Bilateral Cochlear Implantation

IF ONE IS GOOD, ARE TWO BETTER?

You've probably heard of bilateral cochlear implants and wonder if taking your journey in that direction is right for you. At some point in the evaluation process, most cochlear implant candidates do think about whether they should get implants in both ears. The information explained in this brochure may provide insights that can help in making your decision. What's involved in bilateral implantation? What can you reasonably expect if you decide to pursue this course? What do current research studies indicate? What role could technology play in binaural hearing?

Keep reading, and continue to learn as much as possible about what bilateral cochlear implants could mean for you.

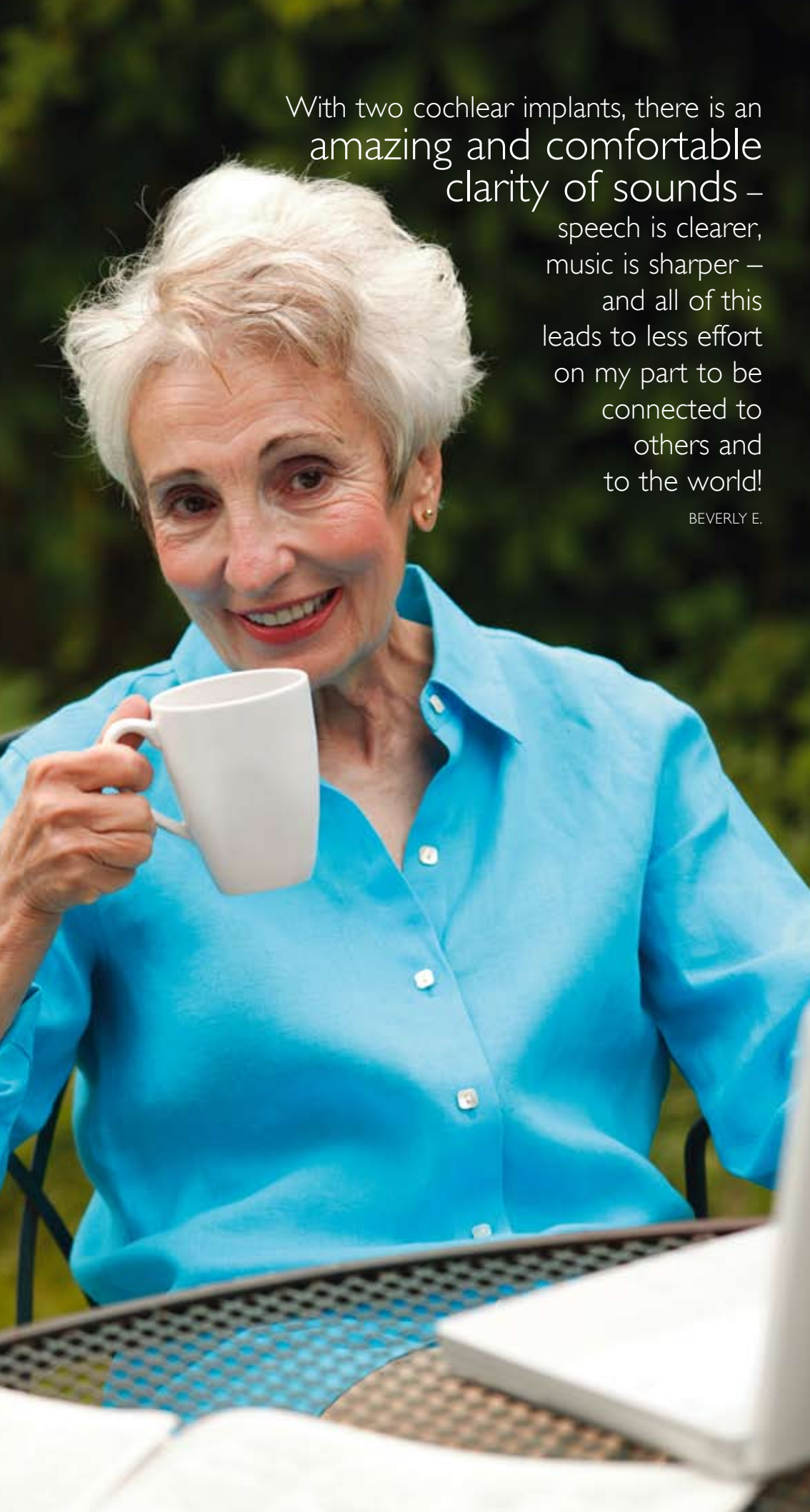
Why Bilateral?

A look into a growing trend

Until 1995, clinics and patients looked at bilateral implants as a technology upgrade, rather than an enhancement to improve binaural listening skills. Bilateral implantation was attempted only occasionally and only in certain types of patients. For instance, instead of replacing a still-functioning older implant, the ear on the other side was implanted with newer technology. At that time, bilateral implantation was also used as a promising strategy for enhancing inadequate performance of a device in the first ear.

But testing of these early patients promised more exciting possibilities. Results indicated that their auditory systems could process sound from both sides, the same way it worked in people with normal hearing. In 1996, a MED-EL patient at the University of Würzburg in Germany was reportedly the first person implanted with a goal of restoring binaural hearing. In 1998, the same clinic accomplished the first bilateral implantation to restore binaural hearing in a child. Since then, bilateral implantation has gained momentum, resulting in thousands of bilateral MED-EL users worldwide, more than two-thirds of them children.

As the research data grows, we can begin to reach some basic conclusions about the effect of hearing with one implant versus two. In addition, we can draw conclusions from the vast amount of research that evaluates binaural hearing in people with normal hearing, with single-sided hearing loss, and those using binaural hearing aids.



With two cochlear implants, there is an amazing and comfortable clarity of sounds – speech is clearer, music is sharper – and all of this leads to less effort on my part to be connected to others and to the world!

BEVERLY E.

What is Binaural Hearing

and why is is important?

The term "binaural hearing" refers to specific listening skills that can only be achieved with two ears. When we hear with two ears, we are able to orient ourselves in space and can choose to pay attention to certain sounds or voices selectively. We can also distinguish important sound information even in difficult listening environments, such as a noisy room with voices in the background. Binaural hearing is extremely important for everyday life and helps us with:

1. The ability to determine the direction of a sound (**localisation**). Localisation helps identify the direction of a sound, so that individuals can react accordingly. For instance, we hear a person call out to us on our right side, and we know which way we need to turn to respond. Just as the brain needs two eyes to determine the distance of an object, it needs input from two ears to hear where a sound comes from.

2. The ability to perceive speech in noisy situations (**speech understanding in noise**). When we hear with two ears, we can more clearly and easily understand speech in classrooms, where background noise is inevitable. We are also better able to separate the important information our friend is telling us from the background noise in a busy restaurant. With two ears, we do not have to listen as closely to conversations, and need less effort to follow a conversation, than when we're listening with one ear.

The position of our ears on the sides of our head makes these binaural abilities unique, and helps us perceive a sound slightly differently with each of our ears. Our brains then analyse these small differences between the right and the left ear. The brain processes the rapid and intricate comparison of differences between ears, giving us the ability to localise sounds, and to distinguish speech from background noise. When we hear with only one ear, we cannot perceive these differences easily, which leads to more difficulty with localisation and speech understanding in noisy environments.

Hearing with two ears

It is well-accepted that listening with two ears provides an advantage in noisy environments[1,2,3,4,5,6] that is necessary for finding the direction of a sound.[7] For people with hearing loss, there is overwhelming evidence that, in most instances, using two hearing aids for amplification helps achieve better performance than only one across a wide variety of conditions[8,9]. It is also well-accepted today that binaural hearing aid fitting can restore sound localisation,[10] at least in listeners who are moderately to severely impaired.[11]

Hearing with only one ear

People with hearing loss in one ear generally report difficulties with hearing conversations on the impaired side, finding the direction a sound is coming from, and understanding speech in noisy situations. However, their speech understanding in quiet environments is generally as good as that of people with "normal" hearing. As listening conditions worsen (i.e. become more noisy), the difficulty experienced by a person with **unilateral hearing loss** increases.[12]

A relatively large number of children experience unilateral hearing loss.[13,14] Children are especially negatively affected by unilateral hearing loss during the years of language learning and academic development. Up to 35 percent of children with unilateral hearing loss fail one or more grades in school, and demonstrate significantly poorer speech understanding in the presence of noise than their normally-hearing counterparts.[15] As expected, localisation ability is significantly poorer in children with unilateral hearing loss than for children with "normal" hearing.[16] Research clearly demonstrates that the benefits of bilateral hearing are lost when only one normally-hearing ear is available. When these statistics are considered along with the real-world challenges of ever-changing noise levels in most school classrooms, the importance of achieving the best possible hearing to support language growth and academic development becomes very obvious. These findings in people with unilateral deafness could lead us to assume that listening with two cochlear implants, rather than one, has important advantages.

I love having two cochlear implants!
Hearing with two is much better than hearing with just one.

RACHEL S. (AGE 5)

Bilateral implant surgery

Most surgeons agree that implanting a second device is really no different than implanting the first. Candidacy requirements are the same, surgical risks should not vary, and potential benefits/limitations of one implant apply equally to two implants. However, your implant team may have varying recommendations or opinions regarding the timing of surgery. Bilateral implants can be placed either **simultaneously** or **sequentially** depending on your decision and consultation with your surgeon.

Simultaneous surgery implies a new implant candidate chooses to receive bilateral implants to start his or her cochlear implant journey. Both implants are placed and activated at about the same time. Although the devices can be placed during one operation, some implant centres recommend two separate surgeries within a short time. Typically both implants are activated together, usually over a day or two. This allows the brain to begin its CI listening experience with sound coming from both ears.

Sequential surgery means a person initially receives one implant, and then later on decides to have the other ear implanted. There are still many unanswered questions about the amount of time that passes between the two procedures and how the timing affects results. Although it is generally thought that a shorter time is better, there are implant users who receive their second implant many years after their first, and are happy they decided to implant the second side. It makes sense that there is a lot of variability – there is no good way to predict how well a person might perform with one implant given their unique history, and that same variability exists with the second implant.

If you are a cochlear implant user who is considering becoming bilateral, talk to your implant centre. Your cochlear implant team will be able to help you establish appropriate expectations based on your history and experience with your first implant. It is very helpful to talk with other implant users who have been through this experience. You'll find lots of MED-EL cochlear implant recipients on the hearpeers.com user forum who will be happy to share their stories.

Lukas has been a bilateral CI user since he was six years old. He is active in team sports. He also plays keyboard and learns Chinese in school.

ACHIM K. :: FATHER OF LUKAS

What to Expect

Whether you choose one implant or two, you need to have a clear understanding of the expectations surrounding cochlear implantation. Your understanding of the process and how it might relate to your particular circumstances will greatly influence your experience and outcome. It is important to work closely with the implant centre to make sure that expectations are realistic given your situation. In general, there are a few things that are worth considering:

1. Expectations may need to be adjusted depending on the hearing history of each ear. Generally, ears that have shorter durations of deafness, that have had consistent hearing aid use even without significant benefit, and that have measurable hearing are viewed as "better" ears for implant. It may be important to understand how much each ear contributed with hearing aids. That doesn't mean that an ear with a longer duration of deafness, for example, shouldn't be implanted, or couldn't contribute to a three-dimensional hearing experience, but expectations may need to reflect different characteristics of each ear.

2. If you are choosing bilateral implantation after having one implant for a while, it will be important to remember that the second ear will need to go through a learning process in the early days, weeks and months, just as the first ear did. Some people find that the process speeds up a bit, but most users would agree that it is realistic to expect an adjustment period. Sometimes this adjustment can come as a surprise – once you become accustomed to hearing with the first implant, it is easy to forget the amount of work that was required to get there. This is especially true for children, who may have received their first implant at a young age and don't remember their early days of implant use very well. It is important for parents to prepare their child that the "new ear" may need some time to learn to hear well.

It is also important to have realistic expectations about equipment maintenance and cost. Battery use will double (although this is easily managed with today's rechargeable batteries). Establish a budget and plan for routine replacements, such as cables, for the second system. You should also consider long-term costs for maintenance and external equipment replacement.

Practical benefits

Later in this booklet, you'll find the latest research findings with bilateral implants. Research studies test subjects in a clinic or lab, and the findings from these studies could help you and your implant centre decide whether bilateral implantation is a good decision for you. However, a lab environment isn't the real world. Aside from clinical test results, patients report practical considerations.

- Many patients suggest that one of the best things about having two implants is that they are **never "off the air."** If you need to replace batteries on one side, for example, the other side is still on while you're putting in new batteries. The small size of the MED-EL audio processor, and our wide variety of wearing options, means you can wear two audio processors without feeling weighed down.

- Special bilateral listening accessories provide a stereo listening experience, which is very exciting for some users. Some patients report that having a second device helps them feel somehow **'balanced' and more connected to their environment** because they have sound input from both sides. Others tell us that they don't have to think so much about how they manage difficult environments – for example, positioning their "good" ear closer to the sound source. Driving might be easier if you are trying to talk with a passenger, especially if your only hearing ear is facing away from the passenger on your other side. Listening effort may also be reduced, as some listeners report feeling less fatigued at the end of the day when wearing two versus one.

- Finally, bilateral implantation **ensures that the "best" ear has been implanted**. Based on your history, your implant centre may be able to tell you that one ear has a better chance of success than the other. But, more often than not, especially when the hearing loss and history is essentially the same between the two ears, "best ear" is impossible to determine. Some bilateral implant users have reported that the ear they thought would hear best with an implant actually doesn't contribute the most. Other patients start by implanting their "worst" ear, but when it quickly begins to outperform the "better" ear that is still using a hearing aid, they begin considering the potential benefit from a second implant.

Bilateral impact on rehabilitation

Listening practice under the guidance of a professional can be very beneficial whether you have one implant or two. We recommend that all children receive auditory therapy in addition to any other types of habilitation for speech and language they might get after implantation. Although fewer adults seek rehabilitation, those who do generally report that it helped them adjust quickly when using either a first or second cochlear implant. The therapy environment is the best place to work on listening in difficult situations, which can translate into communicating with more ease in the real world.

The addition of a second implant may or may not change what your therapist recommends. In the case of simultaneous bilateral implantation, most professionals recommend starting off with both implants on all the time. There might be times where it is important to isolate one ear or the other during therapy or for testing, but in general, both implants are in use simultaneously.

Simultaneous :: both cochlear implants are received at or nearly at the same time.

Sequential :: time has passed between receiving the first and second cochlear implant.

However, in the case of sequential bilateral implantation, therapy recommendations vary from centre to centre, especially if a significant amount of time has passed between the two surgeries. Some therapists recommend using only the new implant for a period of time, so that the "new ear" works harder to catch up quickly. Others recommend using both right away, while some may recommend a compromise. For example, a student might initially wear both implants at school to get academic information, but might only use the new implant in therapy situations, or at home where the demand to understand is not as critical. Talk with your therapist about his or her philosophy, and know that there is no one correct way. If one method doesn't seem to work for you, try another! ,

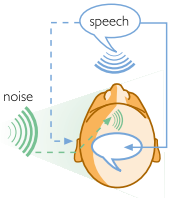
Experience

with bilateral cochlear implants

The interest in bilateral implantation began building momentum in the late 1990's after several case reports at international research conferences. Researchers reported that bilaterally implanted individuals were showing improved ability to understand speech in noisy environments and to locate the direction of a sound, the primary areas where patients with only one implant tend to struggle. As interest has grown, many studies have been reported from both industry and a variety of independent research institutions.

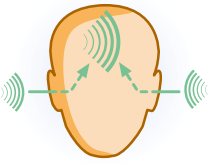
A review of the research

It is possible to test whether a person is able to use sound coming from both ears to make these difficult judgments. If having two ears improves the test score, we call that a "binaural advantage." Generally, four listening skills are tested to determine whether a binaural advantage is present:

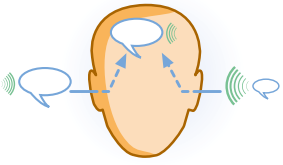


Head Shadow Effect

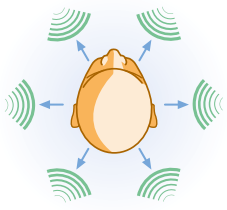
Head shadow effect. The head helps block noise for the ear that is farthest away from the noise. If the head shadow effect is present, the ear farther away from the noise helps the brain more than the ear on the same side as the noise.


Summation Effect

Summation effect. Information presented to both ears increases ease of hearing, because the information is presented twice to the brain – once from each ear. Two presentations give the brain a better chance of understanding the information.


Squelch Effect

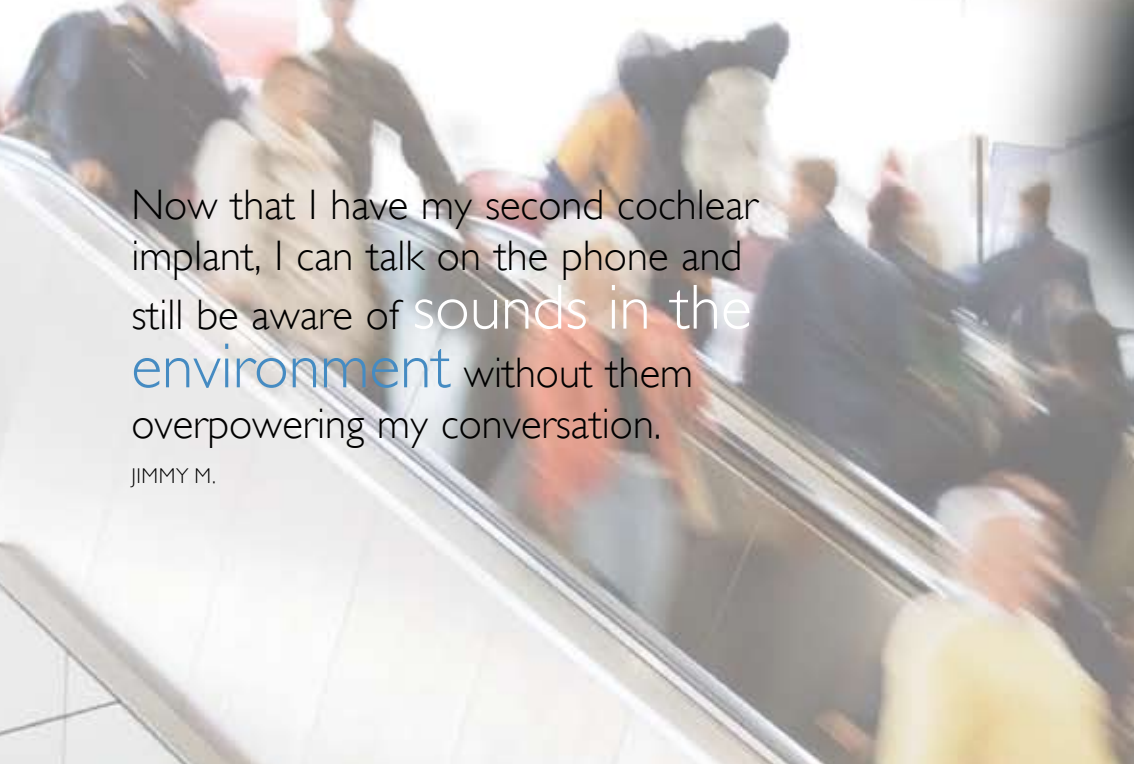
Squelch effect. The squelch effect is the most difficult to describe. It is the ability of the brain to analyse the difference in the mix of speech and noise at each ear. In essence, the squelch effect is the result of the brain using both ears to help minimise background noise.


Localization

Localisation. Localisation is the ability to know which direction a sound is coming from, and helps us orient ourselves in our environment.

Jacob has a much easier time
localising sound with both
cochlear implants than with just one.

RON J. :: PARENT



Now that I have my second cochlear implant, I can talk on the phone and still be aware of sounds in the environment without them overpowering my conversation.

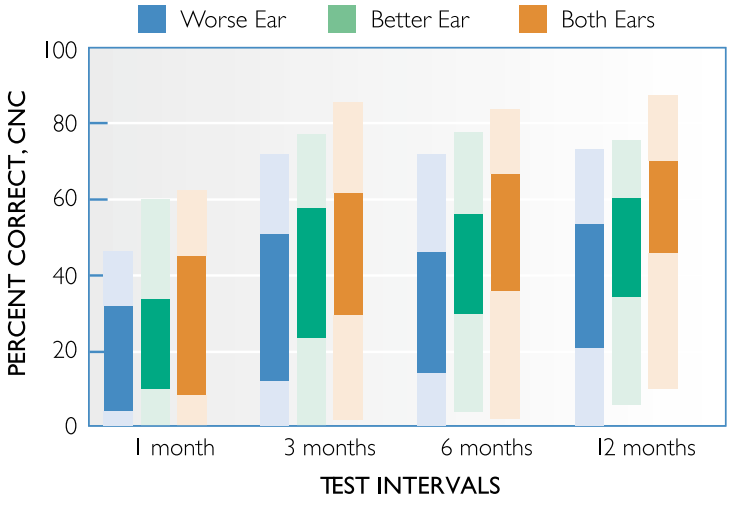
JIMMY M.

In the years 2000–2008, over 200 research studies were published or presented that investigated bilateral implantation. Across these studies, results support the possibility of improved outcomes for both adults and children with bilateral implants. Some of the key findings are summarised here:

Studies in adult users:

- Adult bilateral CI users demonstrated all of the binaural effects (head shadow, summation and squelch) that normal hearing individuals enjoy.[17,18,19,20]
- Several studies have reported restored ability to localise sounds.[21,22,23,24] Two of these studies showed that subjects went from *guessing* where a sound came from while using one implant, to *knowing* the direction when the second implant was added. Another study found that localisation was nearly as good with implant users as it was with individuals with normal hearing. One study noted that localisation abilities developed over time and were stable after five months of bilateral implant use.

- Binaural listening skills seem to develop over the first year of use. Simultaneously implanted adult bilateral CI users demonstrated improved speech understanding in quiet when using both ears compared to only one[25] (summation effect).



This result was found to be present over the first year of bilateral implant use. The head shadow effect was found to be present by six months, and although the squelch effect was not measurable at six months, it was present by one year of bilateral implant use.

- Even when researchers created a more difficult listening situation by using multiple sound sources, a significant bilateral advantage was found, and the largest effect was found in the most difficult conditions.[26]

Studies in children:

- A study of 39 bilaterally implanted children showed that communication behaviour improved with the second implant, especially in difficult listening situations. The children demonstrated better understanding of spoken words, and significantly better understanding of speech in noise when using both implants.[27]
- Although localisation skills are difficult to measure in children, one study showed that 2/3 of a group of bilaterally implanted children were able to tell the difference between two separate but close sound locations, and the implanted children in the study even outperformed children who listened with two hearing aids.[28] Another study on young children found that localisation skills were starting to develop in toddlers with bilateral CIs, but were not seen in toddlers with only one cochlear implant.[29]

Auditory Development

and timing of bilateral implantation in children

Implanted children are a unique group. Unlike adults who may have had hearing and then lost it, children usually learn to listen using only the sound from the cochlear implant. We all know that it is more difficult to learn certain things as we get older – such as learning second languages –v and it has long been suspected that there is a "critical window" of time early in a child's life when he or she has the best chance of making use of sound for the development of language. To make matters more complicated, it is also very difficult to study some of the complex effects of binaural hearing in young children because they can't follow the test instructions.

Taking a very different approach, one group of researchers has studied the brain waves of children with hearing, those with hearing loss, and those who receive unilateral and bilateral implants.[30,31,32] This research group has been able to show that hearing brain waves are not present in deaf children, but they develop after the child receives a cochlear implant. They also found that there appears to be a "sensitive period" for development of binaural listening abilities. Children who received their implants prior to age 3½ were able to take the most advantage of the brain's ability to learn new things, but it didn't seem to make a big difference whether they received both implants at the same time, or one later than the other, as long as both implants were in place by age 3½.



Evan thinks it's such a cool thing to **listen to music** on his iPod® in "stereo sound." It has now become his ritual on the bus ride from school.

STEVE L. :: PARENT

Bilateral implantation and

Technology

We are still learning which sound cues help most with binaural hearing. It seems rather clear that listeners with bilateral implants currently use loudness differences between the two ears to determine the direction of a sound source. Normal-hearing individuals use this loudness difference, but they also are able to use timing cues – the lag between the time the sound arrives at one ear until it arrives at the second ear. Such analysis requires the brain to have access to a special part of the sound wave called **fine structure**. You can learn more about the importance of fine structure in MED-EL's booklet called "FineHearing™ Technology."

MED-EL recently introduced **FineHearing™**, a new method of creating the special sound code that is sent to the implanted electrode. This new method includes fine structure information. In unilateral implant users, clinical trials showed that FineHearing helped to improve music appreciation, as well as the ability to understand speech in difficult situations. It is expected that the addition of fine structure information might also help with music appreciation for people with bilateral implants, because fine structure includes timing cues for low frequency sounds.

Bilateral User Support

The OPUS 2 is the FIRST processor to offer direct support to **bilateral users.** One FineTuner remote control can be used to make adjustments to two audio processors!

In addition to the coding of sound, technology can support practical considerations. For the first time, the OPUS 2 processor from MED-EL offers special built-in features that support bilateral use:

- A **FineTuner™ remote control** that can operate both audio processors. A bilaterally implanted listener needs only one FineTuner to make adjustments to either processor.
- **IRIS** – Individual Recognition of the Implant System – is a feature that works in combination with the PULSARCI100 and SONATATI100 implants to protect against placing the processor on the wrong ear. If the processor is coded for the right implant, then the left implant will simply refuse to respond if the processor is placed on that ear.
- A special **binaural accessory cable** is available to connect to battery-operated devices, such as an iPod®. This supports a stereo listening experience without being any more encumbered than someone using headphones.
- The **DaCapo™ rechargeable battery system** offers two recharge slots in the charger. Fast, four-hour charging ensures that bilateral users can always have a charged spare battery on hand.

References

1 Arsenault, M., Punch, J. (1999). Nonsense-syllable recognition in noise using monaural and binaural listening strategies. Journal of the Acoustical Society of America, 105(3), 1821-1830.

2 Bronkhorst, A., Plomb, R. (1988). The effect of head-induced interaural time and level differences on speech intelligibility in noise. Journal of the Acoustical Society of America, 83(4), 1508-1516.

3 Bronkhorst, A., Plomb, R. (1989). Binaural speech intelligibility in noise for hearing-impaired listeners. Journal of the Acoustical Society of America, 86(4), 1374-1383.

4 Carhart, R. (1965). Monaural and binaural discrimination against competing sentences. Int. Audiology, 4, 5-10.

5 Cox, R., DeChicchis, A., Wark, D. (1981). Demonstration of Binaural Advantage in Audiometric Test Rooms. Ear and Hearing, 2(5), 194-201.

6 MacKeith, N., Coles, R. (1971). Binaural advantages in hearing of speech. Journal of Laryngology and Otology, 85, 213-232.

7 Durlach, N., Colburn, H. (1978). Binaural phenomena. In: Carterette, E. C., Friedman, M. P. (Ed.), Handbook of Perception, Volume IV, New York: Academic Press, 365-466.

8 Byrne, D. (1981). Clinical issues and options in binaural hearing aid fitting. Ear and Hearing, 2(3),187-193.

9 Ricketts, T., Lindley, G., Henry, P. (2001). Impact of compression and hearing aid style on directional hearing aid benefit and performance. Ear and Hearing, 22, 348-361.

10 Dermody, P., Byrne, D. (1975). Auditory localisation by hearing-impaired persons using binaural in-the-ear hearing aids. British Journal of Audiology, 9, 93-101.

11 Byrne, D., Noble, W., LePage, B. (1992). Effects of long-term bilateral and unilateral fitting of different hearing aid types on the ability to locate sounds. Journal of the American Academy of Audiology, 3, 369-382.

12 Sargent, E., Herrmann, B., Hollenbeak, C., Bankaitis, A. (2001). The minimum speech test battery in profound unilateral hearing loss. Otology and Neurotology, 22, 480-486.

13 Lee, D., Gómez-Marín, O., Lee, H. (1998). Prevalence of unilateral hearing loss in children: the National Health and Nutrition Examination Survey II and the Hispanic Health and Nutrition Examination Survey. Ear Hear, 19(4), 329-32.

14 Brookhauser, P.E., Worthington, D.W., Kelly, W.J. (1991). Unilateral hearing loss in children. Laryngoscope, 101(12, pt 1), 1264-1272.

15 Tharpe, A. (2008). Unilateral and mild bilateral hearing loss in children: past and current perspectives. Trends in Amplification, 12(1), 7-15.

16 Humes, L., Allen, S., Bess, F. (1980). Horizontal sound localisation skills of unilaterally hearing impaired children. Audiology, 508-518.

17 Müller, J., Schön, F., Helms, J. (2002). Speech understanding in quiet and noise in bilateral users of the MED-EL COMBI 40/40+ cochlear implant system. Ear and Hearing, 23, 198 206.

18 Schön, F., Müller, J., Helms, J. (2002). Speech reception thresholds obtained in a symmetrical four loudspeaker arrangement from bilateral users of MED-EL cochlear implants. Otology and Neurotology, 23, 710-714.

19 Schleich, P., Nopp, P., D'Haese, P. (2004). Head shadow, squelch and summation effects in bilateral users of the MED-EL COMBI 40/40+ cochlear implant. Ear and Hearing, 25, 197-204.

20 Litovsky, R., Parkinson, A., Arcaroli, J,. Sammeth C. (2006). Simultaneous bilateral cochlear implantation in adults: a multicentre clinical study. Ear and Hearing, 27(6), 714-31.

21 Nopp, P., Schleich, P., D'Haese, P. (2004). Sound localisation in bilateral users of MED-EL COMBI 40/40+ cochlear implants. Ear and Hearing, 25, 205-214.

22 Schoen, F., Mueller, J., Helms, J., Nopp, P. (2005). Sound localisation and sensitivity to inter-aural cues in bilateral users of the MED-EL COMBI 40/40+ cochlear implant system. Otology and Neurotology, 26, 429-437.

23 Senn, P., Kompis, M., Vischer, M., Häusler, R. (2005). Minimum audible angle, just noticeable interaural differences and speech intelligibility with bilateral cochlear implants using clinical speech processors. Audiology and Neurotology, 10, 342-352.

24 Grantham, D., Ashmead, D., Ricketts, T., Labadie, R., Haynes, D. (2007). Horizontal-plane localisation of noise and speech signals by postlingually deafened adults fitted with bilateral cochlear implants. Ear and Hearing, 28(4), 524-41.

25 Buss, E., Pillsbury, H., Buchman, C., Pillsbury, C., Clark, M., Haynes, D., Labadie, R., Amberg, S., Roland, P., Kruger, P., Novak, M., Wirth, J., Black, J., Peters, R., Lake, J., Wackym, P., Firszt, J., Wilson, B., Lawson, D., Schatzer, R., D'Haese, P., Barco, A. (2008). Multicentre U.S. bilateral MED-EL cochlear implantation study: Speech perception over the first year of use. Ear and Hearing, 29(1), 20-32.

26 Ricketts, T., Grantham, D., Ashmead, D., Haynes, D., Labadie, R. (2006). Speech recognition for unilateral and bilateral cochlear implant modes in the presence of uncorrelated noise sources. Ear and Hearing, 27(6), 763-73.

27 Kühn-Inacker, H., Shehata-Dieler, W., Müller, J., Helms, J. (2004). Bilateral cochlear implants: a way to optimize auditory perception abilities in deaf children? International Journal of Pediatric Otorhinolaryngology, 68, 1257-1266.

28 Litovsky, R., Johnstone, P., Godar, S., Agrawal, S., Parkinson, A., Peters, R., Lake, J. (2006). Bilateral cochlear implants in children: Localisation acuity measured with minimum audible angle. Ear and Hearing, 27, 43-59.

29 Grieco-Calub, T., Litovsky, R., Werner, L. (2008). Using the observer-based psychophysical procedure to assess localisation acuity in toddlers who use bilateral cochlear implants. Otology and Neurotology, 29(2), 235-239.

30 Sharma, A., Dorman, M. F., Kral, A. (2005). The influence of a sensitivity period on central auditory development in children with unilateral and bilateral cochlear implants. Hearing Research, 203, 134-143.

31 Sharma, A., Gilley, P., Martin, K., Roland, P., Bauer, P., Dorman, M. (2007). Simultaneous versus sequential bilateral implantation in young children: Effects on central auditory system development and plasticity. Audiological Medicine, 5(4), 218-223.

32 Sharma, A., and Dorman, M. (2006). Central Auditory Development in Children with Cochlear Implants: Clinical Implications. Advances in Otorhinolaryngology. Vol 64. Basel: Karger pp 66-88.

MED-EL

A Visionary Company

Since MED-EL's founders developed one of the world's first cochlear implants in 1975, a strong research tradition has continued to fuel the development of technologically advanced hearing solutions. MED-EL offers implantable solutions to treat different degrees of hearing loss, including cochlear and middle ear implants, combined Electric Acoustic Stimulation and auditory brainstem implants.

1996 Introduction of the COMBI 40+, the thinnest cochlear implant available.

1997 The COMBI 40+ Split Electrode (GB) is introduced for cases of cochlear ossification.

1994 Introduction of the COMBI 40, the world's first multi-channel high-rate cochlear implant.

1990 MED-EL hires its first employees.

1991 MED-EL launches the world's first BTE (behind-the-ear) speech processor.

1995 Introduction of the CIS LINK system.

1977 Implantation of the world's first hybrid multi-channel cochlear implant in Vienna.

1989 Introduction of the COMFORT cochlear implant.

1975 Cochlear implant development started by MED-EL founders Ingeborg and Erwin Hochmair.

2009 EAS in the 2nd generation. European launch of the DUET 2 Audio Processor.

2008 The new MAESTRO™ 3.0 system software approved in Europe. The OPUS processors are now also available for COMBI 40+ implant users.

2007 Approval of EAS, the ideal solution for partial deafness, and the Vibrant Soundbridge® for conductive and mixed hearing losses in Europe. Launch of the DaCapo rechargeable battery system.

2006 Launch of the OPUS processors. The SONATA TI100 cochlear implant, with small titanium housing, and the FLEX electrode for all implant types are introduced.

2005 Introduction of the MED-EL DUET EAS™ Speech Processor in Europe, the first hearing implant system worldwide to integrate cochlear implant audio processing and acoustic amplification in one compact device.

2004 MED-EL launches the PULSAR CI100 cochlear implant, providing future-ready electronics in a ceramic housing.

2003 Acquisition of the Vibrant Soundbridge®, the first implantable middle ear hearing device for mild-to-severe sensorineural hearing loss.

1999 Launch of the TEMPO+ behind-the-ear (BTE) speech processor.

The Hearing Implant Company

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