



## *Cochlear Implants*

### *Round Table*

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*Moderator: Rubens de Brito Neto*

*Participants: Javier Cervera (Spain),*

*John Graham (United Kingdom),*

*Leopoldo Cordero (Argentina), Luiz Lavinsky (Brazil).*

#### ***Rubens de Brito Neto***

We are going to be very practical in this round table. We have some very timely subjects, and I will ask all the participants to be objective and brief in their answers and comments.

First question. When is the time, the minimum age to indicate a cochlear implant in children?

Second question. A child with deafness diagnosed in the pre-lingual stage, who has been deprived of hearing for a long time, without rehabilitation, without sound stimuli: what is the maximum time by which this child could receive a cochlear implant?

#### ***Javier Cervera***

To answer your first question. A cochlear implant (CI) is indicated when the child does not hear and does not benefit from a hearing aid and a hearing prosthesis. This is the most precise indication to enable the child to acquire language. At what time? In general it is after one year of age. Our indication is to place a CI already when the child has just a few months of age. As prerequisite: profound hearing loss where a hearing aid will not bring any benefit. It is essential to perform the CI as early as possible. Many authors mention six months of age, others talk about eight or even ten months. In my opinion, the most important factor is to have a correct diagnosis, with absolute certainty that the child is deaf. From then on there is no minimum age for the child to receive an implant.

Answering your second question. The time the child has been hearing-deprived, without any auditory stimulus, might be for example at eight years of age. Most important is neuronal plasticity that becomes inadequate around seven years of age. In Spain, our group has performed CI in children ten to 12 years of age, but each child needed to have been educated in oral language. From then on, a child 'cannot benefit from a CI'.

#### ***Leopoldo Cordero***

To answer your first question: I believe that the age limit is one year. Before that, only on special occasions. A CI is indicated after one year of age when there is profound hearing loss and no benefit will be obtained with a hearing aid for acquisition of adequate language.

To answer your second question. There is variability. A child receiving a CI after

five or six years of age, with no training or previous auditory stimuli, has a limited possibility of achieving full linguistic development. But this does not mean that the possibility of receiving an implant is excluded. Each case should be individually evaluated. It is quite clear that a child receiving a CI with less previous auditory information and lower chances of training will have a worse result.

### ***Luiz Lavinsky***

I would like to answer your first question. As to the minimum age for placement of a CI, the consensus is that it should be done as of one year of age. But we have to be cautious with the possibility that the auditory system has not reached its full “maturity” at this age. We do not have yet a strict code for ruling on CIs. In cases of autism, for example, it is very difficult to determine a precise approach. This dilemma presents itself only on a few occasions. In the Brazilian Unified Health System (SUS), the child will use a hearing aid for a few months and when the time to receive a CI has come, in practice, the child will already be 18 months old.

Your second question. As to the child older than five or six years of age who receives a CI, but who has no training or previous auditory stimuli, we have adopted a criterion — the age of five years is the maximum to receive a CI. However, there is a certain flexibility when a linguistic code is already present. We had a case of a 21- year-old patient, his father a physician and the mother a psychologist. He was attending law school and was a candidate for a cochlear implant. We implanted the CI with good results, as the patient already had a previous linguistic code. In other words, we have guidelines, but we use some flexibility.

### ***John Graham***

There are **five groups who need referring to have a CI**.

**1-** United Kingdom has universal **neonatal screening**. The majority of **profoundly deaf** children we would therefore expect to be identified more or less at birth. We would therefore expect them to be referred for CI before six months of age. There is no doubt at all that the sooner you implant these children, the better. A group from Texas shows this very clearly — you need to implant these children as soon as possible.

**2-** The next group is children with **bilateral, progressive hearing loss**, and those with CMV (cytomegalovirus) or with wide vestibular aqueducts. For these you need to refer them early so that you can ‘track’ the progressive hearing loss and implant them before they become profoundly deaf. You can track the deterioration in the hearing, and you grab them before they hit the earth, This is better than waiting for them to become profoundly deaf before you refer them for assessment: you don’t want them to remain profoundly deaf for maybe twelve months, while you work them up and assess them. So give them an implant before they become profoundly deaf.

**3-** The third group are **the ones who you give hearing aids** to because they have severe deafness, **but you find they are not getting the language skills you would expect**, in spite of the fact that they are suitable for hearing aids rather than implants. And our team would say: if in doubt, refer them to a CI team for an assessment. We can always send them back if they are not suitable.

4- The next group is those with **sudden hearing loss**, and for these — that includes, of course, post-meningitis patients — these need to have an MRI scan (Magnetic Resonance Imaging) as soon as they are fit to have it; if possible before referral, with general anesthesia. And I appreciate that that could be a problem, if they have just had meningitis, but you need to scan them very early, to check for obliteration, then ossification of the cochlea.

5-The last group is the group which is **incorrectly referred to as having auditory neuropathy**. In other words they have oto-acoustic emissions but are found not to have hearing and not to have an auditory brainstem response (ABR). Seventy-five percent of these children who have been given this very inaccurate term of “auditory neuropathy” do not have a neuropathy at all. They have a **problem in the cochlea itself**. These children do very well with CI. So these are the five groups we would consider for referral.

***Rubens de Brito Neto***

Perfect. You just heard that early diagnosis is most important in a child with hearing loss, and to be very rigid with this child. There are no doubts that a CI is still the best option, if not the only one, in rehabilitation of a child with a hearing deficit. Many children referred to our service in the School of Medicine, University of São Paulo, are often late in coming to us, sent by otolaryngologists, by pediatricians, by family physicians. They are initially referred to centers where they will be rehabilitated by sign-language, not auditory stimuli. There are centers that still provide rehabilitation only by sign-language. There are members of the hearing-impaired community who consider gesture-language as still being the best option.

***Javier Cervera***

Full rehabilitation of a hearing-impaired child should always take place in a multidisciplinary center with audiologists, speech therapists, neuroradiologists, that is all the professionals that make up a team to provide rehabilitation after a CI. We do not favor sign-language, as we believe that the child receiving a CI will recover hearing, and will become a child with hearing and language skills, able to use oral language. That is the reason why we do not agree with sign-language.

***Rubens de Brito Neto***

Perfect.

***Leopoldo Cordero***

Parents who do not have normal hearing refer their children to hearing diagnostic centers. In 95% of cases, parents of children with altered hearing have normal hearing themselves. Rehabilitation of hearing is the objective of this referral, starting with evaluation of the degree of hearing loss and then the correct and adequate hearing aid. If hearing is not improved with a hearing aid, CI is the next step. Anyway, I do not think that one should be *pro* or *con* sign or gesture-language. In some instances it is difficult to establish a communication code through hearing, due to multiple difficulties. In such a case, learning could start with sign language. This is also an option for children of parents with hearing impairment, as there already exists a culture related to gesture-language. The idea is to promote integration of both (whether hearing aid and sign language,

or CI and gesture- language), and use sign language with what it has to offer. We have received patients for implant who had very good communication using sign language but had poor stimulation of hearing, and they had excellent results after CI. We “work” on the hearing aspect, but sign language can make sense in some cases and can also be chosen by parents with hearing-impaired children.

### ***Luiz Lavinsky***

We fully agree with the use of sign language in cases where CI is contraindicated, and they are rare. We have the protocol, a multidisciplinary team with whom we discuss all problematic cases, and sometimes we have to make a “Sophie’s choice,” in which a CI is not indicated for the patient. Gesture-language is a good solution in a case like this. We have a large number of implanted patients who previously had gesture-language and achieved good hearing/linguistic results after the implant. Very often, regionally, where a school that teaches sign language has a strong influence on a child, we exclude it but include it selectively on special occasions.

### ***John Graham***

It is important to remember the role of sign language before CI became available. Before that sign language was the best way for a profoundly deaf child to acquire language. The period before this was recognized, when profoundly deaf children were given hearing aids, was, for the profoundly deaf, something of a disaster. For the moderate to severely deaf, hearing aids allowed them to speak and had a dramatic effect. In numbers this was quite large. Unfortunately, it was overlooked that the profoundly deaf got nothing from hearing aids nor from an oral approach. And this may explain why the congenitally deaf (with a big D), in the UK, are very resentful towards doctors, because they feel that they were abused, so to speak, by teachers at school and by the medical establishment.

**So, what are the indications now for total communication and sign language?**

**First** of all, for **countries that do not have budgets to implement CI** for the entire deaf population, or even any of the population — poor, very poor countries, and this may apply to the profoundly deaf in some of the poorer quarters in the United States, it is useful. **Second, congenitally deaf parents**, in general, are **not prepared to put their children forward to have CI**, and they will continue with sign language. That is their choice. **Third**, of course, we have the difficult group of **late referrals**, at the age of seven, eight, or nine. You know that a CI is unlikely to give this child full language. Maybe, supplementing their learning with sign language could be of benefit.

The problem in our country, and possibly with other countries, is that it is very difficult to find a school that can encourage both oralism and sign language and allow the child to receive as much of either of them as they need: the right proportion for each child. Normally we find that schools do sign language, or do oralism. It is very difficult to get both. This is a pity.

**Four**, the next group is the one that you would expect to do well with a CI if they were given an implant at a very young age. But **they may also have other problems, such as a thin auditory nerves, hypoplasia of the auditory nerves**. In these cases when the nerve exists, but is hypoplastic, very thin, we know that it

will receive good sound sensation from a CI. But after two years in our study, such children have shown no improvement in their speech and in their understanding of speech. These children can hear sounds, but have very bad speech discrimination; they need more than this to get language, and these children, again, would benefit, in my view, from input from sign language.

***Rubens de Brito Neto***

I think that the answers have been clarifying, and I would like to stress that the impaired-hearing patient who is going to receive an implant must have an oral language, must think in an oral manner. Thus, not giving an opportunity or providing a non-oral language to this patient contraindicates CI in the future, with the exceptions mentioned during this round table. For that reason, this is a very important decision to be made by the physician who sees a deaf child for the first time. That is, do not limit the future of this child that may possible through an important technology such as CI by not giving a chance to get to know a certain possibility.

The next question is very controversial: What are we going to do with the opposite ear? We have an implanted ear; what should we do about the other ear? Several articles have been published about bilateral implants, benefits that bilateral implants would have, not only in children but also in adults, but mainly in children by allowing their cortical development. So the question is: Is the economic cost of bilateral implants worth it to achieve a hearing benefit?

I would like to bring up this issue in two ways: thinking about the individual and thinking public health, as many governments, such as ours here in Brazil, pay for a CI. But instead of implanting ten patients, we might perform bilateral implants in only five. So we have to ask: Are bilateral implants in children a valid procedure? Will the answer be the same when we speak of public health?

***John Graham***

This is a very good question. First of all, it is clear that bilateral implants give additional benefits. We know this: You get better speech understanding in the presence of noise, and in our country, schools are not very quiet. They may be very quiet here in the auditorium, but in general, a classroom in the United Kingdom (UK) is a very noisy place. So, better speech understanding in the presence of noise, and also better directional hearing: you can hear where the sounds are coming from. In a few children, you don't know really which ear you should implant. You sometimes get disappointing results if you implant one ear, and you might get better results with the other ear. If you do both, you are bound to have implanted the better ear. You only have a choice of two, after all.

Next, better music appreciation is what you get with bilateral implantation, and generally reports indicate you get better improvement in speech and language. Subjectively people say the sound is more natural — these are, of course, adults. That is one thing. These are qualitative improvements.

The other thing may be more important. What happens to the second ear if the first one suffers a catastrophe and loses the use of the CI? In other words, we have had a number of cases among teams in the UK where the original implant has become infected, the cochlea has become infected, the implant has been removed, and it

is not possible to replace the implant in the original ear. In these cases you have to do the opposite ear, if you do anything. Is it going to be possible to implant the opposite ear at the age of six years? Will it work?

Will it work at the age of eight? Will it work at the age of fifteen years? Twenty years? Children now, born now, if they don't die from obesity, will live to be one hundred years old. Supposing something happens in the next 100 years. Is it going to be possible to implant the opposite ear? We are doing a study, a national study, and it shows very clearly that at eight years, if you have a child implanted soon after birth and something bad happens so they need a second ear implanted at the age of eight, it works fine, no problems.

At forty, it doesn't work. They get a sensation of sound but no understanding of speech. And that, I think is something that has been overlooked. And it is a very important factor. I think we should be considering bilateral implants for that reason. When we have more data I will have a good idea of the cutoff point, a critical age, for a second implant.

Tania, I don't know if you want to include this, but we have now published the results in Cochlear Implants International (in press 2009) and the cut off age is in the mid teens, statistically, though the exact age for an individual child will vary with a number of possible factors such as aetiology, congenital or perinatal deafness, progressive deafness etc. After this cut-off age waiting for newer models of CI, and even gene therapy etc are not likely to help any more than a CI will.

From a public health point of view, of course, it is difficult. I come from University College, in London, which was the home of Jeremy Bentham. Jeremy Bentham was a great lawyer (he's been dead for a long time). His famous saying was that the aim of the state should be to produce the greatest happiness for the greatest number of people. Therefore, if you have a limited budget, and if you can implant ten children with a unilateral implant or five with a bilateral implant, then your duty probably would be to implant the ten. But your real duty is to expand the budget, so that they can all get bilateral implants.

### ***Luiz Lavinsky***

Perhaps I can talk about the Brazilian situation. We do not face this dilemma at this time, as we coordinate the Committee of the Brazilian Society of Cochlear Implants. The dilemma we face is to provide as many implants as possible for Brazilian patients, not to favor bilateral implants. So from the social point of view we would already have a practical limitation, even for people with better financial resources.

What I'm concerned about, and this should be mentioned here, is technological development. If we had implanted two single-channel implants in a patient a while ago, we would have a problem now, because they are no longer at the leading edge of results and technology. In one or two more symposia like this one, Dr. Tania Sih will certainly have a discussion on gene therapy for the rehabilitation of such patients, the possibility of an implantable prosthesis, and mixed electro-acoustic implants and prostheses — in other words, all the new technologies that are coming very rapidly.

And my thoughts at this time are to have an ear waiting for something better. It

is not impossible to remove an implant, but there are some problems inherent to the device itself. If we have two implants, we will have two problems. Thus, I would like to disagree with Prof. John Graham by saying that, at this time, for the Brazilian situation and perhaps the South American, this is a difficult situation. We know that by going bilaterally we will give an advantage to the quality of the hearing, but we would put aside some fundamental aspects such as viability. Perhaps in the future a bilateral CI will become mandatory, but today we are performing unilateral CIs, and we think that we are right.

***Leopoldo Cordero***

I think that indications for bilateral CI are pertinent to situations today, due to the possibility of hearing in environments with noise, locating its origin or source, as Prof. Graham said so well. I believe that bilateral implants are adequate. What happens is that here, in Argentina, indications for bilateral CI are very difficult for economic reasons. However, developmental possibilities with bilateral CIs are better than with a unilateral CI, and this will be a future trend worldwide, with the adoption of bilateral CIs. In developing countries, however, there are economic limitations to this adoption.

***Javier Cervera***

I believe that Prof. Graham gave us an encompassing and correct explanation about the situation, about the advantages of bilateral CIs. In the same way as Dr. Leopoldo Cordero outlined in Argentina, we have economic problems in Spain today. It is not possible to implant all children bilaterally. We would like to, but we have our difficulties. There are some cases where our health system allows bilateral CIs, with indications from a physician. This would be for a child with visual problems, for example, who needs the ears to communicate as she cannot follow with the eyes, whatever the type of language.

***Rubens de Brito Neto***

Otitis media with effusion (OME) is a situation that can occur in a child in the pre-implant stage, during, and after the implant. Will treatment be the same as for a non-implanted child? Yes or no?

***Javier Cervera***

I work in a pediatric hospital. It is quite common to have children with this diagnosis in autumn/winter. What do we do with this child? If there is a need for drainage or removal of the effusion, and there are no problems, we will perform the drainage. After two months with a dry ear, then we can do the CI. If the child has already received the implant when the OME occurs, there is no contraindication for a myringotomy to drain the effusion.

***Leopoldo Cordero***

I have the same opinion. We do not place a CI when there is any inflammatory activity inside the ear. We first drain, then dry and wait, and only then will the child receive the CI. When a patient with an implant develops OME, it is necessary to drain or remove the effusion from the middle ear and then place a ventilation tube, as we have already done.



***Luiz Lavinsky***

I don't have much to add, as we work at the university with patients from less-favored socio-economic classes. There is a longer follow-up in patients with implants who have otitis media with effusion.

***John Graham***

The problem is that we don't, as far as I know, have evidence to say whether it is better — when the child has a middle ear effusion — whether it is better to put the tube in, delay the implant and then implant later, or do the implant in the presence of fluid and just ignore it. There is no published evidence to tell us which is the best course, and there should be, so there is room for a good trial of that. My policy is just put the implant in, even when there is fluid in the middle ear. But of course what we have heard about biofilms makes me a bit more nervous about doing this. After you have done the cortical mastoidectomy there is anecdotal evidence, but again, I think, no published evidence to suggest that the child is less prone to otitis in that particular ear, because of the presence of the cortical mastoidectomy.

***Rubens de Brito Neto***

I would like to thank all the members of this round table for their active participation.