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“KIDS”-programme: an educational setting for deaf (implanted) children.

L.J.I. DE RAEVE

**KIDS, Royal School for the Deaf
Co-ordinator CI-team**

1. What or who is KIDS?

The acronym “KIDS” means “Koninklijk Instituut voor Doven en Spraakgestoorden” or in English “Royal School for the Deaf”.

For near 150 years, KIDS has been a centre of excellence for the education and rehabilitation of hearing impaired children.

At the moment, it is also an institute for autistic children and for children with speech and language disorders. The total number of children is above 500.

As you can see in figure 1, the institute “KIDS” is more than a school. Indeed we have a pre, primary and secondary school but also a boarding house, a rehabilitation centre with a audiological and audio-technical department, a home guidance team, a counselling office for deaf adults, 3 adult houses, and of course the cochlear implant programme.

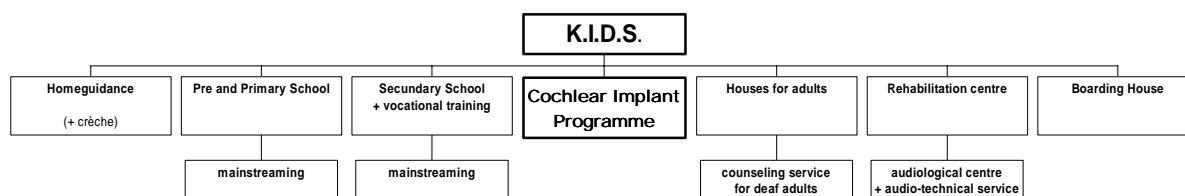


Figure 1. The structure of KIDS

Nearly 200 hearing-impaired (hard-of-hearing and deaf) children are educated by KIDS in home guidance, pre or primary school, secondary (vocational training) school or in a mainstreamed environment. Half of the children who come to KIDS stay in the boarding house from Monday till Friday.

KIDS offers a wide range of facilities for children from 0 to 21. Priority is given to the individual needs of the child. For that reason, the hearing impaired children are differentiated in three groups: an oral department, a total communication (Sign Language) department and a department for children with multiple handicaps. (See second presentation)

In every department, there are children with a cochlear implant. Because all these implanted children are different it's very important to know the child very well so that you and the parents have realistic expectations. And this is not always easy, especially with very young children.

Up till now, 25 children are implanted, mostly under the age of 6. They are implanted with the Philips Lauraflex or with the Nucleus 24 system. MED-EL and Digisonic is also on the market in Belgium, but we have no children implanted with these systems. At the moment Clarion is coming on the market in Belgium and will be used in the near future.

2. Education of deaf children in Belgium (Flanders): recent situation.

Belgium is split in two parts: in Flanders (in the North) they speak Flemish (=Dutch) and the Walloons (in the South) they speak French.

We have 8 schools for hard-of-hearing and deaf children, 5 in Flanders and 3 in Wallonie, for a population of 10 million people. All these schools have also boarding houses. There are 3 Sign Language Schools and 5 schools who differentiate in an oral and a sign language department.

10% of the deaf children and 25% of the hard-of-hearing children are mainstreamed. These children receive between 2 and 4-hours/week extra rehabilitation from a teacher of the deaf. All the children who are mainstreamed are oral children.

At the moment, there is an "experimental" mainstreaming program for deaf children who use sign language. They have a sign language interpreter for 18-hours/week.

When signs are used in schools for the deaf, it will be "signed Flemish or French" (not the Flemish Sign Language). It means that the signs we make follow the structure of the spoken language.

At the moment a lot of research is going on in Belgium on Flemish Sign Language and maybe in the near future we shall switch from Signed Dutch to Flemish Sign Language in some circumstances.(e.g. to teach Geography, History,...)

In KIDS, children who follow an oral program can choose to learn sign language from the age of twelve. In all departments we give the children information on the Deaf World and the Deaf Culture. This is called our "Deaf Culture Curriculum". (See second presentation)

3. Screening of infants hearing.

Until 1998 the infants hearing level was screened at the age of 9 months by the Ewing-screening test: the child is sitting on the knees of the mother while you present a sound (e.g. a spoon in a cup) behind his back. The child, who hears the sound, turns his head, searching for the sound.

From 1999 the Government of healthcare has (after an experimental period) introduced the automatic ABR (auditory brainstem response), called ALGO, to screen the hearing level of all new-born children between the age of 1 and 6 weeks. (Both ears separate)

When you get a “refer” as an answer, you only know that the child has a hearing loss of more than 30 dB. The hearing is checked again a few days later and when you have again a “refer”, the parents are sent to a home guidance team.

They visit the parents at home and make appointments for further audiological tests: ABR, OAE (oto-acoustic emissions)...

From 1999 on, most of the deaf children in Belgium are detected before the age of three months.

We start immediately with home guidance. This means that we give the parents a lot of information, we start with "fitting hearing aids" and we start the rehabilitation. A lot of time is spent on parent-child interaction (using video) and on auditory training.

We try to teach the parents how to communicate with their child.

When the child is between 1; 0 and 1; 6y, we have an idea of what he can do with hearing aids. At this age we can have our first discussion with parents (and ENT-doctor) on cochlear implants.

Only in case of meningitis (ossified cochlea) the child will be implanted before the age of one.

Ps. This is our point of view at the moment, but it changes over time.

4. Receiving a cochlear implant in Belgium : recent situation

The law in Belgium for a cochlear implant is very (too) flexible: every child or adult who wants a cochlear implant can ask for it and every ENT-doctor who works in a multidisciplinary team is allowed to do an implantation.

The cochlear implant Hospital must fill in a big dossier and a committee of the National Health Insurance will discuss it. When they give a positive advice the National Health Insurance will pay for the cochlear implantation (operation and speechprocessor). Parents only pay 500 US dollar.

Up till now, the National Health Insurance never refused a cochlear implant for a child (even multiple handicapped).

This flexible law results in 8 cochlear implant Hospitals for 10 million people, which is too many. But automatically parents go to the bigger teams.

At the moment all cochlear implant systems are available in Belgium for the same price, except Clarion. But they will come on the market soon.

Most CI-hospitals have chosen for two systems. Sometimes there is a small discussion between the CI-hospital, parents and local CI-team on the CI-system.

5. The structure of our paediatric cochlear implantteam in KIDS

Our KIDS-CI-team works in close co-operation with the team at the clinic, the parents and the child. (See figure 2)

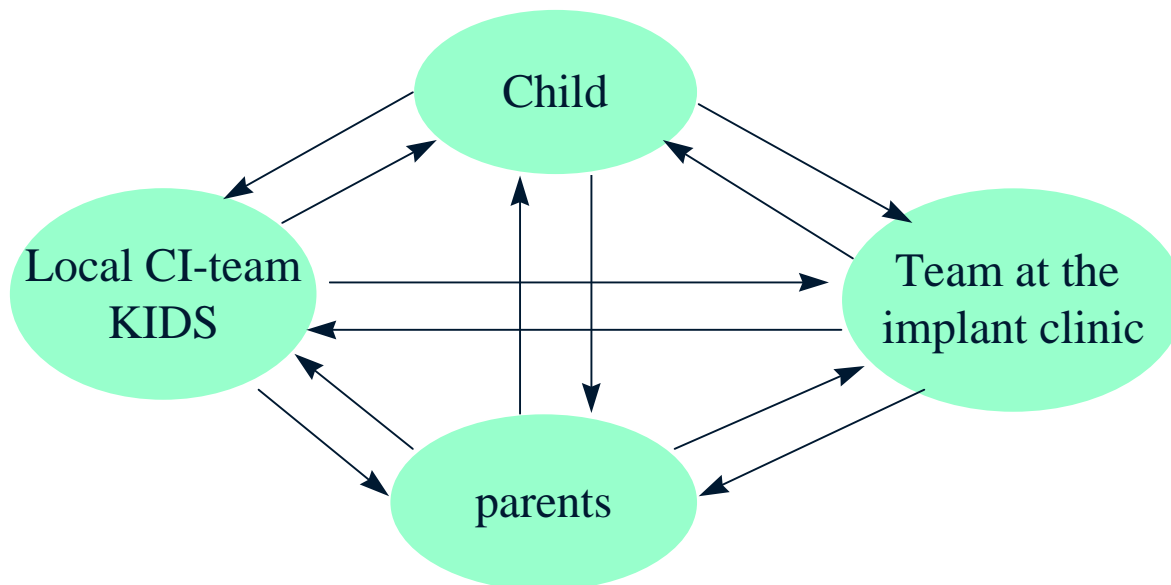


Figure 2. The structure of our paediatric cochlear implant team

All the experiences of education and rehabilitation of deaf people are centralised in "institutes for the deaf". The rehabilitation of CI-children is organised by the cochlear implantteam of the institute and not by the CI-hospital. (Like in most counties)

In the CI-hospital the ENT-doctor does the operation and the audiologist (or engineer) of the hospital is doing the basic fittings.

So it is very important to have a good and close co-operation with the CI-hospital.

Up till now, 25 children are implanted, mostly under the age of six.

6. Criteria, which influence a cochlear implant.

6.1. Functional hearing.

The limitations of acoustic amplifications can be assessed by the audiologist in consultation with the parents, home guidance or education team and the speech and language therapist. A minimum of 6 months of hearing aid use is desirable for all children, and most children will have a much longer trial.

But when the child has little or no speech recognition with hearing aids, after a period of intensive auditory training, then it's time to think about a cochlear implant.

From our experience and from international literature we know that children with aided responses of more than 55 dB across the frequency range from 500-4000 Hz are likely to benefit significantly more from an implant than from normally hearing aids.

Especially the high frequencies play an important role in making a choice.

6.2. Duration of deafness.

We know that the duration of deafness influences a lot the effectiveness of a cochlear implant. The shorter the deafness, the better the results with an implant. We in KIDS, we want to implant deaf children before the age of 6. At the moment, most of our deaf children are implanted between the age of 1; 0 and 3; 0y. And we see a difference in the results between these children and those between 3; 0 and 6; 0y. The brain of these very young children is very plastic and the rehabilitation is going on a more natural way. This issue addresses not only the plasticity of the auditory system but also the period of deprivation as it relates resiliency.

Children who became deaf (e.g. meningitis) or whose hearing level is progressively slowing down, should be implanted as soon as possible.

We have some pre-lingual deaf children who are implanted at a later age, but these are exceptions. They only take place in case of Usher-syndrome (the child will become blind in the future) or in case of very realistic expectation (by child and family)

6.3. Family support and expectations.

Cochlear implantation and the rehabilitation period can be stressful for the whole family and the support from other relatives (e.g. grandparents) will be vital for parents during the operative period, and the ensuing tuning and rehabilitation.

Parents can only have realistic expectations when then received enough objective up-to-date information on their child and on cochlear implantation.

Levels of parental responsibility are high and counselling towards realistic expectations must include the whole family. Grandparents are often a useful source of support for parents of deaf children, but we have the experience that the “average grandparent” has to high expectations. Often you hear them say: “My grandchild is going to hear again”.

Parents remain the strongest source of support for their child. Contact with other parents has been found to promote greater understanding of the probable difficulties and an arena for sharing feelings, which is not possible with implant professionals.

Parents who have realistic expectations and who are not disappointed if early benefit is not seen following implantation (as is probable with young children), have a very positive influence on child. Their communication and interaction style with the child stays very good, which is not happening with parents who are disappointed. Good communication and interaction style of the parents often leads to children who communicate well.

6.4. Medical or radiological indications

Diagnosis of the cause of deafness is all important because a misdiagnosis can potentially result in a child being inappropriately implanted, for example, when there is a retrocochlear cause for the deafness and there is no eight nerve function.

Although the medical history will reveal the cause of the hearing loss in most cases, physical examinations may demonstrate abnormalities to explain the deafness. For example, evidence of one of the many deafness syndromes.

In many instances the diagnosis will be clear (e.g. meningitis) and the issue then becomes one of the suitability for implantation on other grounds. Meningitis presents its own specific problems with the possible development of new bone growth within the lumen of the cochlea, labyrinthitis ossificans. Malformed cochlea's from congenital anomalies may also prevent the full insertion of all electrodes at the time of surgery. When the number of electrodes is severely limited, the performance of the child receiving the implant may be reduced.

6.5. Learning disabilities and intelligence.

As we know from research (Epstein, 1999) and from our own experience, 30% of the deaf children are not only deaf, but have also other problems. This can be: mental retardation, behaviour problems, hyperactivity, autistic behaviour, or learning problems
For example: CMV-infection (cytomegalovirus) may develop varying degrees hearing loss, mental retardation, hyperactivity psychomotor or other neurologic problems.
Because the rehabilitation of a child with a cochlear implant (or acoustic hearing aids) is a learning process, it depends a lot on the learning abilities and intelligence of the child.

So it's important to have information on the learning condition of the child (cognition, motorial level, concentration and memory,...)

6.6. Communication skills : oral or sign language

Assessing the speech and language abilities of children seeking cochlear implants is important to the decision-making process and the planning of a course for postoperative rehabilitation. Language competence should be viewed as comprising both oral and manual modes of communication. Additionally it is meaningful to note the child stimulability for speech. Stimulation of speech and language abilities is an area in which local home guidance teams and school professionals can be of great assistance.

We know that profoundly deaf children who only communicate with sign language are not ideal candidates for an implant. This is because their auditory environment is usually poor and their oral productions are usually scarce and limited.

But when you visit schools for the deaf you see that there is a big difference between schools. Some schools call themselves oral, but give little or no auditory stimulation. Other schools are manual, but spend a lot of time on auditory training.

School programs that have good auditory management for all children are particularly appropriate for children with implants.

From data (De Raeve, 1990) we also know that, in most oral departments, the average level of intelligence is higher than in manual departments. And if you have the 'better' population, your results must be better.

If a child is implanted in a real 'Signing environment', parents must know that the results will be different from oral children.

Our point of view in KIDS is that using signs is not against developing spoken language. In the beginning most of our deaf children need extra visual cues to communicate. Because lip-reading is too difficult for very young children, we use signs. Priority is going to communication: parents must be able to communicate with their deaf child (and vice versa). And we see that a lot of children drop the signs when they learn to speak.

6.7. Provision of support services

Accessibility of the child/family to professionals in the areas of audiology, speech, language, auditory training and education of the hearing impaired is considered as part of the "availability of support services"-factor.

It is senseless to implant a child if there is no (good) support afterwards. We recommend a minimum of three 30-minute sessions per week for speech and auditory activities.

7. Assessment protocol

-Before the assessment phase, parents receive from the co-ordinator of the local CI-team a lot of **objective and up-to-date information** on education of deaf children and cochlear implants.

The parents receive this information in group and individually. We made also an easy-to-read brochure on cochlear implants, based on frequent asked questions.

In our situation in Belgium, it's also important to know more about the different CI-Hospitals, their experience in CI, the systems they use and the financial consequences.

Parents should also know that a lot of deaf adults have regular contact with other deaf people (in a deaf club), because that's their place to be to feel themselves well. In the Deaf club they don't speak, but they use sign language.

-On a **regular** basis (ones every 3 months for children under the age of three and ones every 6 months under the age of 6) an **audiological check-up** (aided/unaided thresholds, Ling Five Sounds) is taking place in KIDS and the results are discussed with the parents.

-It's up to the parents to ask for **an individual conversation with the co-ordinator of the CI-team** (of KIDS). In this first conversation we talk on the possible effect of a cochlear implant on their child and we give them extra information. We prepare the parents to have realistic expectations. They also have the possibility to meet other parents of implanted children.

Parents can only make a "good" decision when they have enough objective information. Parents make the decision if their child will be implanted or not. We never say: "your child should be implanted".

-After this conversation with the parents, we have a discussion about the impact of a cochlear implant in this child living in this particular family. This is a **multidisciplinary discussion** with all personnel, working with the child: audiologist, home guidance team or teacher of the deaf, speech therapist, social worker, educational psychologist,...

The co-ordinator will discuss the results of this conversation with the parents individually.

-It's up to the parents now to decide if they want to start **with preliminary medical and radiological check-ups** or not. If so, the parents choose the CI-Hospital, which they want.

-Next the co-ordinator fills in the **cochlear implant protocol**. (Hellman) and sent it to the CI-Hospital. Within this protocol you can write information on 10 different factors: chronological age, duration of deafness, medical/radiological findings, multiple handicapped conditions, functional hearing ability, speech and language abilities, family structure and support, expectations of the family, educational environment, and availability of support services.

Then the parents have their first conversation at the CI-Hospital with the ENT-doctor. He makes an appointment for medical and radiological tests at the CI-hospital and will discuss these results with the parents afterwards.

In most cases, the parents want to **discuss all results ones again with the co-ordinator**. Parents have always questions about some topics. After this last conversation, the parents make a decision. If they want an implant, the CI-Hospital sends the **dossier to the National Health Insurance** and we start with the preparation of the implantation. Within three months from now, the child will be implanted

8. Preparation for an implantation

8.1.Preparation

Deaf children who will receive an implant, usually wear hearing aids (with or without limited results for low pitches) sometimes combined with a vibro-tactile aid. We practise: the response to acoustic stimuli, silent-loud, long-short,.

Moreover, we try to introduce notions such as high-low and quick-slow with all sorts of material. By using the vibro-tactile aid and especially the vibration-box we let the children experience these notions.

We have seen that children, who had become aware of sounds during this preparation period, already responded after the first fitting.

Children whose remaining hearing capabilities can be used better by means of hearing aids (but who can not reach thresholds of 2000 and 4000 Hz) can be prepared in a more differentiated way, by using speech: e.g. Ling detection, identification.

The children are not only prepared on an audiological way, but also on a psychological way. Lots of children are afraid from hospitals (white cloths) or do not know what's happening with them. We prepare the children by using picture of the ENT-doctor, colour books who explain the implantation, playing after the implantation, and sometimes visiting the hospital,...

8.2.The first fittings

The first fitting is always done in the Cochlear Implant Hospital, together with the parents and the speech therapist (key figure) from KIDS.

First we look for the threshold of each channel and afterwards for the most comfortable levels. (MCL) How many channels we can do in the first fitting depends on the age, preparation level and concentration capability of the child. The average of the first fitting (with young deaf children under the age of 6) is between two and eight channels. Because Belgium is very small parents go home after the first fitting and come back two or three days later for the second fitting. There is a third fitting five days after the second one.

In most cases the speech processor is fitted completely after three sessions.

From now on the parents visit the CI-hospital only every half a year and it's the audiologist in KIDS who is doing the fine tuning (in co-operation with the CI-Hospital)

In between the audiologist from the CI-hospital visits KIDS every two months for a fitting session (together with our audiologists and speech therapist).

At the end of each fitting session more precise information is gathered by means of:

- A tonal audiogram
- The five Ling-sounds on levels of detection, discrimination and identification
- The increase of loudness on various levels
- Balancing the various channels

These four aspects take place in the open field or through the computerised fitting program. Behavioural observation can also provide important information.

8.3. Wearing a conventional hearing aid at the opposite ear.

At the moment nearly all children are implanted uni-lateral. I am sure that in the near future, children will be implanted in both ears. Because a lot of children who are implanted have some residual hearing at the opposite ear, most implanted children were a conventional hearing aid on the opposite ear. Only in case it's an older child, who had never wear a hearing aid at the opposite ear, we do not support this.

The first two months after implantation, in which the basic fitting takes place, we do not support to wear the hearing aid. Afterwards we start again wearing the hearing aid.

In most cases we see in auditory perception tests that the child have the best results when he combines the hearing aid with the cochlear implant.

Even, a few of our children's hearing threshold with the hearing aid is 10 to 20 dB better after they wearing a cochlear implant on the opposite ear.

Sometimes it disturbs the speech perception or the child is telling us it doesn't sound good. In these cases we drop the hearing aid.

9. Personal approach within KIDS-program

9.1. Communication and interaction.

Our approach is based on interaction and communication.

In home guidance we use the media "video" to teach parents how to interact and communicate with their child. It's called "video hometraining" and is designed by Orion.

"Video hometraining" is a practical method in which we can discriminate three phases : the shooting, the analysis and the video feedback.. Through means of video-shots in daily home situations we are going to support, guide and improve interaction between the deaf child en the parents. These shots will be analysed and discussed with the parents. Lets keep in mind that "video" is the medium and not the message.

Teaching and conversation at KIDS are based on **the Maternal Reflective Method** of Dr. van Uden. We try to teach the deaf child his language on the same basis as a mother learns it to her hearing child. She listens to what the child wants to say and say it back in a good phrase. In other words, she plays a double role.

The teacher plays the part of the parent, listening to the child, then taking the conversation on by adding a comment of a question The children soon learn what speech should sound like and how they can communicate. The parent or the teacher is communicating on a very expressive way and rhythmic way and if necessary we use Signed Dutch to support the communication. This conversation is often illustrated on a visual way: a drawing, a picture in combination with some written words.

The language comes from the children, so it's meaningful and relevant. The conversation can be written down in a diary or can be presented later as a reading text. It becomes the basis for language acquisition, reading activities and allows the children to reflect on the new speech and language.

This **reflective** method tries to combine the normal colloquial language from early childhood with the teaching of the rules or laws of grammatical behaviour. This development embraces several steps:

- Real conversation, by the "seizing method" and the "playing of the double part", including all normal forms of language with all linguistic intentions, thus not only statements, but also questions, feelings, calls...
- The utterances of the children should be as rhythmical as possible, for reasons of memory and also of phrase-structure.

Because of this lack of memory, we can not omit reading and writing. This can be used from the age of 2;6-3;0y. What the child can not yet speak, will be written down for him, immediately in the situation. This is kept in the children's diaries in the form of "reading-lessons".

From this "reading-lesson" certain pieces of language are selected which can be used to exercise in the classroom or in speech therapy. Following aspects can be covered:

- Knowledge of vocabulary:
 - passively
 - actively
 - articulation

- Recognition and learning of words and auditory training
- Recognition and learning of the letters of a word
- Analysis and synthesis of the letters of a word (auditory and visually)
- Learning of rhythmic accent-groups (understanding, listening)

- Learning to reflect on language presupposes much reading and many conversations.

In this method, music and rhythmic therapy play an important role. In music lessons we do a lot of auditory awareness games, make music, record music and learn the children that you speak in rhythmic word groups with good intonation.

Teaching a mother-tongue to deaf children should have some characteristics:

- We must enter into conversation with the deaf child as soon as possible
- The language which the child should learn must first of all be understood
- Expressive language should grow from a much larger fund of understood receptive language, which fund must be built up from conversations, the deposit of which is written down in the child's' diaries.
- The children should be helped more and more to find the systematic cues themselves by reflecting first of all on their reading material.
- Composition work (drawings, pictures...) should never be over-emphasised so that reading always remains in the foreground, because only good reading can give deaf children sufficient frequency of language-practice.

The principles mentioned above are quite a programme. But in the programme we discounted the many specific difficulties of deaf children:

- A too low frequency of language practice in comparison with hearing children: therefore education in reading should be strongly in the foreground.
- Difficulties in memory : thus a lot of practice in oral rhythm (singing, talking in accent-groups), a lot of reading and writing (to support the auditory memory)
- The slow beginning in infant years, in which the deaf children stay in one-word phase of expressive language for too long time, and the lipreading and listening cues are still too limited. Only children who are implanted before the age of two have the possibility to develop good listening cues at a young age.

Thus an early start (before the age of 2) with auditory training and speech lessons together an early start with reading and writing (not later than 4 years of age) is recommended.

- The lack of experience in many deaf children, which should be reciprocated by special measures at home, in school and in the boarding house.

Throughout their time in KIDS, constant attention is given to the quality of sound perceived by the pupils. They are given powerful hearing aids as soon as possible. Our audiologists check the hearing levels every six months and see if the hearing aids are still in a good condition. If not, our audio technician repairs the hearing aid as soon as possible. Of course our teachers, speech therapists and care staff are looking out too, and if necessary they send the child to the audio technician.

In KIDS we made it possible that every child wears his own hearing aid in all circumstances and that all external equipment can be connected to their own hearing aids. In all classrooms we use FM-systems, which are connected to the behind-the-ear hearing aids or cochlear implants. All deaf children who are mainstreamed also wear FM-systems.

Each child with an implant is assigned to a speech therapist who acts as a key-figure. She prepares the child to the implantation, accompanies the child during check-ups or fittings and invites the parents monthly to assess the period which has passed, to attend a therapy session and to pass on tips and exercises for the next period.

The high level of care provided at KIDS doesn't stop in the classroom. Each child is put in a residential group with children of similar needs. The dedicated care staff is responsible for the health of the children and all other aspects of their social development. They are also responsible for providing an environment that's homely, friendly and well coming. Conversations are also based on the Maternal Reflective Method and auditory training plays also an important role.

9.2. The importance of reading in language acquisition

International research (Furth, Ewing) shows us that only 20-40% of 16-year old deaf students come to read successfully the book of normal hearing children of 11 years of age.

Deaf children need much more training in reading than hearing children.

The first step is that they read their own diaries, the stories and the language of which they already know still in a general way. This kind of reading has been called "**ideo-visual reading**" (Decroly, Van Uden) because the ideas are already in the minds of the children and they read what they know.

The second step is "**receptive reading**". The children start to read from the diaries of their classmates, friends, the stories and language of which at least part are unfamiliar.

The term "receptive reading" indicates that the child is now receiving ideas more or less unknown to him. The more ideas are unknown, the more the reading will be "receptive reading".

Now it's important to check whether they understand what they are reading. Interesting exercises on this level are: who says what, cut sentences in separate words or accent-groups, as, ask questions and let the children formulate questions, find the question words...

This process of receptive reading embraces two phases.

- The "**vocabulary-phase**", which means that the majority of the words of a text or reading book is known to the child and it can guess intelligently what the content will be.
- The "**structural phase**" in which additional to the knowledge of the words and the expressions, the structure of the language plays an ever increasing part in understanding: figurative meanings, the humour of language, the analysis of sentences...

Because it's so important that deaf children learn to read, we spend a lot of energy (and money) in "reading promotion". There is a big library in school in which the children can lend books on their reading and interest level. Each class has their own small library, which can be used if the children have some minutes free.

Every year, authors and drawers of children books are invited in KIDS.

In the boarding house the children are encouraged to write a letter to their parents, or to send them a fax. (Or an email) All televisions have the opportunity to use teletext.

At the moment we have also the opportunity to use Internet.

10. Education of deaf children: oral or/and manual

You can talk about the "education of deaf children" on different point of views. You can talk about it from:

- **A philosophical point of view**; how do we think about deaf people and their way of living in our society. It can be strictly oral (oralism), manual (manualism), total communication or a more differentiating philosophy.
- The **coding strategy** you use, is corresponding to your philosophy.
- The **(didactic) method** which is used to reach your aim. You can teach on a very constructive or imitative way or on a more reflective way, which is more in the middle between the other two.

10.1. KIDS-vision on the education of deaf/Deaf children.

KIDS has chosen (since 1970) for a more differentiating philosophy, in which we learn the children to communicate by using a reflective method.

We are sure that deaf children need to be educated on a **possible integration in two worlds**: the world of the hearing and the world of Deaf people.

We came to this conclusion because research in Belgium and Netherlands (Pool-project, 1995) showed us that 95% of deaf adults (between 20 and 40 year) have regular (minimum ones a week) contact with other deaf people. The communication code is Sign Language instead of 80% of the population came from Oral schools or were mainstreamed.

The code you chose depends on **the choice of the parents and/or the learning possibilities of the child**. Especially deaf adults want their children's first language is Sign Language. But 95% of deaf children have hearing parents. The impact of learning difficulties on 'oral' language will be discussed in 10.2.

This means automatically that both languages should be implemented in the school program:

- If spoken language is the first language, then the children have the possibility to learn "Sign language" from the age of 13 (beginning of secondary school) On all school levels (from 3;0 to 21 y) special attention is given to "Deaf Culture and Deaf awareness" (See 10.3)
- If Sign language is the first language, special attention is going to speech and spoken language from childhood on.

10.2. The impact of learning difficulties on ‘oral’ language.

We know that an oral development in many deaf children is not satisfactory, even after many years of education. The reason can be a lack of external circumstances (level of education, parent co-operation, teacher qualification...) but also additional disabilities in the child: mental deficiency, autism, spasm, hyperactivity,...

But some, normal intelligent, deaf children (15-20%) in addition to being deaf also suffer from learning difficulties, which impede satisfactory development in spoken language, speech and lip-reading. Routine psychological testing does not indicate these difficulties.

It is possible that lip-reading or the development of speech is a single problem.

However, the development of the auditory and visual memory, the auditory listening capacities, feeling for rhythm and the development of fine motorical movements plays an important role.

These learning disabilities can be detected by the age of 3 or even younger. Special tests have been developed to detect these problems.

The testbattery is called “learning conditions of deaf children”, created by M. Broesterhuizen (1995) and adapted by L. De Raeve.

There are three parts and each part contains several subtests:

1. Development of rhythm and motorical movements:

- tongue movements
- finger movements
- imitating successive folding movements
- tapping successively four cubes in a shown order
- repeating rhythmically patterns or syllables

2. Visual cognition and memory:

- remembering simultaneously presented coloured rods
- remembering simultaneously presented pictures
- association of symbols (animals)

3. Language development

- articulation index
- pre-school passive language test

So at the end you can see how the child is functioning on all different levels and when you count all the results together you can read in a table “the prediction of oral communication”. E.g. 90% of the children with the same result came to an oral communication.

Of course this testbattery is not the only way to differentiate deaf children, but it can confirm our practical experience.

For me an experienced teacher of the deaf or speech therapist in combination with this testbattery gives the best predictive level.

Ps. Additional learning problems are not a contra-indication for a cochlear implant. For some of these children the cochlear implant has a very positive influence and the learning problems became less big then before. A cochlear implant and the intensive rehabilitation have a positive influence on the auditory memory, auditory feedback and rhythm.

10.3. Deaf Culture and Deaf awareness

As said before, most deaf adults need regular contact with other deaf people. Even with the best hearing aids or cochlear implants and with a good spoken language level, they are not integrated for 100% in the hearing world. For example when hearing people are talking to each other in a group, it's impossible for the deaf person to follow this conversation. Also in bad listening conditions they feel themselves "deaf".

Research (Marschark, 1993) shows us that those deaf adults, who have little or no contact with other deaf people, make a bigger chance to psychological problems. The same research shows us also that Deaf children from Deaf parents have little or no psychological problems. (Same average as hearing people).

For these reasons we started 1997 in KIDS with a "Deaf culture and Deaf awareness program". Until than it was possible that were educated in KIDS without seeing one deaf adult. Because, except two, all personal in KIDS was hearing, we started to invite deaf adults (as a model) on a regular basis:

- In **pre-school**, ones in a month, Deaf adults come to the different groups to tell the children a **fairy-tale or a story**. Spoken and Sign language is used.
- In **primary school**, Deaf adults visit all classes every month for two hours. They teach the children the use of **different communication systems**: spoken language, Signed Dutch, Flemish Sign Language, Fingerspelling, Cued Speech, the importance of reading...
- In secondary school, the Deaf adults come every two weeks for two hours. They give the pupils information on "Deaf Culture", "Deaf Awareness" and social securities (Sign Interpreters, Hearing Aids, Deaf Clubs, Fax,...

Twice a year a deaf mime player or the theatres of the deaf are invited.

11. Rehabilitation

The aim in the rehabilitation of young children with cochlear implants is to enable them to learn to listen to the new sensations of sound, to attach meaning to them and to use their hearing in the development of spoken language

To maximise the benefits from the implant system, the children need the following:

- Wearing the device all waking hours, in good working order
- Appropriate tuning of the device
- Good listening conditions (bearing in mind the difficulties to listen in background noise)
- Opportunities to develop appropriate listening and communication skills
- Experience of success in developing listening and communication skills in age-appropriate interactions
- Co-operation of all people involved with the child

These requirements are not so different from those for young children who wear conventional acoustic hearing aids. However there are some differences in working with children with a cochlear implants:

- The complexity of tuning the device
- The complexity of monitoring device well functioning
- The sudden onset of audition after a period with little or no auditory input
- The expectation of greater access to mid and high-frequency information

11.1. Sound awareness

In home guidance and in the beginning of the nursery school “sound awareness” plays an important role.

Shortly after being born the child comes into “touch” with sounds. First and foremost through the mother, but also through the surrounding world, which is experienced as a whole.

There are for example certain sounds within the world of a baby and infant which reappear.

Although quite unawareness impressions at first, they can become patterns of recognition.

Finally there is also the experience of sounds which the child creates itself (initially unconscious). For deaf children this natural process does not go without saying.

Because the hearing impaired child misses all these factors partially or entirely, there is a chance that the babbling will stop. Therefore it is of utmost importance to activate and train the awareness towards sounds as soon as possible.

In terms of sound awareness there are two interest groups, the child and its environment (parents, therapists, family)

A child experiences a sound (musical or non-musical). It listens to it, looks for its source and puts a meaning on it.

Thus the motivation is created to listen again. Equally important is experimenting by the child itself. In this way the child not only tries to imitate the experienced new sounds but also discovers that it can produce new sounds on its own. Again, the motivation to listen is enhanced. This entire process continuously takes place on a non-musical (vocal and ambient sounds) and a musical level

For deaf and hard of hearing children this process is less spontaneous. Its accidental character is partially or entirely lacking.

This brings us to the process of raising awareness to sounds of our other target group: the parents, therapists and coaches.

They have to realise that auditory training is of essential importance for language development. The use of a good hearing aid will enhance and enable the spontaneous character of hearing sounds. Experience has taught us that hearing aids are used well in families where sufficient attention is placed upon raising awareness to sound.

We must give the child the chance to experience as many sounds as possible, whatever the situation may be.

Make it clear when you hear something, **visualise** it and, if possible, look for its source.

Create expectations: e.g. When in summertime the ice-cream cart passes (usually they are as regular as clockwork), make a drawing and make it clear that hearing the cart means ice cream. Or, take the children on an explorative expedition: what can I hear in a house or in a classroom? Who or what is producing the sound? Equally important is the following question: what could the child use to make a sound? Stimulate the child in thinking up all sorts of sound games (e.g. drumming with a wooden spoon)

Reward children when they babble spontaneously or react to sound.

Exercises to train listening skills on a non-musical level, and especially the vocal aspects, are covered mainly by speech therapists. On this subject they also pass on suggestions to the class teacher and the music teacher. In all these disciplines attention is placed upon noticing ambient sounds.

Auditory training on a musical level is taken care by two music teachers. Every week the toddlers get 2 sessions of 50 minutes each, the children who go to grammar school one. This training consists of 3 domains: listening to music, making music and recording music. Within these domains, we concentrate on sound aspects or sound qualities, morphological principles and the giving of meaning.

11.2. Daily individual speech therapy.

The approach developed in KIDS tends towards the synthetic (or top-down approach) in which children learn to use hearing in natural situations, discovering the rules of communication for themselves and becoming able to use their useful hearing in the development of language. In auditory training sessions we go from natural situations to analytic auditory training.

Each child with an implant is also assigned to a speech therapist who acts as a key-figure. She prepares the child to the implantation, accompanies the child during check-ups or fittings and invites the parents monthly to assess the period which has passed, to attend a therapy session and to pass on tips and exercises for the next period.

The individual speech therapy always departs from a conversation or reading class which corresponds with a certain observation or experience.

The contents of this therapy depends on several factors:

- Intelligence
- Chronological age
- Mental age
- Age onset of deafness
- Age at which the child received an implant
- Additional problems (dysphasia, learning disabilities)
- Code of communication

The way in which the exercise material is presented also depends on the child. We employ specific material, pictures, illustrations, sign language, and gestures.

All this is recorded in a book, which the child regularly takes with him to the boarding house or home. In this way a transfer to other situations is created.

The topics in the individual speech therapy are articulation training, auditory training, lip-reading and the increase of vocabulary and language. These topics are not isolated, but a continuous interaction is created. From the conversation or a written text, we select environmental sounds, onomatopoeia, words, phrases or sentences. This material is trained on different levels and in different conditions.

A lot of energy is put in auditory training, especially with cochlear implant children. The basis for auditory exercises is our KIDS listening-cube. Every exercise is chosen out of this cube. (See figure 5)

In this cube you can distinguish three parameters:

- The material: environmental sounds, vocalisations, words, phrases, text...
- The listening condition: with or without background noise, lip-reading, distance to the speaker, open or closed set.
- Exercise level: detection, discrimination, identification or comprehension.

An example of an exercise: identification of words in closed set, by using the telephone.

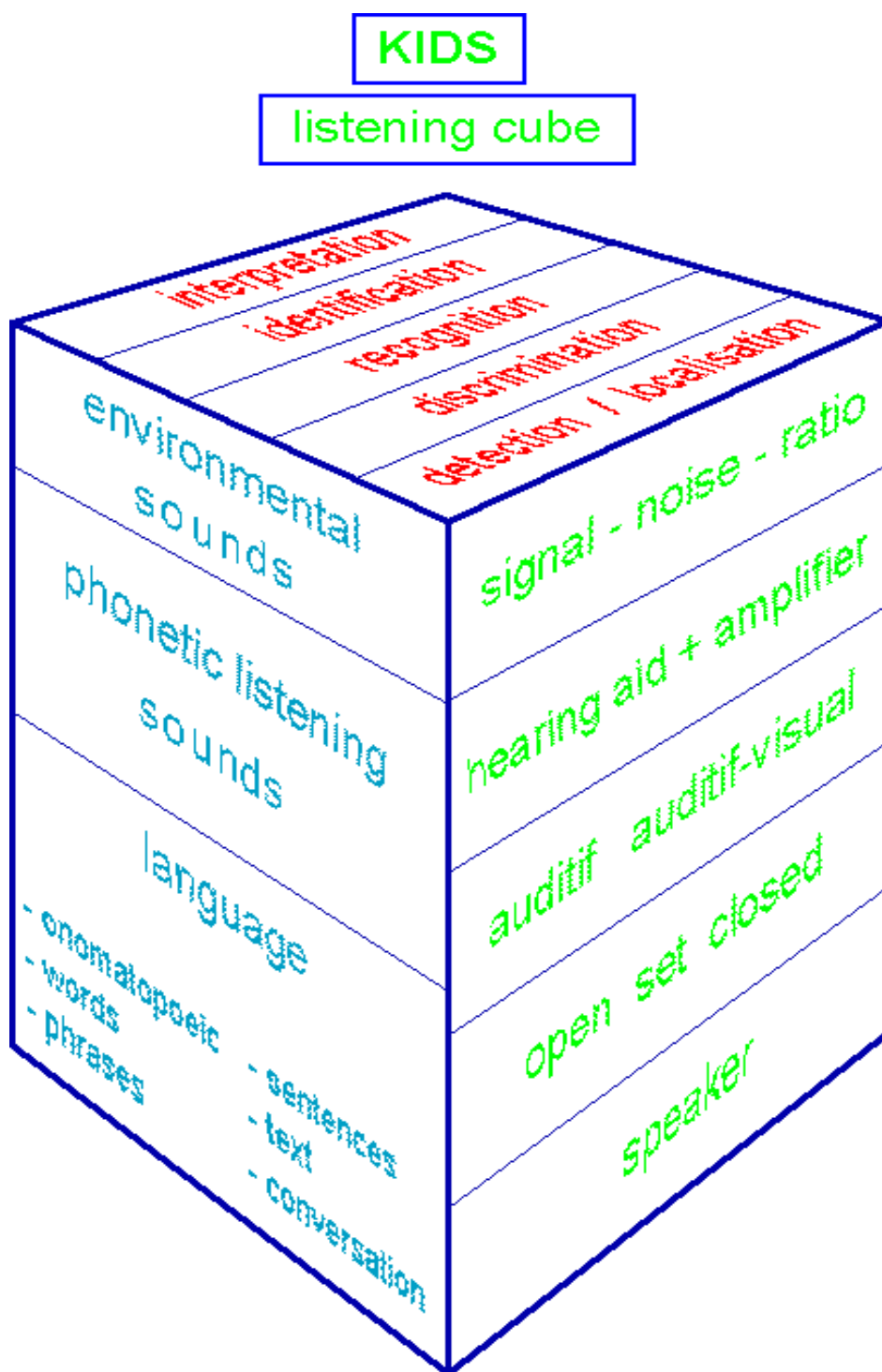


Figure 5. KIDS listening cube

12. Parental collaboration

Deafness in one member of the family affects the others (Luterman) and cochlear implantation also does not affect merely the recipient. Cochlear implantation and rehabilitation period can be stressful for the whole family and the support of other relatives will be vital for parents during the operative period, the ensuing tuning and rehabilitation. If early benefit is not seen following implantation (as is probably with young children) disappointment expressed by other members of the family is most unhelpful. Parents remain the strongest source of support for their child (Evans).

A part from parents' evenings, regularly organised by the school or a parents' committee, there are a large number of individual contacts with the parents of cochlear implant children, both during the period of selection (preparation) and rehabilitation.

The educational psychologist is the key figure before implantation. He gives the parents objective information on cochlear implant systems, cochlear implant hospitals, expectation, rehabilitation and financial consequences. There is always the possibility to bring the parents in contact with other parents of implanted children.

When the parents have made the decision to implant their child, the child is assigned a speech therapist who acts as a **key figure**. Pre-implant, she accompanies the child during selection tests (MRI, CT scan...) and after implantation she accompanies the child during check-ups or fittings. Moreover, she invites the parents monthly:

- To assess the period which has passed
- To attend a therapy session
- To pass on tips and exercises for the next period
- To pass on techniques that parents can use to stimulate their child's language development

We teach the parents to visualise conversations at home and to collect them in a book (a diary). Initially they consist of simple words, accent groups and sentences accompanied by drawings or pictures.

The diary is a way to recall, repeat and learn this experienced language in function of the auditory training. As the child grows older, the goal is to form longer sentences and to increase the recorded language.

The drawings and pictures will gradually disappear. From the moment the experienced language is recorded, it is equally important to continue exercising in function of auditory training.

13. Follow up.

13.1. KIDS-testbattery.

To measure this evolution we created in KIDS our own test battery in which the tests are not selected because of their high statistical performance but their practical use: to give us the information we want to know, at a short time and interesting to do for young children. Most of the tests existed, and we translated them into Dutch.

We selected 12 tests and 3 questionnaires on 7 different parameters. We are not only focused on auditory skills (sound awareness, prosodic information, auditory perception) or speech perception skills, but also on phonetic evolution (articulation), the expressive and receptive language level, lip-reading skills, voice quality, their way of communication (code), and how they use the implant in real live situations. (See figure 6)

All the children were tested, before CI, after 1 month CI, after 6 months...(every 6 months).

1. Warble tone audiometry
2. Auditory perception skills:
 - environmental sounds (DASL)
 - onomatopoeia (KIDS)
 - sounds (Ling) + words (Erber)
 - sentences (Pap-V)
 - by telephone (NPCIP)
3. Phonetic evaluation (ASIA)
4. Language test: receptive + expressive (RTOS)
5. Lip-reading: 20-word test (KIDS), lip-reading test (van Uden)
6. Voice quality Scale (Buffalo III)
7. Daily live:
 - MAIS (Meaningful Auditory Integration Scale)
 - MUSS (Meaningful Use of Speech Scale)

figure 6. KIDS test battery for cochlear implant children

13.2. The evaluation of Auditory Responses to Sound. (EARS)

The EARS is the most commonly used battery in the world. It exists of 7 assessments, which span the range of abilities from detection of environmental sounds through to open set speech discrimination. It's available in more than 14 languages.

EARS consist of:

- 1 profile: **The Listening profile** in which the clinician records the child's ability to environmental sounds, musical instruments, voice, Ling sounds, own name in quiet...
- 3 Closed-set tests :

*Monosyllable, Trochee, Polysyllable-test	Pattern-identification
*Monosyllabic word list	Word-identification
*IOWA Tyler-Holstad closed set sentences	Sentence-identification

- 3 Open-set tests :
 - *Monosyllabic word list Monosyllabic word recognition
 - *Glendonald Auditory Screening Procedure (GASP-sentences) Recognition of simple questions
 - *Language specific sentences Recognition of unknown sentences
- 2 Questionnaires :
 - *MAIS (Meaningful Auditory Integration Scale): Questions about how well the child wears the device, responses to environmental and speech sounds.
 - *MUSS (Meaningful Use of Speech Scale): Considers voice control, production of speech-like sounds and communication strategy.

14. Results.

14.1. Average threshold.

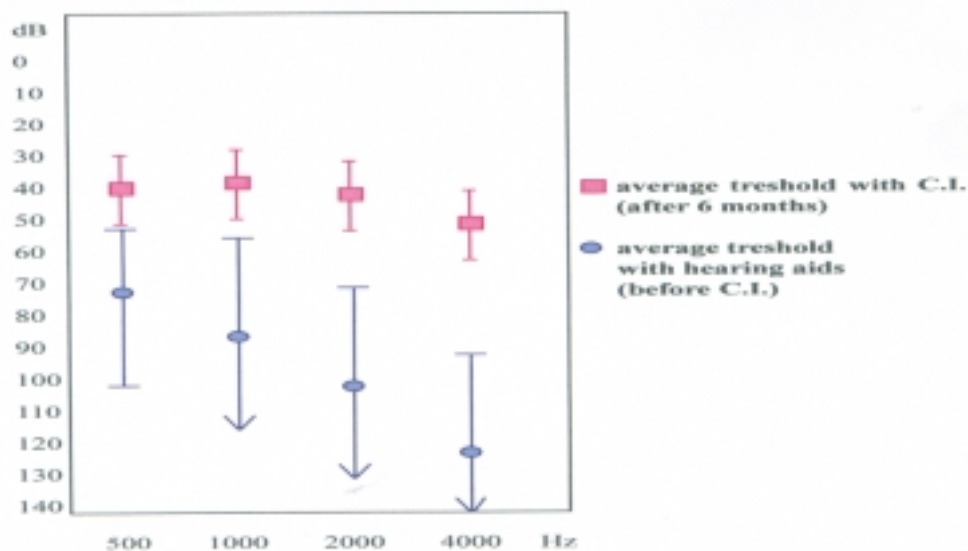


Figure 7 : average threshold with hearing aids and CI

When we look at figure 1, we can see that all the children, who are implanted in KIDS, have a better threshold with the cochlear implant than with the conventional hearing aids. We see the biggest benefit in the high frequencies. The average threshold with a CI 6 months after implantation is 43 dB.

This results at the moment in **the boarding-level of 55 dB**. At the moment a lot of CI-centres take 55 dB **with conventional hearing aids at all frequencies (500-4000Hz)** as the boarding to implant a child or not.

14.2. Speech perception.

A very easy way to evaluate the perception of speech is to use the **Ling-five sounds** (aa, ie, oe, s en ch). These five sounds enclose nearly the whole speech spectrum.(low, middle and high frequencies).

It's easy to test if the children can detect or identify these five sounds.

In figure 8 we can see that 6 months after implantation nearly 90% of the children detect all five sounds.

Ling Five-sounds : detection level

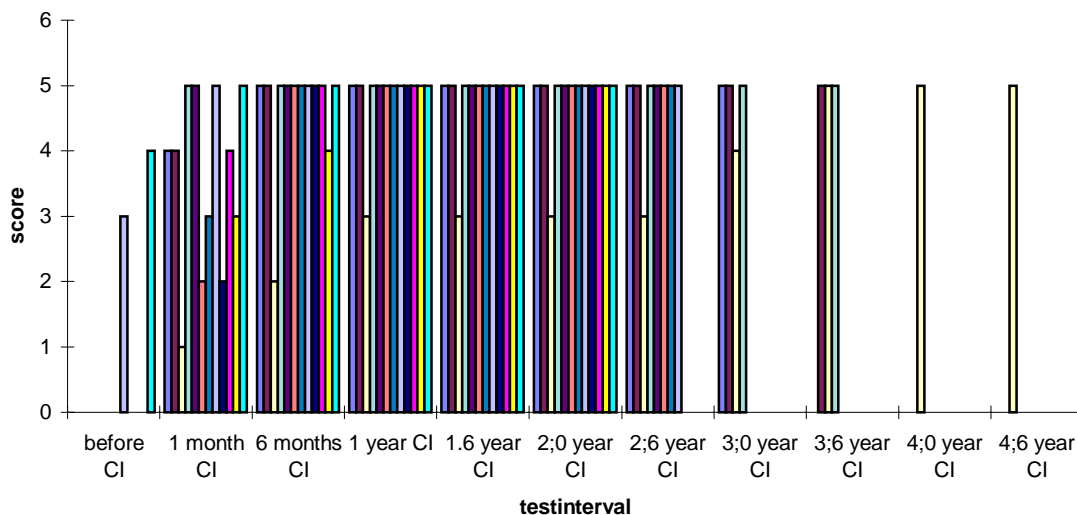


Figure 8 : Ling Five sounds : detection level

At the same time they can identify 60% of the speech sounds. (See figure 9). In most cases the children have no problems to identify the vowels. Identifying consonants, especially high frequency consonants, is not so easy for them. Of course, nearly nobody has ever heard these consonants with hearing aids.

Two years post-implant the average score of identifying consonants is 80%. They detect the "s" and "ch" but there is no identification.

Ling Five sounds : identification level

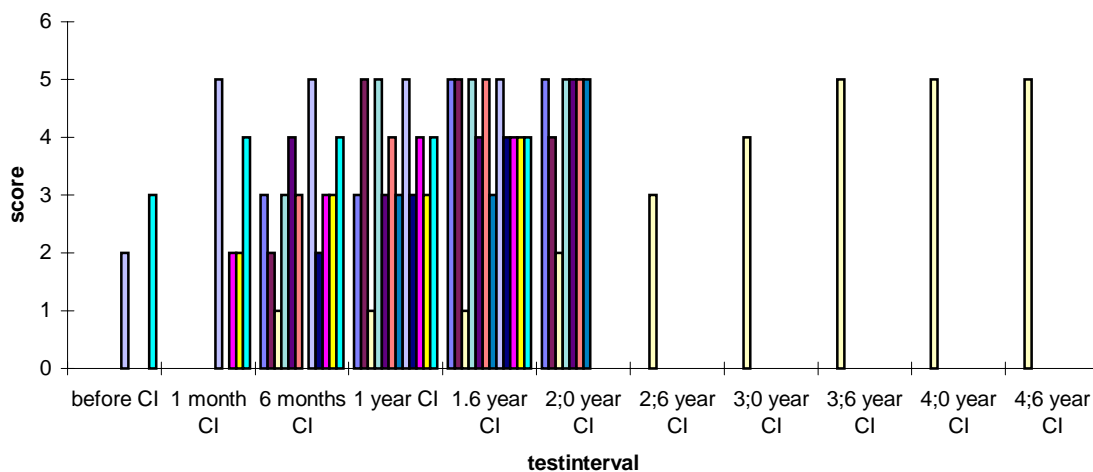


Figure 9 : Ling Five sounds : identification level

14.3. Language development.

After implantation we notice the first performance in the passive language development. It's easier to communicate with the children.

In figure 10 we can see the passive language development of 7 children by using the Reynell Language Development Test.

We have put the children before the implantation in different colours. After implantation they are all in red. The average passive language acquisition of normal hearing children is the blue line. The purple line is the score two SD (standard deviation) below the average.

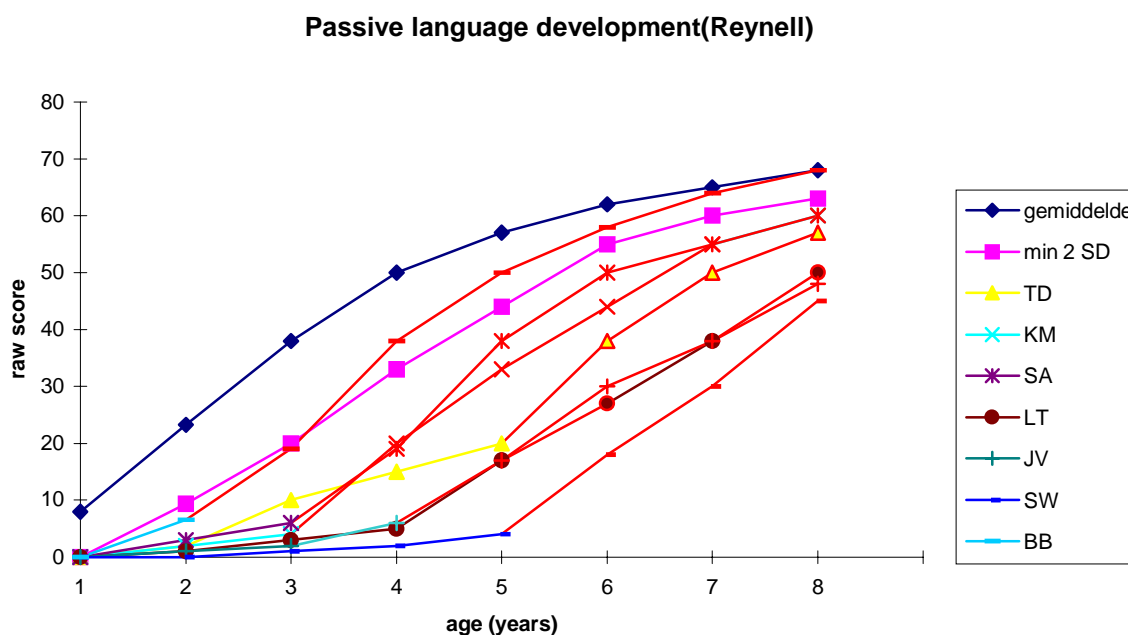


Figure 10 : passive language development of 7 implanted deaf children

We can conclude that children's passive language is growing immediately after implantation and on a tempo that is the same as hearing children. But their score will never equalise the score of the hearing children.

Ps. Only child KM reaches that level and she is implanted before the age of 2. So maybe it's possible for some deaf children to reach the same passive language level as hearing children, but than they need an implant very young (<2y).

Real performance in the active language development is detected after two years of implantation. In other words, a child needs first a lot of passive information, before she uses it on an active way. (See figure 11)

Active language development

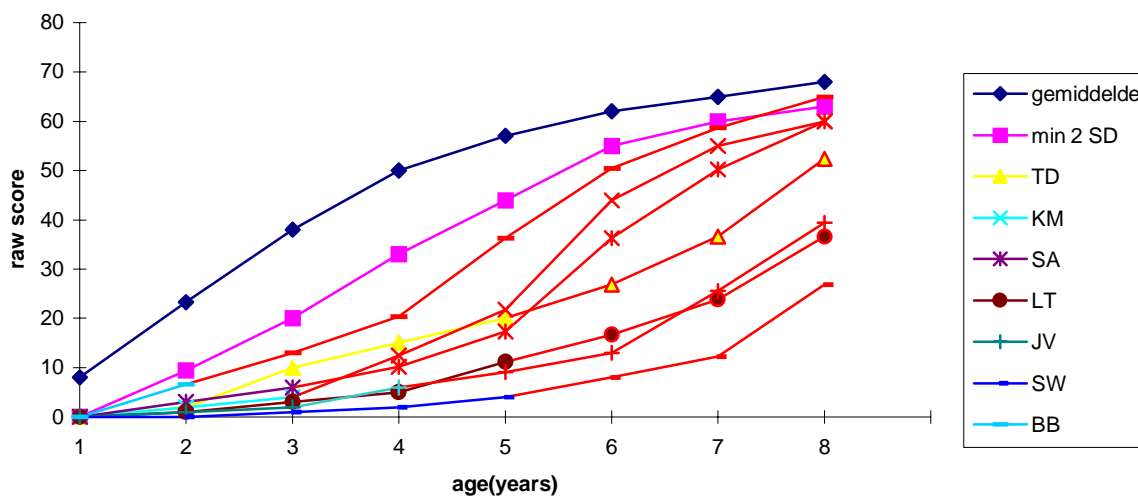


Figure 11: active language development of 7 implanted deaf children

14.4. Influence on the communication code.

When we look at figure 6, we see that a cochlear implant can have a big influence on the communication code that is used.

Before implantation only 10% of the children communicates pure oral. But 2 years after implantation 50% of the children is communicating on an oral way.

All children, who used only manual codes before implantation, have developed oral skills 2 years after implantation.

Communication code (children implanted <5y)

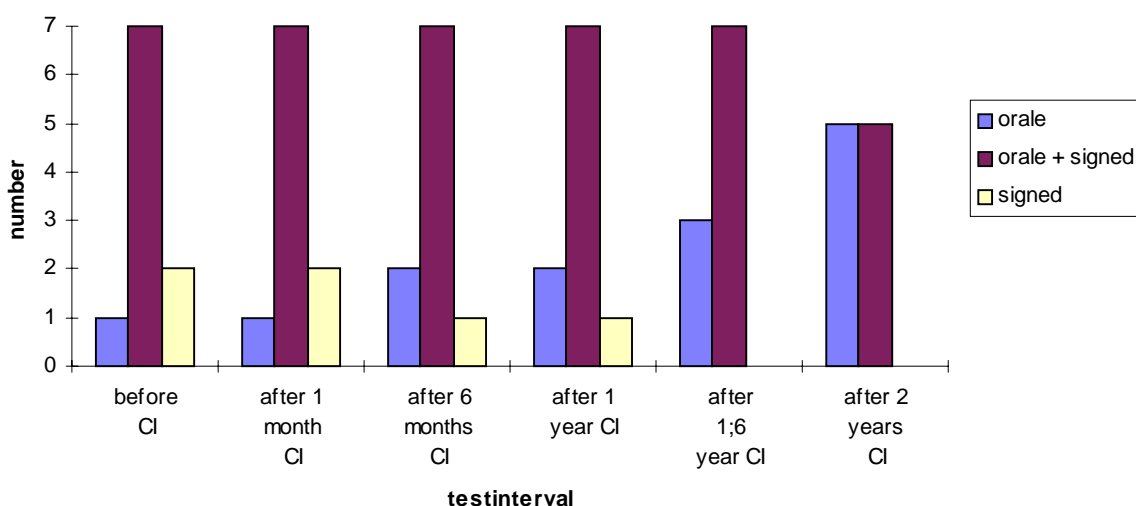


Figure 11: communication mode of 10 implanted deaf children

14.5. Auditory performance in daily live.

All children and adults implanted in KIDS are still wearing their device.

The children implanted before the age of 6 are wearing their device the whole day, from the morning till the night.

If we look at the score (see figure 12) that parents give their child on the MAIS-questionnaire (Questions about how well the child wears the device, responses to environmental and speech sounds) we see that the scores are progressively growing after implantation.

Meaningful Auditory Integration Scale (MAIS)-parents

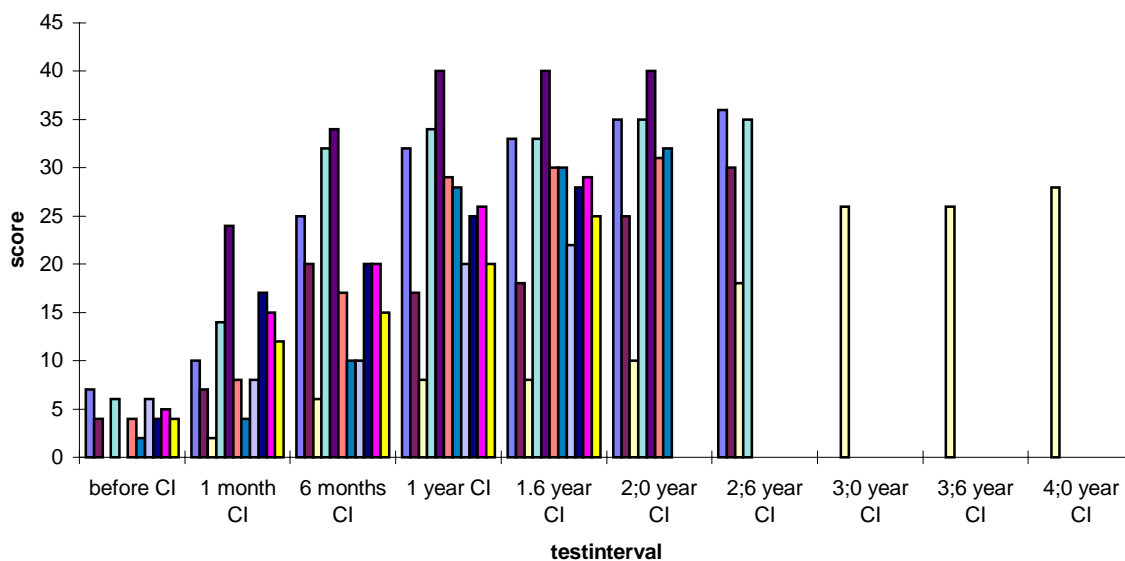


Figure 12: Meaningful Auditory Integration Scale scored by the parents of implanted children

Conclusion

Nearly all children in KIDS are implanted after 1995. So I can not give you information on a long-term base. For all the children the results are better with the implant than with the hearing aids. Even 4-5 years post-implant, the auditory performance is still growing.

On the other hand, we in KIDS believe that a key issue in the debate about cochlear implant is the understanding and accepting of richness of Deaf Culture, which a lot of deaf people need to acquire a balanced personality.

Similarly, rather than regard deafness as a disease, and cochlear implants as a medical aids to improve hearing, we prefer to think of cochlear implants as aids to communication. The rehabilitation program at KIDS is therefore structured on the basis of this philosophy.

Leo De Raeve, co-ordinator CI-team

K.I.D.S.

Borggravevijverstraat 9

3500 Hasselt

Belgium

tel. + 32 11 222593

fax. +32 11 242014

email : Leo.De-Raeve @ village.uunet.be

References

- Allum D., *Cochlear implant rehabilitation in children and adults*, London, 1996.
- Broesterhuizen M., *Het diagnostisch model van de eupraxie, St.Michielsgestel*, Nederland, 1995.
- Decroly O., *Contribution à la pédagogie de la lecture et d'écriture*, Brussel, 1907.
- De Raeve L., *Differentiële psychodiagnostiek bij kinderen met een auditieve handicap*, Groot Bijgaarden, 1990.
- Epstein S., *Medical aspects of hearing loss for the consumer and the professional*, The Volta Review, vol 99, nr 5.
- Erber N., *Auditory Training*, Washington 1982.
- Estnabrooks W., *Auditory-Verbal Therapy*, Washington 1994.
- Ewing A. & Ewing E., *Teaching deaf children tot talk*, Manchester, 1964.
- Furth, H., *Comparison of reading test norms of hearing and deaf children*, 1966.
- Goldberg, Windle, *Developmental Approach to Successful Listening (DASL)*, Texas, 1986.
- Ling D., *Early Intervention for Hearing-Impaired Children*, Massachusetts, 1984.
- Marschark M., *Psychological Development of Deaf Children*, New York, 1993.
- Mc Cormick, Archbold & Sheppard, *Cochlear Implants for young children*, London, 1994.
- Nevins M.& Chute M., *Children with cochlear implants in educational settings*, London, 1996.
- Plant, *Tactaid training Program*, New South Wales, Australia, 1989.
- Post I. & Trondhjem, *Cochlear Implants with Emphasis on the Pedagogical Follow-up for Children and Adults*, Kolding, 1997
- Schmid-Giovanni S., *Hören und Sprechen*, Meggen, Schweiz, 1996.
- Uden van, A., *A world of language for deaf children: basic principles*, Amsterdam, Netherlands, 1977.
- Van Hedel R. & Coninx F., *Curriculum Hoortraining*, IvD, St. Michielsgestel, Nederland, 1995.