

HOPE Cochlear™
(Re)habilitation Resources

Therapy: Same or Different for a Child with Two Cochlear Implants

MaryKay Therres, M.A. CCC-SLP, LSLS Cert AVT
The Children's Hospital of Philadelphia

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Introduction
Cochlear America's Commitment to Educational Outreach


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MaryKay Therres, M.S., CCC-SLP, LSLS Cert. AVT

- SLP on The Children's Hospital of Philadelphia CI Team
- Previous member of Children's Hospital Oakland CI Team
- Co-author *AuSpLan: A Manual for Professionals Working with Children who have Cochlear Implants or Amplification*
- Co-developer and co-instructor of Professional Preparation in Cochlear Implants program
- Over 15 years experience with children who are deaf HoH





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Definitions



Rationale

Current Research and Implications for Candidacy

Therapy



Definitions





Thanks to my audiology advisors

Michael Jackson, M.S., CCC-A
Audiologist on the cochlear implant team at The Children's Hospital of Philadelphia


Adeline McClatchie, L.C.S.T., Dip. Aud., CCC-A
Previous director of the cochlear implant program at Children's Hospital Oakland and currently a private consultant





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Binaural Hearing: the coordination of sound in the central auditory pathways from hearing occurring in both ears

Bimodal Devices: cochlear implant in one ear (electric) and hearing aid in the other ear (acoustic)

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Bimodal Pros and Cons


Pros:


1. Depending on residual hearing, may provide great benefit
2. Enhanced music appreciation^{1,2}
3. Keep nerve stimulated, minimize auditory deprivation
4. Provide some binaural hearing benefits (possibly performance in noise, localization)³

Cons:

1. Often lack of usable residual hearing
2. Differing benefit between ears
3. Managing equipment
4. Feedback issues, ear molds
5. Benefit vs. Hassle- Is it worth it?


1 El Fata F, James C, Laborde M, Frayse B. (2009). How much residual hearing is 'useful' for music appreciation with cochlear implants? *Audiology and Neurotology*. 14(5):14-21.
2 Sucher C, McDermott H. (2009). Bimodal stimulation: benefits for music perception and sound quality. *Cochlear implants International*. 10(3):36-39.
3 Ching T. (2005). The evidence calls for making binaural-bimodal fittings routine. *The Hearing Journal*. 58(1):32-41.

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Bilateral cochlear implants: cochlear implant in one ear (electric) and cochlear implant in the other ear (electric)

- **Simultaneous:** receive both implants in one surgery
- **Sequential:** receive one cochlear implant in one surgery and after a period of time receive the other cochlear implant in a second surgery

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Terminology

- Right ear - Left ear
- Old implant - New implant
- Old ear - New ear
- First implant - Second implant
- First ear - Second ear
- Original implant - Bilateral implant



Waar nu Ant. slings

Rationale





Waar nu Ant. slings

B Robert Peters. Rationale for Bilateral Cochlear Implantation in Children and Adults. 2006. Cochlear Americas White Paper.

Article reviewing data available (scientific literature, presentations) and the Dallas Otolaryngology Cochlear Implant Program experience and rationale for providing binaural hearing to cochlear implant recipients

Available at:
www.cochlearamericas.com/PDFs/bilateral_white_paper.pdf





Waar nu Ant. slings

Why Two Ears?

- Human brain is organized to receive and process sound from binaural sources
- Brain can sample and compare the spatial, temporal, and amplitude characteristics of an acoustic signal and merge the incoming signals from the two ears together
- “Normally hearing” brains use rapid, real time analysis of signals from the two ears and use the combined data to hear

B. Robert Peters, MD





Binaural Hearing in Normally Hearing Ears

Binaural hearing made possible by:

- Head shadow effect
- Binaural redundancy and summation
- Binaural squelch effect



Binaural advantage results in improved speech understanding in quiet and in noise, as well as sound localization ability

B. Robert Peters, M.D.



Head shadow effect: the head acts as an attenuator of sound where the ear that is closer to the sound source hears the sound louder and sooner. These intensity and timing differences assist in localizing sound.

Also, when noise is present the ear furthest from the noise would have the more advantageous signal to noise ratio.



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Binaural redundancy and summation: results in signals being louder and providing more access to softer sounds when listening with both ears rather than one ear. With bilateral signal presentation there is a redundancy with the information resulting in an enhanced sensitivity to small changes in intensity and frequency that contribute to improved detection and/or speech recognition. This assists in understanding of speech in quiet.

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Binaural squelch effect: is the process by which our ears and brain receive both speech and environmental noise and focus on what you want to hear and tune out what you don't want to hear. Reflects central auditory system analyses that occurs by comparing interaural level differences and interaural time differences between the two ears. This contributes to sound localization.

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Why Bilateral Cochlear Implants ?

Want to give an individual the best access to sound and the possibility of developing some binaural skills which may assist in improving understanding in noise, localization of sound and greater ease of listening.

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Potential Benefits of Bilateral Cochlear Implantation (CI)

- The literature^{e.g.1,2} has reported benefits of bilateral CI (vs. unilateral) for many, if not most, patients in the following areas:
 - Improved understanding in quiet or noise
 - Improved localization ability
 - Patient satisfaction & perceived benefit

¹ Brown, K, & Balkany, T (2007). Benefits of bilateral cochlear implantation: A review. *Curr Opin Otolaryngol Head Neck Surg*, 15: 315-318.

² Litovsky, R, et al. (2006). Simultaneous bilateral cochlear implantation in adults: A multicenter clinical study. *Ear and Hearing*, 27(6): 714-731.

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Current Research and Implications for Candidacy

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Sharma A., Dorman M., and Spahr A.
A Sensitive Period for the Development of the Central Auditory System in Children with Cochlear Implants: Implications for Age of Implantation. *Ear and Hearing* 2002;23:532-539.

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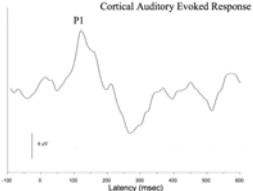
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Auditory Evoked Cortical Potentials

What are Cortical Potentials?

Measures of brain waves (EEG) in response to sound

Faster responses can be correlated to better speech discrimination, cochlear implant performance, greater maturity of auditory system



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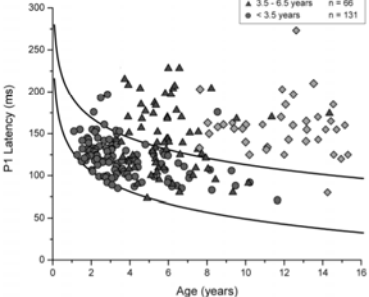
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Sharma et al. 2002

Cochlear Implanted Children (N = 245)

Age of implantation

- ◊ > 7 years n = 48
- ▲ 3.5 - 6.5 years n = 66
- < 3.5 years n = 131



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Central auditory system requires sound input in the first few years of life if effective central auditory development is to take place

There is a sensitive period of 3 1/2 years during which cochlear implantation occurs into a highly plastic central auditory system

Implantation after 7 years occurs into a reorganized central auditory system

Sharma et al. 2002

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The P1 data suggest that the most optimal period for central auditory developments is during the first 3.5 years of life. There is some variability in the data between the ages of 3.5 to 7 years. However, in all likelihood, the sensitive period ends at age 7. These findings also correspond to previous research (Kirk, et al., 2002) that shows that children with congenital deafness who are younger than age 4 and receive a cochlear implant develop significantly better speech and language compared to children who receive implants after 6 – 7 years of age.

Sharma, A. & Nash, A. (2009). Brain Maturation in Children with Cochlear Implants. *The ASHA Leader*, April 14, 14-17.

Kirk, K.I., Miyamoto, R.T., Lento, C.L., Ying, E., O'Neill, T., & Fears, B. (2002). Effects of age of implantation in young children. *Annals of Otolaryngology, Rhinology, and Laryngology-Supplement*, 189, 69-73.

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P1 Latency and Bilateral Cochlear Implants

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The same sensitive period and time course for normalization of the central auditory evoked potential is now known to exist for the 2nd implanted ear

Early implantation and longer term cochlear implant use in one ear is inadequate in preserving the plasticity of the auditory pathways that serves the opposite ear

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For sequentially implanted children tested at their center: the trajectory of P1 latency change of the 2nd implant ear was similar to the trajectories of children who received their 1st cochlear implant at the same age at which the test subject received their second implant

This was strong evidence of a sensitive period or “window” of opportunity to acquire effective binaural integration from their second ear

-- B. Robert Peters, M.D.


Waar nu het begint 




Conclusion:

Window of opportunity for children to maximally develop central binaural mechanisms from 2nd ear implantation would seem to be highest under 3.5 years of age, intermediate potential up to 7 years of age and minimal potential over age 12 years, despite being high performers with their first implant

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In absence of consistent contralateral hearing aid use, children less than 8 years of age are most ideal candidates

Reluctant to implant 2nd ear of children over 12 who did not use a hearing aid in the second ear at least until six years of age


With continued hearing aid use, children of any age can be considered good candidates


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Age of the second implant has significant effect on amount of benefit received and even a child's willingness to use the second device: younger is better






Some Bilateral Candidacy Factors


- Age
- Cochlear anatomy
- Hearing aid use
- Previous implant performance
- Language comprehension
- Patient/Family motivation
- Pre versus Post-lingually deafened







**Candidates-
Expected Better Outcomes**

- Younger children-minimal other issues
- Children utilizing hearing aid in other ear and demonstrating some auditory benefit
- Children with progressive hearing loss who had access to sound for meaningful period of time
- Normal anatomy
- Children who show significant benefit with the first cochlear implant
- Children of any age who were post-lingually deafened



Candidates- Expected Poorer Outcomes to Non candidate



- Older children who have not had auditory access (stimulation) with the other ear
- Limited benefit or use from 1st implant (i.e., multiple issues)
- Poor anatomy



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Therapy



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**Auditory Skills Pyramid
Hierarchy of Speech Intelligibility
Language Levels**



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Focus of Goals-Simultaneous

- Auditory (perception and receptive language), speech production, expressive language
- At times work with each ear alone for speech perception and practice and monitoring

SAME (with few adaptations)


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Focus of Goals: Sequential


- Auditory (perception and auditory memory)
- Receptive language, speech production and expressive language should always be addressed utilizing both cochlear implants

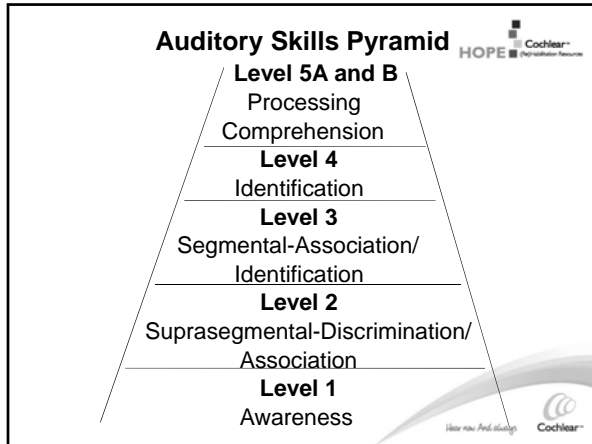
DIFFERENT

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- Monitor Skills
- Develop skills to age-appropriate level or to the level of 1st ear
- Start with closed set progressing to open set
- Start with structured activities moving to unstructured activities
- Start with simple advancing to more complex vocabulary/language

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-
- Sequential Bilateral Habilitation:
Auditory**
- Awareness
 - Suprasegmental-Pattern Perception
 - Segmental-Speech Discrimination
 - Identification
 - Comprehension/Processing
 - Localization
 - Background noise
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- Two Main Auditory Goals**
- Speech Discrimination/Auditory Perception
 - Auditory Comprehension of longer chunks of information
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Auditory Goal

Awareness


Suprasegmental-Pattern Perception



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**Auditory Goal: Discrimination
(Speech Perception)**

- Speech Sound Difference in Isolation
- Vowel and Consonant Difference
- Vowel Only Difference
- Consonant Only Difference
- Tracking



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Auditory Activities

Discrimination

- Differences in isolation: Ling sounds
- Vowel and Consonant differences: words father apart and bring closer together (shoe-ball, book-boat)
- Vowel differences: cat-kite-cut-coat-cute



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Auditory Activities

Discrimination

- Consonant differences: manner (shoe-boo-moo), voice (coat-goat), place (Kate-cape-cake)
- Word lists (ie: SPICE, CAST)
- Word and Sentence Level: draw a circle around Kate and underline cape


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Auditory Activities

Discrimination

Tracking (repeat verbatim, which works on auditory discrimination and auditory memory): text books, current assigned reading

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Auditory Activities:

“iPod” Therapy: Listen to music with lyrics printed out

Listen to books on tape-follow along with the book


Watch and listen to familiar movie


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Auditory Goal: Identification

- Number of key words
- Closed to open set
- Length of sentence
- Complexity of the language (less familiar vocabulary)



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**Auditory Goal:
Processing/Comprehension**

New Cochlear Implant Old Cochlear Implant


<ul style="list-style-type: none">• Paragraphs• Conversation	<ul style="list-style-type: none">• Vocabulary• Answering questions• Cognitive language
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Auditory Activities


- Paragraphs: simple to more complex information, short to longer paragraphs; text books, news/current events/interests (newspaper, magazines, internet)



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Auditory Activities


- Conversation: familiar topic to open-ended; choose variety of topics and let know when changing topic to changing topic randomly without warning, add other participants to the conversation



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Auditory Activities: Both Implants


Localization: hide a noise making toy, find a ringing cell phone, hide and seek, have two or more people in room and make noise on each side, have several different noise making toys around the room that go off at different times



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Auditory Activities: Both implants


Background Noise: start with simple tasks (following directions) to more difficult (paragraphs of information); decrease the signal to noise ration; use music, talk radio, white noise as background noise



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Habilitation: Auditory


- In class: both cochlear implants
- With new implant alone: in therapy settings-frequency/intensity dependent upon overall listening and spoken language skills and academic skills
- At home: some time spent with new implant alone


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Timeline


- Our experience is that for those children deemed to be appropriate candidates, auditory skills in the second ear generally become similar to auditory skills acquired with the first ear by 12 months of bilateral use


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Resources


- **SPICE** (Speech Perception Instructional Curriculum & Evaluation) www.cid.edu/home.aspx
- **CAST** (Contrasts for Auditory & Speech Training) www.linguisticsystems.com
- **Jean Gilliam DeGaetano** www.Greatideasforteaching.com
- **Marilyn Toomey** www.childrenspublishing.com and www.superduperinc.com
- **Sound and WAY Beyond™** www.CochlearAmericas.com/HOPE
- Additional papers and guidance on the Cochlear Americas website at www.CochlearAmericas.com


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Conclusion

- Know the research and set realistic expectations
- Different types of outcomes with the bilaterally implanted ear
- Simultaneous: therapy is the SAME
- Sequential: therapy is DIFFERENT - Focus of therapy on auditory skills


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Upcoming HOPE Online

Tuesday, January 25, 3:00 pm ET
 Young Children with Conductive Hearing Loss: What are the Technology Options
 George Cire, Au.D., CCC-A, Cochlear Americas

Wednesday, February 2, 3:00 pm ET
 Preparing Students to be Successful in their Learning Environments
 Cheryl DeConde Johnson, Ed.D., The ADVantage – Audiology, Deaf education Vantage-Consulting

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Early Intervention Workshops 2011


- Facilitating Spoken Language Development for Young Children with Hearing Loss
- One Day Introductory Seminar for Early Intervention and Educational Professionals
- Three More Sites: Albuquerque, NM (Mar 15), San Marcos, TX (March 16), Fairfax, VA (May 18)
- For more information, go to www.regonline.com/hopeworkshops
- Or call Sarah Gard at 303.524.6848, sgard@cochlear.com

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Helping Adults and Children with Cochlear Implants Enjoy Music Workshop 2011



- One day workshops for professionals; evening (or half day) workshops for adults and parents
- Four sites scheduled so far (watch for more)
- Chicago (Jan 13/14), Toronto (Feb 11/12), Ann Arbor, MI (April 12/13), Houston (April 26/27)
- For more information, go to: www.regonline.com/hopeworkshops or call Sarah Gard at 303.524.6848, sgard@cochlear.com



Contact Cochlear



- For questions about this seminar, please contact: THERRES@email.chop.edu
- For inquiries and comments regarding HOPE programming, please contact: dsorkin@cochlear.com
- For a Certificate of Participation, please send your completed Feedback Form to:
- hopefeedback@cochlear.com



Questions?

