Introduction to Cochlear Implants, Candidacy Issues, and Impact on Job Functioning

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Definitions

- Hearing impairment: means any degree and type of auditory disorder.
- Deafness: means an extreme inability to discriminate conversation speech through the ear.

Definitions (continued)

- Conductive impairments: refer to a defect in the auditory system which interferes with sound waves reaching the cochlea.
- The locus of the lesion in conductive hearing losses lies in the outer or middle ear.
Definitions (continued)

- Sensorineural impairments: refer to defects to the auditory pathways within the central nervous system, beginning with the cochlea and auditory nerve.
Definitions (continued)

• Mixed impairments involve both conductive and sensorineural defects.

• Hearing impairments after 19 years of age do not seem to severely affect speaking ability and language.

Definitions (continued)

• Hearing losses occurring from birth to 19 years of age are referred to as prevocational deafness or prelingual deafness.

• Tinnitus refers to a sound arising within or about the cochlea.

Speech Frequencies

• Speech frequencies range from 250 to 8000 hertz.

• A pure tone audiogram tests the patient’s hearing at the intervals of 250, 500, 1000, 2000, 4000, and 8000 hertz for each ear.

• Normal hearing is defined as hearing the above hertz at or below 25 decibels.
Noise Trauma

• Usually, ear protection should be worn if the sound is at or above 85 decibels.

• Hearing impairments can results if exposed to sound above this level.

• Too much noise exposure may cause a temporary change in hearing (your ears may feel stuffed up) or a temporary ringing in your ears (tinnitus).

Noise Trauma (continued)

• Examples:
  • Soft rustle of leaves            10 dB
  • A whisper at four feet          20 dB
  • Busy traffic                    70 dB

Noise Trauma (continued)

• Air conditioning unit, 20 ft.  60 dB
• Food blender         (4 Hrs.)  88 dB
• Power mower       (:30)       96 dB
• Rock band        (:0375)     108- 114 dB
Cochlear Implant

- A device that electrically stimulates the auditory nerve of patients with severe-to-profound hearing loss to provide them with sound and speech information.

Multi-channel Devices

- Cochlear Corporation (Clark & colleagues)
  - Nucleus 22 electrodes – stimulated sequentially
  - Nucleus 24 – both body worn and ear level processors
  - Four types of processing strategies approved by the FDA for use in this implant over the past 15 years

Nucleus 24 System
COMBI 40+
Cochlear Implant System

Advanced Bionics System

CLARION Electrode 2002
Designs

Spiral Electrode
Spiral Electrode with Positioning System (EPS)
HiFocus Electrode with Positioning System (EPS)

Three generations of electrodes, designed to enable CLARION’s unique feature—simultaneous stimulation.
Best Implant System??

• No clear-cut winner
  – The multi-channel systems all have ranges of success
• Individual choice
• Studies that have compared devices have not compared current generations of implants equally (Tyler, et al. 1996)

How a Cochlear Implant Works

Æ Sound picked up by microphone
Æ Speech processor
Æ Coded into electrical impulses
Æ Transmitter coil
Æ Through the skin via FM waves
Æ Receiver stimulator
Æ Electrodes
Æ Nerve
Æ Brain
University of Florida Cochlear Implant Program

- Implanted first patient in 1985
- Currently follow over 300 cochlear patients
- Over 70,000 multi-channel implants worldwide

Cochlear Implant Costs

- The cost for a cochlear implant at Shands is approximately $60,000 to $70,000

(Holmes, 2003)

Cochlear Implant Team

- Surgeon
- Audiologist
- Speech-Language Pathologist*
- Psychologist
- Social Worker
- Rehabilitation Counselor**
- Educators*
- Parents*

*Pediatric team **Work Entry/Re-Entry Goal
Formal Evaluation

• Medical
• Audiological
  – Standard audiometric unaided test battery
  – Aided speech perception
  – Aided speechreading

Formal Evaluation

• Speech and Language *
  – Receptive and expressive skills
  – Imitative and spontaneous productions
• Psychological *

*Required for all children and if deemed necessary by other members of the team for adults

Pre-implant Counseling Topics

• Candidacy criteria
• Cochlear implant hardware
• Realistic expectations
• Individual and family commitments
• Social considerations
• Communication mode
Who is a candidate?

- Severe-to profound sensorineural hearing loss
- Hearing loss did not reach severe-to-profound level until after acquiring oral speech and language skills
- Limited benefit from hearing aids

Who is a candidate? (continued)

- No medical contraindications
- Strong support system
- Appropriate expectations
- Highly motivated

Who is an adult candidate?

- ≤ 50% aided speech recognition on recorded sentence material in the ear to be implanted
- ≤ 60% aided speech recognition on recorded sentence material in the unimplanted ear
**Who is a pediatric candidate?**

- ≥ 12 months of age
- Little or no benefit from hearing aids
- <20% Best-aided word score on older children
- Educational program that emphasizes auditory skills development

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**Who is not a candidate?**

- Individuals who are not candidates medically
- Individuals with unrealistic expectations
- Individuals who identify themselves primarily with Deaf Culture and not with hearing culture

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**Post-Surgical Intervention**

- Initial speech processor fitting (hook-up)
  
  – 2 consecutive days, 1-2 hours each day
Post-surgical Intervention - Adults

- Follow-up programming, rehabilitation and evaluation
  - Months 1-2: 1/week
  - Months 3+: every 6 - 12 months

Post-surgical Intervention - Children

- Follow-up programming, rehabilitation and evaluation
  - Months 1-3: 1/week
  - Months 3-4: 2/month
  - Months 4+: every 6 months

Outcomes for Post-lingual Adults (continued)

- Top 30 % function fairly well on the telephone
- Bottom 30 % avoid the phone
- The rest use the phone with significant others or only when necessary
Study


Impact of a Cochlear Implant on Job Functioning

This study was supported, in part, by a grant from the Florida Association of Speech-Language Pathologists and Audiologists Foundation

Purpose

• The purpose of this study was to evaluate the impact of cochlear implants on the job functioning of 21 adults with severe to profound sensorineural hearing loss.
Sample

- Twenty-one clients from the University of Florida Cochlear Implant Program, agreed to participate in the study by filling out the questionnaire, and supplying names and addresses of employers and allowing us to send questionnaire to them.

Sample (continued)

- These persons have post-lingual deafness.

- Post-lingual deafness is defined as having its onset after the development of speech and language (after approximately age six years).

Sample (continued)

- Confidentiality was assured.

- Only nine clients were working (four were retired or self employed).

- Seven of the nine employers returned completed questionnaires.
Instrument

• An Abbreviated Profile of Hearing Aid benefits Questionnaire (APHAB), developed by Cox, Gilmore, and Alexander (1995), was modified for this study.

• Four of the original questions on the APHAB that were unrelated to the work environment were deleted so that each form consisted of 20 items (client and supervisors).

Results for Clients' After and Before Ratings

• The clients' ratings indicated that they perceived that the cochlear implant had a positive impact on their job functioning.

• A Wilcoxon Matched-Pairs Signed-Ranks Test:

  \[ T = 11, n' = 20, p < .01. \]

Bar Graph of Clients' After and Before Ratings
Results for Supervisors' After and Before Ratings

- The supervisors' ratings indicated that they perceived that the cochlear implant had a positive impact on the clients' job functioning.
- A Wilcoxon Matched-Pairs Signed-Ranks Test:
  - $T = 30.5$, $n' = 20$, $p < .01$.

Supervisors' After and Before Ratings

Figure 2: Supervisors' After and Before Ratings

Discussion

- Both the supervisors and cochlear implant users indicated the clients were:
  - more aware of warning signals,
  - more able to understand conversations in most environments, and
  - were able to identify sounds in their environment after receiving their implants.
Discussion (continued)

• These findings are congruent with the pilot study.
• The only negative affect of the cochlear implants indicated by both the clients and their supervisors was that traffic noises were more bothersome than before surgery.
• Of course, before surgery they did not hear traffic noises.

Discussion (continued)

• The supervisors differed from the clients in the pre-implant assessments on issues relating to understanding in difficult listening situations.
• The supervisors tended to over rate in comparison to clients rating their own abilities to comprehend in these environments.

Implications

• Both clients and supervisors should be counseled on the potential benefits and limitations of cochlear implants in the workplace.
• Appropriate expectations as to improvements in speech communication and the ability to detect warning signals should be covered.
Implications (continued)

• At the same time they should be aware of the negative effects of noisy backgrounds to cochlear implant users.

QUESTIONS?

Project Hope

National study on the impact of hearing loss
Policy Analysis Brief, April, 2000
Economics of Hearing Loss

- Severe to profound hearing loss is expected to cost society an average of $297,000 per individual, over $1 million if the individual is pre-lingually deaf.
- Costs include both direct medical and nonmedical costs, educational costs as well as indirect productivity losses.

Source: Project HOPE, Policy Analysis Brief, April, 2000

Costs by Age of Onset

![Costs by Age of Onset Graph]

All Costs are inflated to 1998 dollars using the Urban Consumer Price Index.

Lifetime Cost Comparison Of Other Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Lifetime Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe to Profound Hearing Impairment</td>
<td>$297,000</td>
</tr>
<tr>
<td>Schizophrenia</td>
<td>$295,000</td>
</tr>
<tr>
<td>Epilepsy (noninstitutionalized with frequent seizures)</td>
<td>$172,000</td>
</tr>
<tr>
<td>Rheumatoid Arthritis (25-year cost for young women)</td>
<td>$130,500</td>
</tr>
<tr>
<td>Stroke</td>
<td>$129,200</td>
</tr>
<tr>
<td>Near-Drowning</td>
<td>$98,500</td>
</tr>
<tr>
<td>Accidents with Firearms</td>
<td>$87,100</td>
</tr>
</tbody>
</table>

Source: Project HOPE, Policy Analysis Brief, April, 2000
COST OF COCHLEAR IMPLANT

• Total Treatment Costs
  ➢ Approximately $63,000


Cost of Cochlear Implants Vs Lifetime Costs of Deafness

Demographics
(Cochlear Corp)

• Severe to profound hearing impairment affects 500,000 to 725,000 Americans
• To date: 18,000 surgeries in the US
  – 5 years & younger 22%
  – 6 to 21 years 24%
  – 22 to 64 years 37%
  – 65 years & older 17%

**Societal Impact: Age**

The severe to profound hearing loss population is divided into four age groups:

- 0-17 yrs: 9%
- 18-44 yrs: 16%
- 45-64 yrs: 18%
- 65+ years: 57%

Source: Project HOPE calculations from the 1990-91 National Health Survey, and U.S. Census, 1991

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**Barriers to Access**

- Implantation of cochlear implants is extremely low among those who could benefit
  - Lack of consumer/professional awareness
  - Social and ethical issues
  - Lack of insurance
  - Financial disincentives, i.e., inadequate reimbursement


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**Conclusion**

- Severe to profound hearing impairment has a staggering cost to society
- Cochlear implantation results in cost savings to society
Questions

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Additional Resources and Information from the Web

• JAN’s Webpage (www.jan.wvu.edu/media/Hearing.html)
• Cornucopia of Disability Information – Hearing Impairments (http://codi.buffalo.edu/hearing.htm)
• League for the Hard of Hearing (www.lhh.org)
• National Institute on Deafness and Other Communication Disorders (www.nidcd.nih.gov)
• The Deaf Resource Library (www.deaflibrary.org)
• Journal of Deaf Studies & Deaf Education (http://deafed.oupjournals.org)