scott, 2006:84).
- *Auditory ability* (including pure-tone audiometry, listening skills, auditory attention span and memory, phonological awareness, speech perception and speech discrimination). It is crucial to evaluate the extent to which a child can receive auditory information from the environment. The auditory information will indicate what type of sounds or words the child is aware of and what sounds or words can be discriminated or identified. This information also provides an indication of the stage

of auditory development, which is essential for intervention planning and auditory training (Mahshie, et.al, 2006:128).

- *Language skills* (including receptive and expressive skills). Children's receptive and expressive language abilities must be evaluated in order to be able to set appropriate intervention goals according to language skills. Results from language assessments also help determine which tests or methods to use in evaluations or during intervention (Mahshie, et.al, 2006:108)
- *Speech production* (including speech repertoire, intelligibility and voice use). "Spoken language is the pathway for expressive communication" (Mahshie, et.al, 2006:155). As a result it is important to constantly assess progress and provide appropriate intervention in order to maximise the child's speech production skills.
- *Everyday communication skills*. Evaluation of everyday communication skills is crucial to determine if the child is receiving appropriate access to communication, as it is an essential prerequisite for communication development. Evaluating the child's environment ensures that the intervention goals are aimed at providing the maximum support for everyday communication (Mahshie, et.al, 2006:104).

Various assessment protocols for children on different linguistic levels exist, however, for the purpose of this research study, a protocol for children in the transitional stage of spoken language development will be applied in an inclusive educational setting (Mahshie, et.al, 2006:81).

The above-mentioned areas of assessment have been included in the assessment protocol suggested by the Pretoria Cochlear Implant Programme, to obtain outcomes regarding the holistic development of children with cochlear implants. Previous research regarding the frequency of assessment, suggests that recipients should be assessed once every six months until the children are within the functional language stage of linguistic acquisition. Thereafter, assessment should occur annually for the next five years, and then every two years (Tye-Murray, 2004:751). According to the Nottingham Cochlear Implant Programme, a child with a cochlear implant is monitored annually by a trained teacher, and at one, three, five, seven, ten and fifteen years after cochlear implantation, by a speech-language therapist involved in a Cochlear Implant Programme (Dyar, 2003). Serial assessments are important because it provides the only way in which rate of development can be monitored and patterns

of developmental change can be identified. This is crucial for clinical management and decision-making regarding the support needed (Mahshie, 2006:104).

It is essential for all the multidisciplinary team members to work together to achieve enhanced performance and outcomes. The individual members of a Cochlear Implant Programme may contribute professional or clinical insights in different ways and at different stages after the cochlear implantation.

In an attempt to overcome the challenges mentioned when assessing a young child with a cochlear implant, it seems feasible to determine the clinical relevance of the assessment protocol suggested by the Pretoria Cochlear Implant Programme. In order to establish the value of the proposed assessment protocol, a descriptive study was selected.

The aim of the descriptive study is firstly to determine the feasibility of using the proposed protocol in children with cochlear implants, and secondly and simultaneously to refine the protocol. By addressing the issues regarding assessment of young children with cochlear implants, the researcher can ensure that all the vital areas are assessed, and that all the information needed about the children's communicative and general development is obtained in a time and cost efficient manner. "Neither unaudited experience nor logical thought can replace controlled clinical trials, so until documentation of a procedure's effectiveness can be demonstrated, it should be considered a false idol and worship withheld," (Wilson, 2004:3).

This study will therefore provide answers to the research question by investigating the relevance of the proposed protocol, by administering the transitional stage assessment protocol on children in an educational setting.

1.3 DEFINITIONS OF TERMINOLOGY

In order to prevent concept misinterpretation the following key concepts are defined as follows for the purposes of this study:

1.3.1 *Assessment*: n. Estimate the size or quality of (Thompson, 1995:74).

- 1.3.2 *Cochlear implant*: “A device to improve the hearing of profoundly deaf people who derive no benefit from conventional hearing aids. It consists of an electrode that is permanently implanted into the inner ear (cochlea). An external device with a microphone and an external processing unit passes information to the electrode using radio frequency waves. The implant is powered by batteries in the external part of the device” (Thompson, 1998:135).
- 1.3.3 *Formal assessments*: Tests usually standardised and normed. Standardised means that there is a consistent manner in which items are to be presented and child responses equated. Normed means that the test has been given to a group of children that supposedly represent all children for whom the test was designed and scores determined for typical functioning (Owens, 1999:59).
- 1.3.4 *Habilitation*: Suggests that a person never functioned normally. Services are designed to help individuals overcome the challenges posed by a disability (Soer, 2001:17).
- 1.3.5 *Inclusive educational setting*: An educational philosophy that proposes one integrated educational system – versus the two-tiered regular and special education – based on each classroom becoming a supportive environment for all its members (Owens, 1999:486).
- 1.3.6 *Informal assessments*: A descriptive approach to assessment based on observation and conversational sampling. The clinician can apply his/her own theoretical model to the assessment process and can probe and assess areas that seem most handicapping to the child (Owens, 1999:68).
- 1.3.7 *Intervention*: Intervention is a directed, purposeful process. It is the intentional application of resources with the aim of developing, improving, or changing conditions within an individual, environment, or interactions between an individual and the environment. Intervention always results in both intended and unexpected outcomes, which may be either positive or negative in nature (Smith & Kane, 1998:374).

- 1.3.8 *Multidisciplinary team*: Representatives from many professionals that function in a co-operative and interactive manner (Shprintzen & Bardach, 1995:14).
- 1.3.9 *Outcome*: n. a result; a visible effect (Thompson, 1995:968).
- 1.3.10 *Paediatrics*: The general medicine of childhood. Handling a child requires a special approach at every age from birth (or premature birth) to adolescence and also a proper understanding of parents (Martin, 1998:479).
- 1.3.11 *Protocol*: official formality observed; the rules, formalities, etc. of any procedure, group etc. (Thompson, 1995:1101).
- 1.3.12 *Relevance*: n. Bearing on or having reference to the matter in hand (Thompson, 1995:1161).
- 1.3.13 *Rehabilitation*: Restore to effectiveness or normal life by training etc. especially after illness (The Concise Oxford Dictionary, Ninth Edition, Clarendon Press: Oxford, 1995:1158). Rehabilitation services are designed to help individuals overcome the challenges posed by a disability. Rehabilitation implies that the individual had normal function and lost it (Soer, 2001:17).

1.4 RESEARCH PROGRAMME

The study will be presented according to the following layout.

1.4.1 Chapter One: Orientation and rationale of the study

Chapter one will provide an introductory orientation to the study. The trends in current research will be described, from which a rationale for the study will be formulated. Following this, a specific research question will be asked, namely, what is the validity and functionality of the Pretoria Cochlear Implant Programme Assessment Protocol administered on children functioning within the transitional stage of spoken linguistic development. Definitions of the most important terms to be used in this study will also be included.

1.4.2 Chapter Two and Three: Cochlear implant programmes and assessment of a young child in South Africa

Chapter two and three will contain the theoretical part of the study. The literature survey will discuss the different assessment protocols used at other Cochlear Implant Programmes, in comparison to the protocol suggested by the Pretoria Cochlear Implant Programme members. The focus will be on the value and validity of the different existing cochlear implant assessment protocols, compared to the current protocol. Theoretical concepts regarding the assessment of a young child with a cochlear implant in South Africa will also be included.

1.4.3 Chapter Four: Research methodology

This chapter describes the research design in order to provide answers to the research question. The main aim and sub-aims of the study will be stated. The Pretoria Cochlear Implant Assessment Protocol will be administered on eight children with cochlear implants functioning within the transitional stage of spoken linguistic development, in an attempt to answer the proposed research question. A descriptive research design will be utilised. A description of the subjects, material and apparatus used, data collection procedures, as well as the manner in which the results will be statistically analysed, will also be included in this chapter.

1.4.4 Chapter Five: Results and discussion

Chapter five mentions the research results and findings, followed by a detailed discussion and interpretation of the results. The extent to which the results are able to provide answers to the problem statement and sub-questions, will then be discussed. Recommendations for the educational setting and assessment protocol will be made.

1.4.5 Chapter Six: Conclusions, implications and recommendations

The summary of the research results will be discussed in this chapter. This will be followed by conclusions made regarding the findings of the study, as well as the implications for clinical practise and further research. Shortcomings and advantages of the study will also be identified.

1.5 SUMMARY

This chapter aims to provide the relevant background information on cochlear implants in order to clarify the topic of the study and to create a broad perspective on the importance of the rationale for this study. Cochlear implants are provided to severely and profoundly hearing-impaired children on the hypothesis that short-term outcomes in auditory receptive skills, will translate via a cascade of medium-term outcomes into greater independence and quality of life. In order to measure the outcomes and progress achieved from cochlear implants, effective assessment protocols are vital. The factors contributing to the success of cochlear implantation are discussed as well as the challenges when assessing this heterogeneous population. Outcome measures were outlined, explaining the importance of providing information for the intervention programme and for funding of cochlear implants. An assessment protocol suggested by the Pretoria Cochlear Implant Programme was recommended in order to overcome the challenges mentioned. This study will determine the relevance of the assessment protocol proposed by the Pretoria Cochlear Implant Programme. Additionally, the current study aims to provide professionals with a better understanding of the clinical aspects of measuring progress in the paediatric cochlear implant population.