

Rehabilitation for Bimodal Users

BINAURAL HEARING SERIES



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Binaural hearing gives optimal access to sound.

Hearing is normally accomplished with two ears, and the brain is organized to receive and then process sounds from two ears.

The following are the key benefits conferred by binaural hearing:

1. Binaural loudness summation and redundancy
 - A sound heard by two ears is usually judged as louder than a sound heard by one.
 - In the bilateral condition there is redundancy of information which assists in speech recognition.
2. Head shadow effect
 - The head acts as an acoustic barrier when sound is presented.
 - Therefore, sound arrives at the two ears in different ways (time and intensity).
3. Binaural squelch effect
 - The central auditory system processes the different stimuli received from each ear and represents it with a higher signal-to-noise ratio (SNR) by comparing the interaural time and intensity differences.

These benefits result in:

- Localization of sound
- Better understanding of speech in both quiet and noisy situations
- Improved ability to follow conversation
- Reduced listening effort
- Improved feeling of balance

Bimodal users are those who use a cochlear implant (CI) on one side and a hearing aid on the other. For some users there may be useful residual hearing on the hearing aid side which can be used in tandem with the CI. Others may be candidates for bilateral CI but for a range of reasons have only one. For further information on benefits of bimodal hearing, [click here](#).

Depending on the level of residual hearing and effectiveness of the hearing aid, bimodal users can often take advantage of the binaural hearing. This condition provides to access the benefits listed.^{1,2} Choice of cochlear implant is an important consideration to take advantage of binaural benefit. Information on this can be found [here](#).

Rehabilitation for bimodal users aims to maximize the benefits of both devices to allow best outcomes for the user.

There are different situations in which bimodal use occurs.

1. **Simultaneous CI and hearing aid user.** This user has received a CI on one side and a hearing aid on the other side at the same or about the same time.
2. **Sequential CI and hearing aid user.** This user has worn bilateral hearing aids previously and then received a CI on one side.

Rehabilitation With Children

There are two key aims of rehabilitation for children who are bimodal users.

The first is to maximize spoken language development. The second is to enhance the benefits of binaural hearing conferred by the bimodal condition.

Simultaneous Users

1. Pre-implant counselling is important for all potential users of a cochlear implant. All typical counselling aspects should be covered, such as risks of surgery and need for ongoing rehabilitation. The following important additional considerations for the bimodal condition should be discussed.

- a. The expectation that both devices will need to be worn during all waking hours.
- b. The expected benefits of each device. If there is little residual hearing, the user's family needs to understand that the CI side will likely be favoured by the child, and that non-use of the hearing aid is a risk. For these children, there may be limited binaural benefit. If there is significant residual hearing, counselling of the user's family can highlight potential for the child to benefit from all aspects of binaural hearing. However, this will depend on several factors including the length of time that the poorer ear has not received sound, the degree of hearing loss, and the hearing aid gain.
- c. The need for commitment to additional rehabilitation to maximize binaural hearing benefits. This is particularly important for the sequential user.

Expectations Questionnaire for Children (EQC) may be helpful in pre-implant counselling discussions.

2. Ongoing assessment and monitoring of the use of both devices, using data logging if available, will support best outcomes. Regular assessment and monitoring speech perception skills is recommended. This will be dependent on the age and ability of the

child. This information along with informal assessment and discussion about daily listening abilities and challenges will allow realistic therapy goals to be set. Ongoing monitoring of speech, language, and literacy skills is also important.

3. Development of listening and spoken language skills. All children with hearing loss are at risk of delays in their speech, language, and literacy development. Goal directed therapy based around family involvement is recommended. For guidance in therapy planning and parent/caregiver coaching, review *The Essential Steps to Paediatric Cochlear Implant Habilitation* and the [MED-EL Lesson Kits](#). Contact your [MED-EL representative](#) or the MED-EL Rehabilitation Department at rehabilitation@medel.com to obtain copies on any of the mentioned resources.

4. Development of binaural benefit. For children who have developed some auditory and language skills, activities which focus on development of localization and listening in noise can be included in the rehabilitation programme. Some suggestions for suitable activities for development of localization can be found [here](#).

Auditory skill development in background noise should also be included. Activities based on the auditory skills development hierarchy with various types of background noise may be added. Phonological development, global language skills, attention, and memory influence listening-in-noise performance. Start with low intensity background noise and target already well-established auditory skills. Suggested background noise to add, from easiest to hardest:

- Steady state noise (e.g., white noise), other noise unrelated to spoken language (e.g., orchestral music)
- Multi-speaker babble (individual speakers indistinguishable)
- Speaker babble with highlighted salient spoken phrases

Activities carried out in background noise are taxing for users. Keep activities brief (less than ten minutes). Monitor carefully the level of background noise presented. It is suggested that activities are started at +15 dB SNR and progressed to louder levels as confidence improves and performance grows.

5. Caregiver and family education. Training in how to improve the child's listening environment(s) and use communication strategies to support more successful communication interactions in daily life will be beneficial. This may also involve training for education staff.

6. Ongoing expectations counselling is important to support caregivers to maintain high but realistic expectations for their child's progress.

Sequential Users

Children who receive a CI in an ear formerly aided by a hearing aid will need special attention in addition to the activities suggested above.

As they have spent significant time with hearing aids, they will need specific activities to ensure that the benefit from the new CI is maximized.

A "Wear Schedule" should be developed so that the child has some time with the new cochlear implant alone. See below for details.

Rehabilitation With Adults

Rehabilitation for adults needs to focus on maximizing binaural benefit.

1. Pre-implant counselling is important for all potential users of a cochlear implant. All typical counselling aspects should be covered, such as risks of surgery and need for ongoing rehabilitation. The following important additional considerations for the bimodal condition should be discussed.

- a. The expectation that both devices will need to be worn during all waking hours.

- b. The expected benefits of each device. If there is little residual hearing, the user should come to understand that the CI side will likely be favoured. For these adults, there may be limited benefit for aspects of binaural hearing. If there is significant residual hearing, the user should understand that there is potential to benefit from all aspects of binaural hearing.
- c. The need for commitment to additional rehabilitation to maximize binaural hearing benefits. This is particularly important for the sequential user.

Expectations Questionnaire for Adults (EQA) may be helpful in pre-implant counselling discussions.

2. Ongoing assessment and monitoring of the user's CI use and speech perception with their CI is important to support best outcomes. Discussion of daily listening abilities and challenges will allow realistic therapy goals to be set collaboratively with the user. Monitoring and sharing progress, even if slow or small, is important.

3. Development of binaural benefit. Activities which focus on development of localization and listening in noise can be included in the rehabilitation programme. Some suggestions for suitable activities for development of localization can be found [here](#). Auditory skill training in background noise should also be included. Start with low intensity background noise and target already well-established auditory skills. Suggested background noise to add, from easiest to hardest:

- Steady state noise (e.g., white noise), other noise unrelated to spoken language (e.g., orchestral music)
- Multi-speaker babble (individual speakers indistinguishable)
- Speaker babble with highlighted salient spoken phrases

Activities carried out in background noise are taxing for users. Keep activities brief (less than ten minutes). Monitor carefully the level of background noise presented. It is suggested that activities are started at +15dB SNR and progressed to louder levels as confidence and performance grows.

4. Communication therapy to understand how to improve the listening environment and use clarification strategies. Communication partner training will support more successful communication in daily life.

See *MED-EL's Resources to Support Rehabilitation*.

5. Ongoing expectations counselling is important to support users to adjust to their CI and to support them in maintaining high but realistic expectations for progress.

When a CI is first provided, a "Wear Schedule" should be developed to give some time with the new CI alone.

Developing a "Wear Schedule"

- At all times when in the CI alone condition, keep the hearing aid nearby and visible to the user. If a situation arises of uncertainty or fear (e.g., if a visitor arrives into the home), allow the user to replace the hearing aid if desired.
- Some users will be anxious about removing their familiar hearing aid which they have come to rely on. Reassure them by explaining how long this is for. For example, "It's just for five minutes", or "We'll put it back soon". Use an egg timer or timer on a phone if visual support is needed.
- Include time with the CI alone when the user is relaxed at home and involved in typical activities.
- Include time with the CI alone in rehabilitation. Set goals for auditory skill development with the CI. Begin at the point of non-performance coupled with stimulability. These skills then become the current goals for the CI side.
- Begin rehabilitation based on teaching the goals. Usual techniques for rehabilitation for auditory skill goals should be employed. When focusing on development of auditory skills, reduce the cognitive load of activities. For example, for children avoid the teaching of new vocabulary or concepts in the auditory skill activity, for adults ensure there is easy access to materials needed.

Note that the "Wear Schedule" is usually recommended for around two to three months, after which time the use should be in the bimodal condition at all times.



MED-EL Resources to Support Rehabilitation

For adult users, visit the [MED-EL Blog](#) for further information on auditory training and communication strategies including how to improve the listening environment, use clarification strategies, and communication partner training. The MED-EL Blog 5-part series [Rehab For Adults: Auditory Training With Your Cochlear Implant](#) provides more information and resources for auditory training.

The *Hearing Implant Sound Quality Index (HISQUI)* is a validated questionnaire that can be completed in 10–15 minutes. It will support discussions with the recipient about their daily listening abilities and challenges and assist in identifying therapy goals collaboratively. Available for free [download](#).

Hear Today allows clinicians to evaluate recipients' current level of functioning with their CI. It also provides recipients with tips to improve their listening skills in everyday situations. *Hear Today* is available as an app. Alternatively, contact MED-EL to obtain a hard copy.

Hear at Home provides exercises for auditory training designed for use at home with family or in therapy. The exercises provide the speaker with detailed instructions on how to present the materials and can be adapted according to the abilities of the recipient. Contact MED-EL to obtain a hard copy.

Expectations Questionnaire for Adults (EQA) may be helpful in pre-implant counselling discussions. Contact MED-EL to obtain a hard copy.

The Essential Steps to Paediatric Cochlear Implant Habilitation is a guide for professionals working with families who have children using cochlear implant(s) or being considered for cochlear implantation. It lists goals for parents/caregivers and the child, pre-implant and at three levels post-implant. It can be used to identify intervention targets and monitor progress. In addition, it includes an explanation of key strategies effective in facilitating best listening and spoken language outcomes and information about Play Sounds and how to use them. Contact MED-EL to obtain a copy.

Download the [MED-EL Lesson Kits](#) for free paper-based CI rehabilitation resources. The Lesson Kits are a series of themed kits to support rehabilitation sessions with young children. Each Lesson Kit has multiple activities with goals at different levels, so that activities may be tailored to the abilities of individual children. The MED-EL Lesson Kits are available in several languages.

Expectations Questionnaire for Children (EQC) may be helpful in pre-implant counselling discussions. Contact MED-EL to obtain a hard copy.

Contact your [MED-EL representative](#) or the MED-EL Rehabilitation Department at rehabilitation@medel.com to obtain copies of any of the mentioned resources.

References

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2. Yoon, Y.S., Shin, Y., Gho, J.S., & Fu, Q.J. (2015). Bimodal benefit depends on the performance difference between a cochlear implant and a hearing aid. *Cochlear Implants International*, 16(3):159-67. doi: 10.1179/1754762814Y.0000000101



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