MED-EL

EXPERT WEB SERIES TRANSCRIPT
Long Term Spatial Hearing Improvement and Suppressive Effect on Tinnitus After CI in Profoundly SSD Patients

Dear Ladies and Gentlemen, in the following 20 minutes, I would like to talk to you about our long term experience of cochlear implantation in single-sided deaf patients. Now, before I move on with the presentation, I would like to give you a short introduction of who am I, who is the cochlear implant team that I'm working with, we as a member of the HEARRING group, and then I will go through the presentation. So [00:00:30] first, a definition of single-sided deafness. What's in the name? What's the definition of single-sided deafness? Then part three and four, we'll discuss our long-term results of cochlear implantation in single-sided deafness. So mainly we will focus on the tinnitus suppression in our patients as well as on the improved spatial hearing capabilities. And then at the end of the presentation, I will give a summary of the presentation.

So first of all, my name is Griet Mertens. I'm [00:01:00] coordinating the cochlear implants research program at the Antwerp University Hospital. I did my PhD about three years ago in 2015 and it was on this topic, so on single-sided deafness in cochlear implantation, as you can see on the slides our cochlear implants team is a multi disciplinary environment. So first of all there are, of course the surgeons the head of the departments is Professor Van de Heyning. Then there are the fitting audiologists, some [00:01:30] additional professionals like there are the speech language pathologists, the Neuro physiologists, oral rehabilitation specialists, psychologists, social workers and so on. And it's only with a very close communication between those stakeholders, between those disciplines that we can offer a good care for our cochlear implant patients. And it's not only a close communication between our in-house disciplines, it's also a close communication [00:02:00] within the HEARRING network.

And the HEARRING network it's a network of 30 experts worldwide in the field of hearing implants and one of the aims of this HEARRING network for example, is to assess minimal outcome measures, standards and so on, just to provide each potential implant user with the best possible hearing implant or hearing solution. And I'm also happy to say that this [00:02:30] HEARRING network group, it's not just including only ENT surgeons, but also other skills professionals like there are audiologists, for example. Now let's move onto the definition of single-sided deafness and for the definition of single-sided deafness, I would like to refer to the consensus paper of the HEARRING and in that consensus paper you can read the definition of single-sided deafness, so it's having one normal or semi normal hearing ear in one side and a deaf ear in the contralateral side. And the normal hearing [00:03:00] ear, we can define it with a pure tone average of 30 dB HL or better, and then the deaf ear is defined as a pure tone average of 70 dB HL or worse. Then there are also the patients with the asymmetric hearing loss, the same deaf ear, so 70 dB HL or worse, but in the contralateral side they were having a mild to moderate hearing loss. A mild to moderate hearing loss is defined as having a pure tone average between 30 dB HL and 55 dB [00:03:30] HL.

Here you find an overview of the four main treatment options for today, as there are four single-sided deafness. First of all, there's the do nothing solution as far as we can call it a solution, of course. Then there are the well known CROS Traditional hearing aids, bone conduction devices, and then the fourth solution for single-sided deafness is the cochlear implantation and in this presentation I will mainly talk about the cochlear implantation [00:04:00] solution. Although several studies have shown that cochlear implantation is a safe and reliable solution for single-sided deafness, there are a lot of studies, discussing the results of single-sided deafness in cochlear implantation. But the outcome measures across these studies, they vary highly. So that is why we need a unified testing framework for single-sided deafness because only with the consistent use of a defined outcome measure across [00:04:30] centers, high-level evidence can be generated. So that is why within the HEARRING group we came up with the unified testing framework. And on this slide you see an overview of the four main parts that should be included in a minimal test battery for testing single-sided deaf patients. First of all, there's a speech perception in noise testing should be included in a minimal test battery. Then there's sound localization testing questionnaires to investigate [00:05:00] quality of life, and if applicable, also questionnaires related to the tinnitus of the patients

Here we find an overview of our publications regarding the results, I will show to you in a minute. So let's have a look at our included patients. We included 23 subjects who were suffering from single-sided deafness, so they were having one normal or semi normal hearing ear and in the contralateral side, they were single-sided deaf and therefore implanted [00:05:30] with a cochlear implant.

Now, before I move on, I want to stress out that it's very important that all of our patients were included because of their major complaint, which was the tinnitus, so the ipsilateral incapacitating tinnitus, not the single-sided deafness, but really the major complaint of having the cochlear implant was the tinnitus. We divided our patients into two categories. First of all, there are two patients with a single-sided deafness, so with a normal hearing ear in one side, [00:06:00] deaf in the contralateral side, and then there are the patients with asymmetric hearing loss, so with having a mild to moderate hearing loss in one ear and deaf in the contralateral side.

This is a very important slide with the inclusion and the exclusion criteria. They are very, very important to achieve the benefits of the treatment. So to have the tinnitus suppression in the end. First of all, the patient must suffer from a subjective tinnitus, which is due to the ipsilateral profound sensorinerural hearing loss. [00:06:30] The tinnitus must be their primary complaints, like mentioned before, the patient must rates their tinnitus loudness on a visual analog scale more than six out of 10 on a visual analog scale, but this for more than six months. Of course, patient must have realistic expectations, send their treatments of tinnitus may not have any effect in the past. Patients of course, must have a patent Scala tympani to allow cochlear implantation. And like I mentioned before, a normal hearing [00:07:00] in the contralateral side or a mild to moderate hearing loss.

Then some very important exclusion criteria. First of all, patients with major depression are excluded from the study. Also, patients with an objective tinnitus or with the somatic tinnitus are excluded and then patients who are not willing to attend regular followup or rehabilitation sessions afterwards are also excluded. For this study, we were not including patients with tinnitus duration of [00:07:30] more than 10 years. That was just because it was more than 10 years ago. I know nowadays there are new upcoming studies including patients with tinnitus duration of more than 10 years or deafness of more than 10 years. However, for this long followup study, we did not include duration of tinnitus of more than 10 years. One of the questions, at a long-term test interval and this long-term test interval was on average 10 year after implantation. [00:08:00] The question was, how often do you still wear your cochlear implants, and then all of our patients reported that they wear their implants seven days a week. One of them is wearing the implants five hours a day on average, but the majority, 96 percent, they reported that they switched on the cochlear implant as soon as they get up in the morning and they only switch it off again just before going to bed at night.

The methods that we've used for our long followup study [00:08:30] are shown on this slide, so we were using the tinnitus questionnaire to assess the tinnitus burden of our patients, and we were also assessing the tinnitus loudness visual analog scale to assess the tinnitus loudness in our patients. This visual analog scale is a scale going from zero up until 10, zero quiet no tinnitus, up until 10 very loud can not get any worse. And here I will show you the results. So on the vertical axis, [00:09:00] the visual analog scale, the lower the rating, the better the benefits of course. And on the horizontal axis you see the different time intervals, so pre-op up until the long-term test interval, which was on average 10 years after implantation. And as you can see, there's nice improvements up until three months after activation. And these benefit remain stable for a very long time of followup.

Now, if we have a look at the long-term test interval when our patients take [00:09:30] off the implants again, then the tinnitus loudness, comes back in the same degree as prior to cochlear implantation, and then the results from the tinnitus questionnaire again on the vertical axis, the lower the score the better the benefits, or the more benefit of the tinnitus reduction and on the horizontal axis, the different time intervals going from pre-op again, up until the long-term test interval and there we also found the same results, so significant improvements up until [00:10:00] three months after activation of the cochlear implant and also this benefit remain stable for the longer term of followup. Another question that we asked at the long-term test interval was whether still the tinnitus is reported as the primary advantage of having their cochlear implants or whether the primary advantage has switched to the improved hearing capabilities?

And there we found that our single-sided deaf subjects indeed report still that tinnitus is still their primary advantage of [00:10:30] having their cochlear implants whereas in the patients with asymmetric hearing loss, now the improved hearing capabilities has become the primary advantage of having their cochlear implant. So tinnitus suppression was the main reason for cochlear implantation, and as you could see in the previous slide, there was a nice significant tinnitus suppression over time. That's in addition to the tinnitus suppression, improved spatial hearing capabilities can also be expected after cochlear implantation in [00:11:00] a single-sided deafness. So that's why we also wanted to test those spacial hearing capabilities. Now, what's the definition of spatial hearing? It's the capacity of the auditory system to interpret different spatial paths by which sounds may reach the head. So by using those spacial hearing a person is able to understand speech in noise and also a patient is able to localize where the sound is coming from.

So we want [00:11:30] to test those spacial hearing cues in our single-sided deaf CI recipients, and I will first get you through the speech reception in noise results. So there are four main binaural cues, or semi-binaural cues, for example, summation effects, the ability to listen with two ears to one sound source can achieve in normal hearing listeners a benefit up until 6 dB. Then there's squelch effects, [00:12:00] the ability to extract input of non informative background noise from information coming to the people. Then there's the head-shadow effect and spatial release from masking. Those are all binaural or semi-binaural effects. So when a patient is having only one ear, he can not benefit from the summation effect nor from the squelch effects and only partially from the head-shadow effect and from spatial release from masking. So that's why we wanted to test those binaural cues in [00:12:30] our single-sided deaf CI recipients.

And indeed we found a significant summation effect, a summation benefit of 1.3 dB in our patients. We didn't find a squelch effects. We did find a head-shadow effect in spatial release from masking up until 3.3 dB. Besides those binaural effects, we also wanted to test whether having a noise at the single-sided deaf aided side is influencing the speech perception. Especially [00:13:00] in these challenging environments, you can expect that when having noise at the deaf side is a benefit, but having noise at the deaf side, and the deaf side is aided, it can be a disadvantage. So we wanted to test those challenging environments, so on the slide you can see on the vertical axis, speech in noise, the lower, the better to speech perception and we wanted to test it for an unaided condition, the condition with the bone conduction device and a condition with the cochlear [00:13:30] implants and luckily we didn't find significant influence of having the cochlear implant on in those challenging environments, so good news. Then we also tried it with having a bone conduction device aided at the single-sided deaf side of our patients and then we found a significant deterioration when having a bone conduction device in those single-sided deaf patients in these challenging environments.

Now, besides [00:14:00] listening to speech in noise, another spatial hearing capability is localizing where the sound is coming from. So sound localization and we also assessed these abilities in our single-sided deaf CI recipients. In the Antwerp university hospital, we are using a sound localization setup of a nine loudspeakers going from minus 90 degrees up until plus 90 degrees. This is how it looks like in real life, and for [00:14:30] this study we were using a broadband noise stimulus, so this is a slide where we normally would put the results of a localization tests on the horizontal axis, the target Azimuth, where the sound is coming from the vertical axis the response or where the person thinks the sound is coming from, and then it will results in a diagonal when a person is perfectly able to localize where the sound is coming from.

Here you can see an example of [00:15:00] a patient, a single-sided deaf patients without a cochlear implants, and as you can see, the data points are lying, not close to diagonal, so this patient is not able to localize where the sound is coming from. He's got a sound localization error of 106, but then when he switches on the cochlear implants, you see that the data points are coming closer to diagonal and the localization error decreases to 37 decrease. Now let's have [00:15:30] a look at the overall localization results of our population, again, for the single-sided deaf patients as well as for the patients with asymmetric hearing loss, the vertical axis, the localization error, so the lower the error the better the localization ability and then the dotted line represents the chance level of our setup. And if we then have a look at some monaural conditions, we see that patients are performing worse than 00:15:59] level so they are not [00:16:00] able to localize where the sound is coming from and with the monaural conditions, I mean a CI only condition so where we put a muff to contralateral normal hearing side or condition with only the normal hearing ear and without the cochlear implant, but then when they switch on the cochlear implant, they switch to a binaural condition, and then we see a nice significant improvement for the sound localization abilities.

So based on this overview, [00:16:30] based on these studies, we can conclude that cochlear implantation in single-sided deafness and incapacitating tinnitus can improve the hearing capabilities. Like there are speech perception in noise and sound localization, and in a specific population it can also decrease the tinnitus loudness. So unilateral hearing loss is nowadays a new indication for cochlear implantation and since 2013 also CE marked in children [00:17:00] and in adults as well.. And then with this final slide, I would like to thank you all very much for your attention. If you have any questions, please do not hesitate to contact me directly.