Advances in Cochlear Implants
edited by I.J. Hochmair-Desoyer and E.S. Hochmair
Manz, Wien © 1994

Habilitation Issues in the Management of Children Using the Cochlear Multiple-channel Cochlear Prosthesis

Robert S.C. Cowan, Elizabeth J. Barker, Shani J. Dettman, Peter J Blamey, Gary Rance, Julia Z. Sarant, Karyn L. Galvin, Pam W. Dawson, Rod Hollow, Richard C. Dowell, Brian Pyman, Graeme M. Clark
Department of Otolaryngology, University of Melbourne,
Cochlear Implant Clinic, Royal Victorian Eye & Ear Hospital,
& The Australian Bionic Ear & Hearing Research Institute,
East Melbourne, AUSTRALIA

498

Abstract - **Since 1985, a significant proportion of patients seen in the Melbourne cochlear implant clinic have been children. The children represent a diverse population, with both congenital and acquired hearing-impairments, a wide-range of hearing levels pre-implant, and an age range from 2 years to 18 years. The habilitation programme developed for the overall group must be flexible enough to be tailored to the individual needs of each child, and to adapt to the changing needs of children as they progress. Long-term data shows that children are continuing to show improvements after 5-7 years of device use, particularly in their perception of open-set words and sentences. Habilitation programs must therefore be geared to the long-term needs of children and their families. Both speech perception and speech production need to be addressed in the specific content of the habilitation program for any individual child. In addition, for young children, the benefits of improved speech perception should have an impact on development of speech and language, and the focus of the programme for this age child will reflect this difference in emphasis. Specific materials and approaches will vary for very young children, school-age and teenage children. In addition, educational setting will have a bearing on the integration of listening and device use into the classroom environment.**

1. INTRODUCTION

It is now clearly accepted that multiple-channel intracochlear implants can significantly improve speech perception for postlinguistically deafened adults [1]. Developments in speech processing strategies employed in the Minisystem 22 multiple-channel cochlear implant have also shown improved benefits for patients on tests of speech perception using open-set words and sentences [2]. While speech perception results are encouraging for adult patients, many clinicians and educators are focused on assessing benefits for children with profound hearing impairment, who often show significant delays in development of communication skills [3]. Since the first implantation of a ten year old child in 1985 at the Cochlear Implant Clinic of the Royal Victorian Eye & Ear Hospital with the mini-implant developed by Cochlear Pty Limited, there has been a rapid expansion in the numbers of children using the device both in Australia and world-wide.

These children are a more diverse population than postlinguistically deafened adults. Children may have either congenital or acquired etiologies of hearing impairment, a wide range of age of onset and duration of profound hearing loss, a wide range of residual hearing thresholds and history of hearing aid use in the pre-implant period, a wide range of age from 2 years to 18 years, and very differing levels of communication and social skill development. These factors, and others such as educational program, method of communication, and parental motivation present difficulties in assessing benefits from cochlear implant use, and identifying contributing factors to maximum benefit from use of the device. Carefully controlled studies of benefits of implants for profoundly deaf children are now currently underway in many countries, and recent results from the Melbourne group of children have shown that 60% of the children are achieving some understanding of open-set words and sentences using their cochlear implant alone, without the aid of lipreading [4],[5]. However, the results also suggest that improvements, particularly in development of implant-alone understanding of words and sentences, may not be evident for several years, in contrast to results for postlinguistically deafened adults who often show significant benefits within a few months of implantation.

While many research studies aim primarily at establishing the degree of benefit to speech perception from use of multiple-channel cochlear implants, the effect of improved speech perception abilities on development of receptive and expressive language is of particular concern to clinicians working with young children. For these patients, the aim of clinical habilitation should be to promote language growth through listening, since only through the acquisition of

An example may illustrate the importance of sound awareness and discovery-learning: A child was opening and closing the toiletdoor and he asked "Why does the flushing stop when I close the door and start again when I open it?"

We want the client and the partner to keep record of their experiences in a diary. It is very important to write down the first impressions. When there seems to be little progress, reading the diary reminds them of all tiny steps that have already been taken.

D. Main Issues in the Rehabilitation of Adults

A substantial part of the rehabilitation of adults is formal training. It can be divided into two parts that run in parallel.
One part is auditory training with the client. This training is based on a curriculum that is developed at IvD. It describes the various levels of auditory training. Rather than making use of sets of fixed exercises, we try to attune training contents, materials and methods to the individual client. This demands a lot of knowledge and flexibility of the therapist. Close monitoring of the client's achievements is necessary to prevent failure and to keep the training challenging.
The other part is transferring the role to the co-therapist. While working with the client, the speechtherapist explains the levels and aims of auditory training. She introduces exercises and sets an example to the co-therapist. Gradually she will let the partner take over the therapy. If necessary she will optimalise the partner's voice and articulation and often a lot of attention has to be given to the way the co-therapist corrects or guides the client.

E. Main Issues in the Rehabilitation of Children

For children the rehabilitation is a very long process that takes place in their home and school situation. For that reason we put much effort in guiding parents and the child's teacher and speechtherapist. The children that are in our programme do not have to be pupils of IvD-schools. But cooperation of the school is a necessity.
Working with the child is mainly restricted to the tuning. With children this takes every morning of the two-weeks rehabilitation period. Because there are always two children present, the children can alternate and play in between.
In the beginning of the rehabilitation we do no auditory training yet. Our main concern is that the children get familiar with the processor and the headset and that they like to use it. We stimulate the children to use the processor a few short moments every day.
In the guidance of parents the following issues are emphasized: Parents hope that their child will be a star. We keep putting much effort in tempering expectations and in guiding them to cope with expectations of grandparents, neighbours etc. that often put a lot of pressure on the parents and the child.
We try to help them to find ways for informal training in their home situation. Some parents are very eager to start 'working' with the child immediately, others are afraid to demand too much. We stimulate parents to take their child on a voyage of sound-discovery.
A speechtherapist gives hometraining to guide parents, similar to the training in IvD's early intervention programme. The therapist will demonstrate how the parents can play with their child and challenge it to listen, to give visual attention etc.
To guide the child's teacher and speechtherapist that have to become the child's co-therapists we have a special programme. Some children are attending schools with a TC or sign language setting that are not familiar with auditory training.
Up to now we are overwhelmed by the devotion and enthusiasm of the schools involved.

CONCLUSION

Client and co-therapist both have to be aware of the possibilities and the restrictions of the CI. After the rehabilitation they should be able to continue the discovery-learning at home or in school, at their own level, in their own manner. We try to create a feeling of competence and responsibility.

THIS GLOBAL APPROACH ENABLES US TO WORK PROCESS-ORIENTED
REHABILITATION IS GUIDED DISCOVERY LEARNING,
THAT SHOULD CONTINUE IN THE CLIENT'S HOME/SCHOOL ENVIRONMENT.

functional language skills will children be integrated into their educational setting and community. While habilitation must encourage this goal, the focus and planning of habilitation programs for individual children will be affected by factors such as the chronological age of the child, language skills of the child, and speech perception abilities of the child.

This paper presents speech perception and language results for several children. The implications of achieved benefits to language with the device are discussed in relation to effects on habilitation.

II. METHODS

Subjects for this study were 3 children currently using the Minisystem 22 multiple-channel cochlear implant. Specific details for these 3 children are shown in Table 1.

Table 1
SUBJECT DETAILS FOR THREE CASE STUDIES

	Child 1	Child 2	Child 3
Age at Implant	2 years, 6 months	5 years, 2 months	5 years, 5 months
Aetiology	unknown	rubella	meningitis
Age at Onset	congenital	congenital	2 years
Years post-op	3 years	5 years	7 years

Child 1 was implanted at an early age, whereas Child 2 and Child 3 received their implant when slightly older. Aetiology varies across the 3 children, as does age at onset. The 3 children have significant experience with their devices, with Child 3 having 7 years of device use.

Speech perception benefits were measured using standard open-set Phonetically-Balanced Kindergarten (PBK) words or Bamford-Kowal-Bench (BKB) sentences. Results were obtained for both the implant-alone, and implant plus lipreading conditions. Language results were measured using the Peabody Picture Vocabulary Test of receptive language. The test is administered orally using lipreading and listening.

III. RESULTS

Speech perception and language results for the 3 children are shown in Table 2.

As shown, Child 1 was implanted at age 2, and is now nearly 6 years of age. She has shown rapid improvement in speech perception since implantation, and is now achieving significant levels of speech perception with the cochlear implant used alone, or in combination with lipreading. Receptive language scores measured on the PPVT have also showed rapid gain since implantation. Table 2 shows both PPVT language age, and chronological age. For a hearing child with no other problems, these two levels should be equivalent (i.e. the child will have age-appropriate language). Pre-implant, Child 1 showed little language ability on the PPVT, with an effective "gap" of 2 years between PPVT age and chronological age. This gap has now narrowed considerably.

Child 2, with congenital deafness, was implanted at age 2, and is now 9 years of age. Although Child 2 now has significant implant-alone scores on open-set word or sentence tests, these benefits were not obtained until approximately 3 years post-implant. Prior to this time, benefits were limited to supplementation of lipreading. Overall progress has been gradual. Similarly, language progress has been gradual. At implantation, Child 2 showed a gap of approximately 5 years between chronological age and PPVT language age (i.e. language age of near 0 at chronological age 5). While there has been improvement in language age, a significant delay is still evident in the results of Table 2.

Table 2
SPEECH PERCEPTION AND LANGUAGE TEST SCORES FOR 3 CHILDREN

Test Administered	Condition	Child 1	Child 2	Child 3
Speech Perception				
- pre-implant	hearing aids	0%	0%	0%
- post-implant	CI alone	63%	41%	52%
	CI + lipreading	72%	62%	98%
Receptive Language				
- pre-implant	PPVT age	0	0.2	1.8
	chronological age	2.6	5.2	5.5
- post-implant	PPVT age	4.5	4.2	12.1
	chronological age	5.8	9.2	12.1

Child 3 was deafened at age 3, implanted at age 5, and is now 12 years of age. Child 3 showed limited benefits for the first 4 years of device use, primarily being some supplementation of lipreading. Subsequently, consistent gains in speech perception ability have been shown on open-set word and sentence tests, and Child 3 now shows significant implant-alone speech perception. Language scores at implant showed a delay of approximately 3 years. After 7 years of experience with the cochlear implant, Child 3's language is now at age-appropriate levels.

IV. Discussion

Child 1 is showing simultaneous development of both speech perception and language, although there still remains some delay in language. With children implanted at a very young age, it may be reasonable to expect improvements in language to occur within the first few years of implant use. Intensive habilitation encouraging language development may result in growth of independent functional communication skills at a much earlier time following implantation.

Results for Child 2 show a much more gradual development of speech perception and language, with significant improvements occurring only after several years of experience with the implant. Habilitation needs for this child will differ from Child 1 in that long-term support is required, and the emphasis of the programme should be primarily on language training as well as listening.

Child 3 shows results for a longer-term user. Although benefits were limited during the first 4 years following implantation, significant open-set listening skills are now evident. Similarly, benefits in terms of language were limited during the first 4 years of device use, but Child 3 has subsequently developed age-appropriate language. Habilitation for Child 3 was long-term, extending over 6 years with an emphasis on listening and development of language at all stages. Child 3 is now fully integrated at school, and requires only minimal support and device maintenance.

In summary, children who are implanted at a very young age may show rapid language growth. Intensive habilitation in the early stages of their programme may assist them to achieve an age-appropriate level earlier. Children implanted at an older age may require an extended habilitation programme focusing on long-term acquisition of language. It is important that parents are made aware of and plan for these differing habilitation needs prior to implantation. Benefits to speech perception and language may not be fully evident for many children until after several years of implantation, however, age appropriate language and full educational integration may be realistic goals for implanted children in long-term habilitation can be provided.

V. REFERENCES

1. RC Dowell, DJ Mecklenburg & GM Clark: Speech recognition for 40 patients receiving multichannel cochlear implants. Arch.Otol. 112, 1054-1059, 1986.
2. RC Dowell, LA Whitford, PM Seligman, BK-H Franz & GM Clark: Preliminary results with a miniature speech processor for the 22-electrode Melbourne/Cochlear hearing prosthesis. J.Otorhinolaryngology, Head & Neck Surgery, 1167-1173, 1990.
3. AE Geers & JS Moog: Predicting long-term benefits from single-channel cochlear implants in profoundly hearing-impaired children. Amer.J.Otol. 9, 169-176, 1988.
4. RSC Cowan, RC Dowell, BC Pyman, SJ Dettman, PW Dawson, G Rance, EJ Barker, JZ Sarant & GM Clark: Preliminary speech perception results for children with the 22-electrode Melbourne/Cochlear hearing prosthesis. Adv.Otorhinilaryngol.48:39, in press.
5. PW Dawson, PJ Blamey, LC Rowland, SJ Dettman, GM Clark, PA Busby, AM Brown, RC Dowell & FW Rickards: Cochlear implants in children, adolescents, and prelinguistically deafened adults: speech perception. JSHR 35, 401-417, 1992.

Author/s:
Galvin Karyn L.; Dawson Pam W.; Hollow Rod.; Dowell Richard C.; Pyman B.; Clark Graeme, M.; Cowan, Robert S. C.; Barker, Elizabeth J.; Dettman, Shani J.; Blamey, Peter J.; RANCE, GARY; Zarant, Julia Z.

Title:
Habilitation issues in the management of children using the cochlear multiple-channel cochlear prosthesis

Date:
1993

Citation:
Cowan, R. S. C., Barker, E. J., Dettman, S. J., Blamey, P. J., Rance, G., Zarant, J. Z., et al. (1993). Habilitation issues in the management of children using the cochlear multiple-channel cochlear prosthesis. In Third International Cochlear Implant Conference, Innsbruck.

Persistent Link:
http://hdl.handle.net/11343/26886