Which Ear Should Be Implanted?

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Learning Objectives

- Understand the long-held tenets of which ear to implant, based on
  - Degree of hearing loss
  - Vestibular function
  - Length of auditory deprivation

- Become familiar with newer data supporting or refuting these beliefs

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Selecting an Ear

- Somewhat arbitrary if:
  - Imaging shows same anatomic characteristics bilaterally
  - Same historical hearing loss

- Balkany et al., 2002
  - Considerations for ear choice in children receiving CI

Table II. *Considerations for selecting the ear to be implanted*

- Hearing
  - Choose better ear
    - Anacoustic opposite ear
    - Disuse > 10 years opposite ear
    - Neither ear useful
  - Choose worse ear
    - Good residual in both ears
- Imaging
  - Absolute contraindications
    - Aplasia
    - Absent auditory nerve
  - Choose better ear
    - Ossification
    - Dysplasia
    - Facial or vascular anomaly
    - Pneumatization
- Medical
  - Choose better ear
    - Recurrent otitis media
    - Prior ear surgery
    - Cerebrospinal fluid
- Other
  - Timing
    - Most recently deafened
  - Language
    - Choose right ear

- Connell and Balkany, 2006

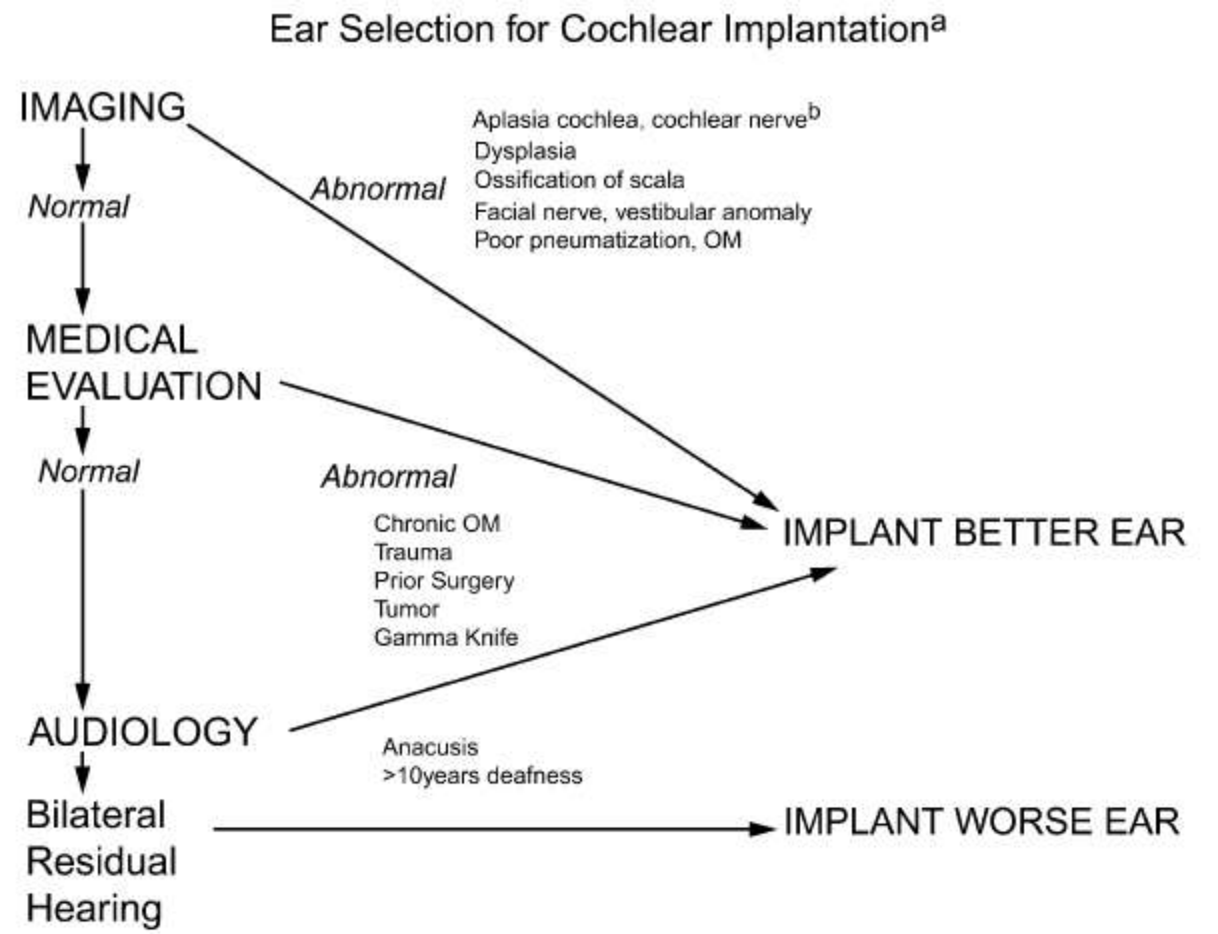


Fig. 2. Considerations for selecting the ear to be implanted. [a]After candidate meets implantation criteria, demonstrates appropriate expectations and habilitation options. These are general guidelines. Each patient must be evaluated individually. [b]Absolute contraindications.

Degree of Hearing Loss

- Long-held assumption:
  - Operate on the worse-hearing ear

- Why?
  - Patients may benefit by wearing a contralateral hearing aid in addition to CI for better hearing in noise
  - Vestibular function likely better in the ear with more hearing
  - Preserve better-hearing ear for use of future technologies

Degree of Hearing Loss

- New idea:
  - Better-hearing ear may provide better opportunity for speech perception benefit with CI
  - Theoretically, the ear with better hearing has a better neural substrate for stimulation

Degree of Hearing Loss

- Implanting the better-hearing ear: Argument **Against**
  - Hearing and histologic status of the implanted ear is not related to speech perception outcomes with a cochlear implant
    - Studies have shown that post-operative speech recognition has a similar relationship to **preoperative speech recognition** and **duration of deafness**, regardless of whether the implanted ear is better or worse-hearing

Degree of Hearing Loss

- Rubenstein, Parkinson, Tyler, & Gantz, 1999
  - Better hearing, shorter duration deafness ear implanted

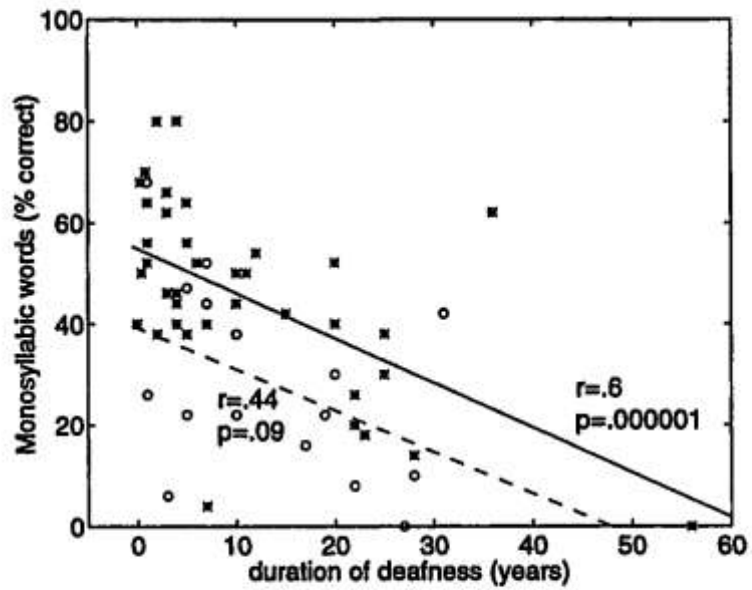


FIG. 2. Monosyllabic word recognition as a function of duration of deafness for patients implanted with CI-22 and CI-24 devices. The asterisks include "new CI-22" and CI-24 patients fitted with a solid regression line. The circles include "original CI-22" patients fitted with a dashed regression line. Note that speech reception in the more recent group is better predicted by duration of deafness than in the original CI-22 group.

Degree of Hearing Loss

- Rubenstein, Parkinson, Tyler, & Gantz, 1999
  - Better hearing, shorter duration deafness ear implanted

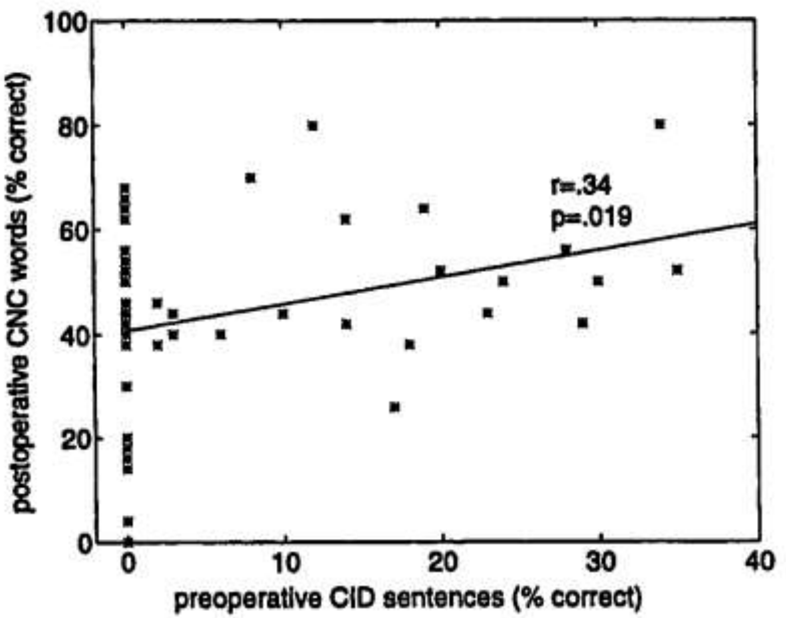
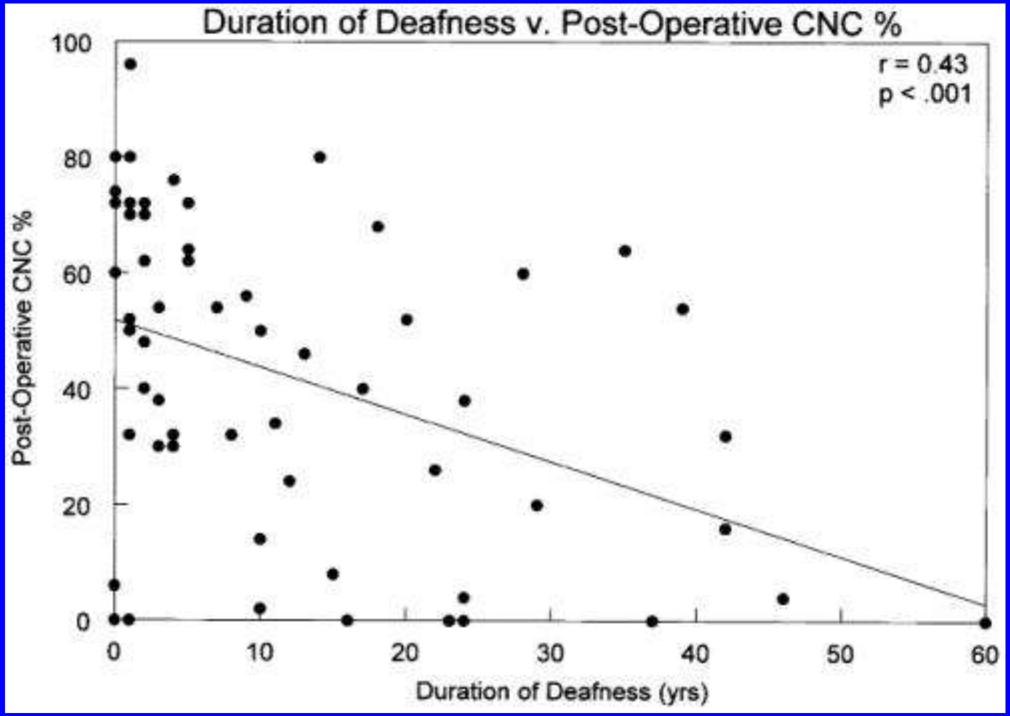


FIG. 3. The CNC score as a function of preoperative CID score for the recent cohort of patients implanted with CI-22 and CI-24 devices running SPEAK. A statistically significant relationship is apparent (*p* = 0.019, = 46).

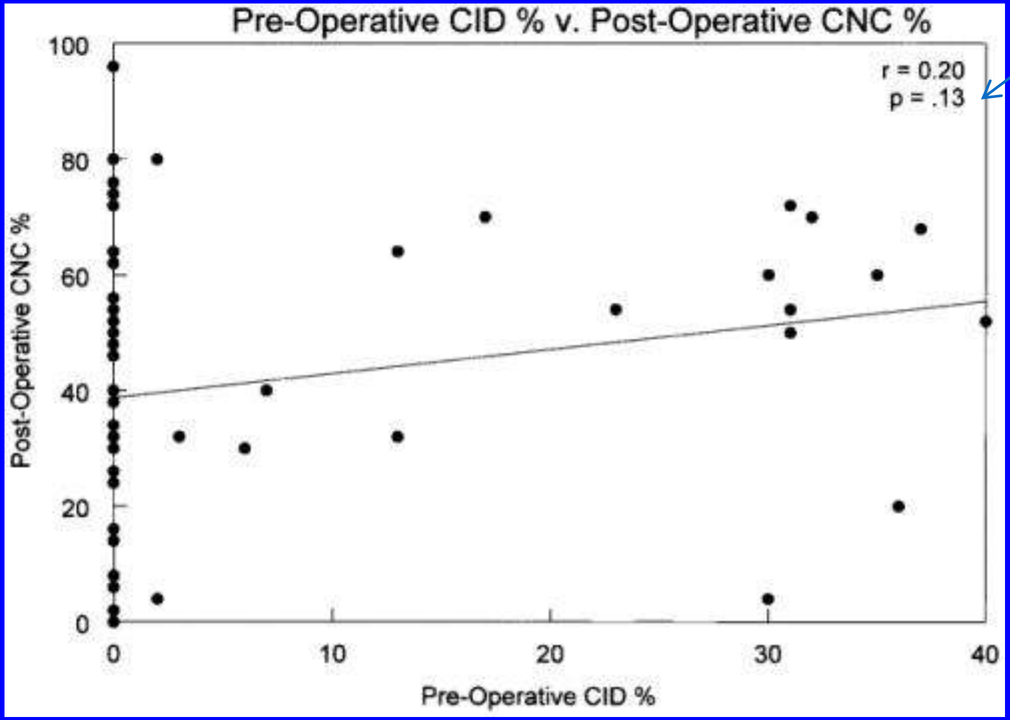
Degree of Hearing Loss

- Friedland, Venick, & Niparko, 2003
  - Poorer hearing ear implanted



Degree of Hearing Loss

- Friedland, Venick, & Niparko, 2003
  - Poorer hearing ear implanted



Degree of Hearing Loss

- Implanting the better-hearing ear: Argument **Against**
  – Hearing and histologic status of the implanted ear is not related to speech perception outcomes with a cochlear implant
    - No relationship between spiral ganglion density and speech perception performance in a series of 16 cochlear-implanted temporal bone cases

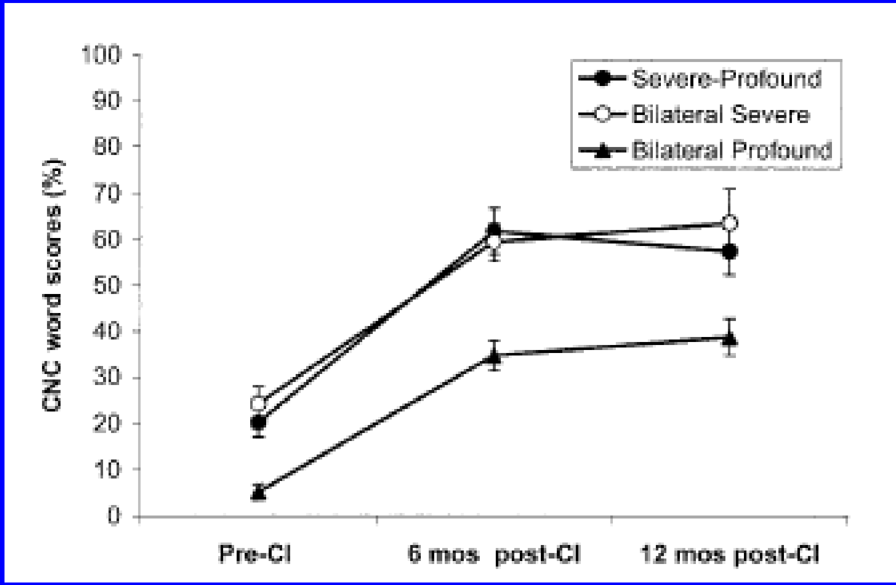
Linthicum, Fayad, Otto, Galey, & House, 1991

Degree of Hearing loss

- Francis et al., 2004
  - Hypothesized that speech perception outcome is the same whether or not implanted ear has profound or severe levels of hearing loss, provided similar levels of residual hearing in the nonimplanted ear
  - Retrospective study
    - Postlingually deafened adults
    - Classified according to PTA as bilateral severe, severe-profound, bilateral profound

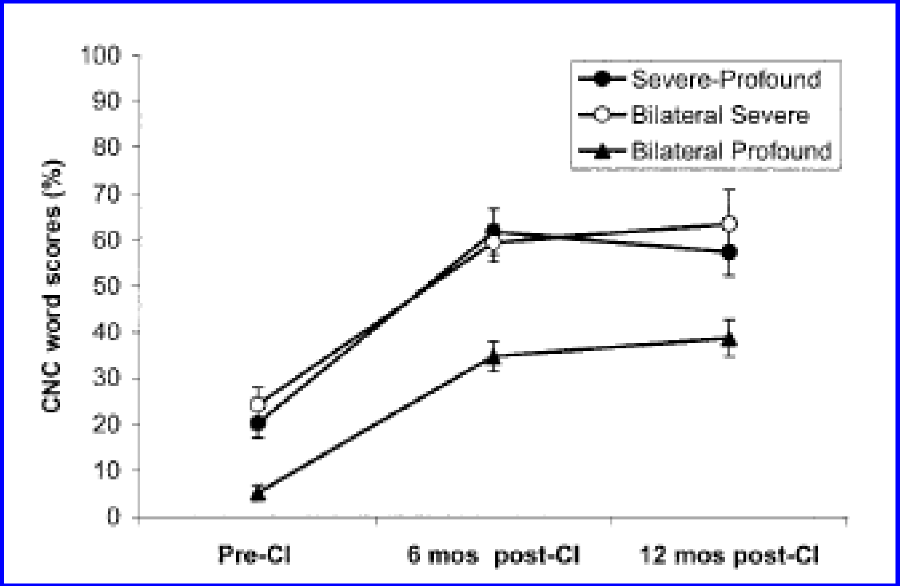
Degree of Hearing loss

- Francis et al., 2004
  - In asymmetrical group, no significant difference in mean speech perception scores compared with bilateral severe group within 1 year after implant
  - Despite profound hearing loss of implanted ear



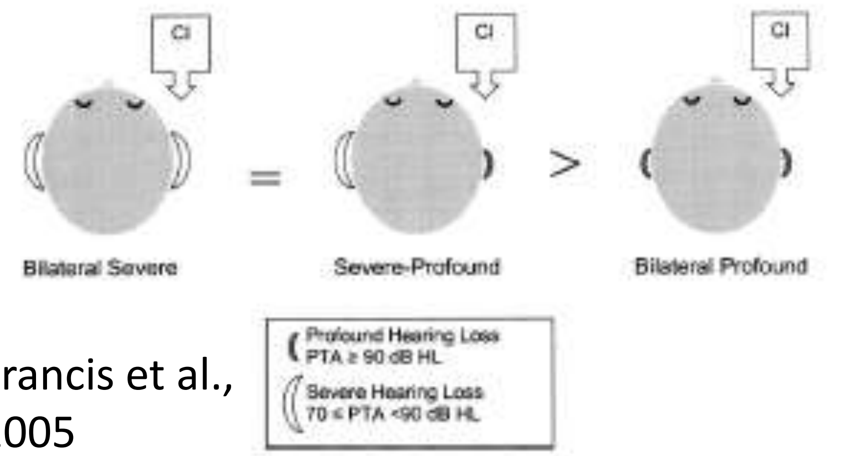
Degree of Hearing loss

- Francis et al., 2004
  – Bilateral profound group had lower speech perception results compared with patients with residual hearing in one or both ears



Degree of Hearing Loss

- Francis et al., 2005
  - Hypothesized that
    - Patients with residual hearing in one or both ears have superior speech recognition with a CI than patients with bilateral profound hearing loss
    - Speech recognition results among patients with residual hearing in the nonimplanted ear are the same whether the implanted ear has severe or profound levels of hearing loss



Francis et al., 2005

Degree of Hearing Loss

- Francis et al., 200**5**
  - Conducted retrospective study of all adults with postlingual deafness upon whom cochlear implantation was performed
  - Johns Hopkins, between 1992 and 2004
  - Used preimplant PTAs to classify individual ears
    - Between 70 and 90 dB HL = severe
    - 90 or more dB HL = profound
  - Looked at preoperative and post operative speech recognition testing

Francis et al., 2005

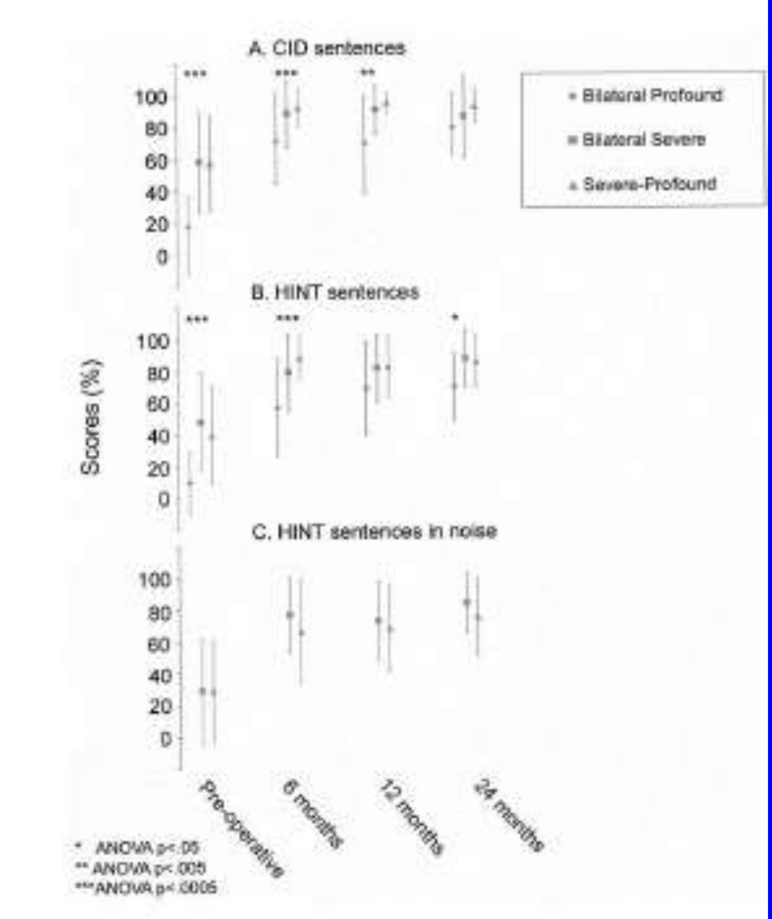
Degree of Hearing Loss

- Results
  - Speech recognition outcome influenced by pre-operative hearing acuity and age at CI

Francis et al., 2005

Degree of Hearing Loss

- Results
  - Residual hearing in one (severe-profound HL) or both (bilateral severe HL) ears was associated with superior speech perception relative to patients with bilateral profound hearing loss
    - **Regardless of whether implanted ear has severe or profound hearing loss**



Francis et al., 2005

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Degree of Hearing Loss

- Conclusions
  - No additional benefit to implanting the better-hearing ear
    - can be preserved for use with a hearing aid for better speech understanding in noise and sound localization
  - Benefit received by patients with residual hearing likely mediated by trophic effects on **crossed** pathways in the CNS
    - INDEPENDENT of preoperative functional status of the implanted ear

Francis et al., 2005

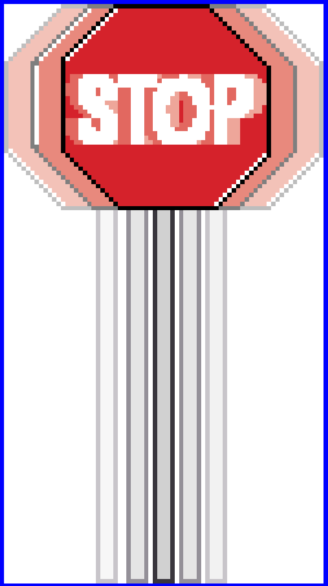
Vestibular Dysfunction

- Invasive nature of implantation can lead to peripheral vestibular dysfunction

- Patients with severe and profound sensorineural hearing loss often have reduced vestibular function

Vestibular Dysfunction

- The ear with reduced caloric function is invariably the “worse”-hearing ear



- Implanting the better ear could potentially induce bilateral peripheral vestibulopathy → oscillopsia

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Vestibular Dysfunction

- If implanting “worse” ear to avoid causing oscillopsia by injuring the “better” ear during implantation, important to consider whether implanting the “worse” ear leads to a worse outcome

Vestibular Dysfunction

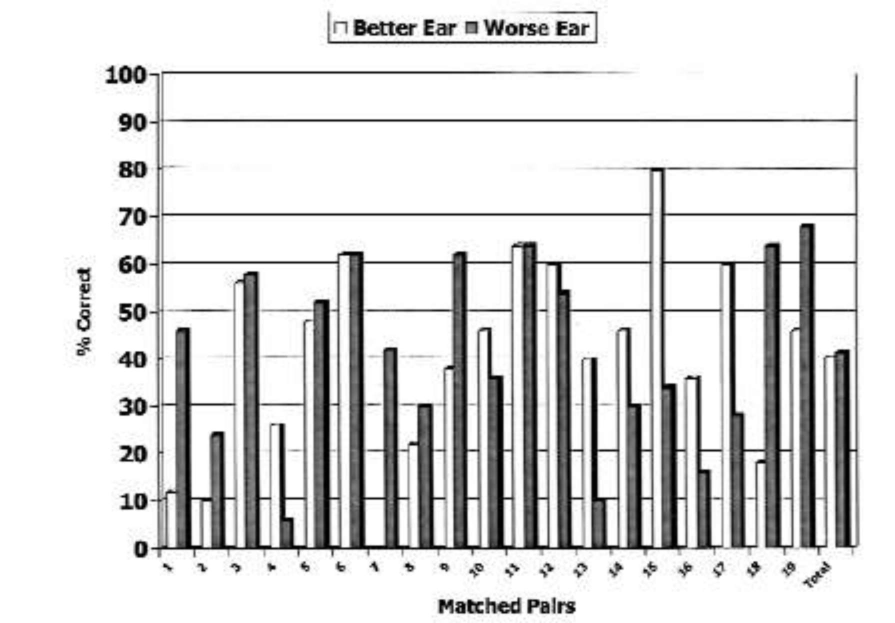
- Chen et al., 2001
  - Retrospective cohort study
  - Two groups of CI recipients selected
  - Matched based on
    - Duration of deafness
    - Age at implantation
    - Implant types
    - Processing strategies

Vestibular Dysfunction

- Chen et al., 2001
  - 19 patients received implant in “better” ear
  - 19 received one in “worse” ear
    - i.e. ear that was not amplified or had caloric dysfunction

Vestibular Dysfunction

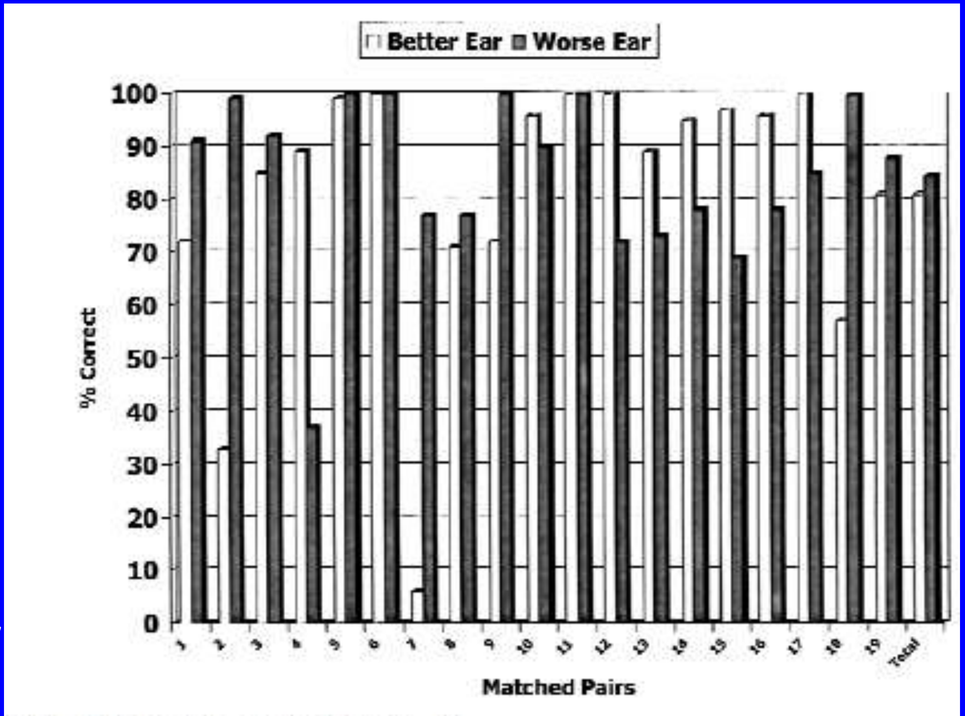
- Chen et al., 2001
  - Results
    - No apparent differences between mean CNC word recognition and CID sentence scores at 1 year between the two groups



CNC word recognition scores for matched subjects (n = 19).

Vestibular Dysfunction

- Chen et al., 2001
  - Results
    - No apparent differences between mean CNC word recognition and CID sentence scores at 1 year between the tw groups



CID sentence scores for matched subjects (n = 19).

Vestibular Dysfunction

- Chen et al., 2001
  - Conclusions
    - Provided that historical background of hearing loss in two ears is not very different, implanting the “worse” ear does not adversely affect performance
    - Choosing the “worse” ear for purposes of protecting vestibular function in the “better” ear does not necessarily jeopardize CI’s final outcome

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Length of Auditory Deprivation

- Duration of severe to profound deafness is one of the most important predictors of successful CI outcomes, according to several studies

- Less information available on outcomes in cases where severity of hearing loss and hearing aid use is different for each ear

Length of Auditory Deprivation

- Long-held assumption: implant the ear with more recent loss
  - Poor functional outcomes for implantation of ear with long term auditory deprivation

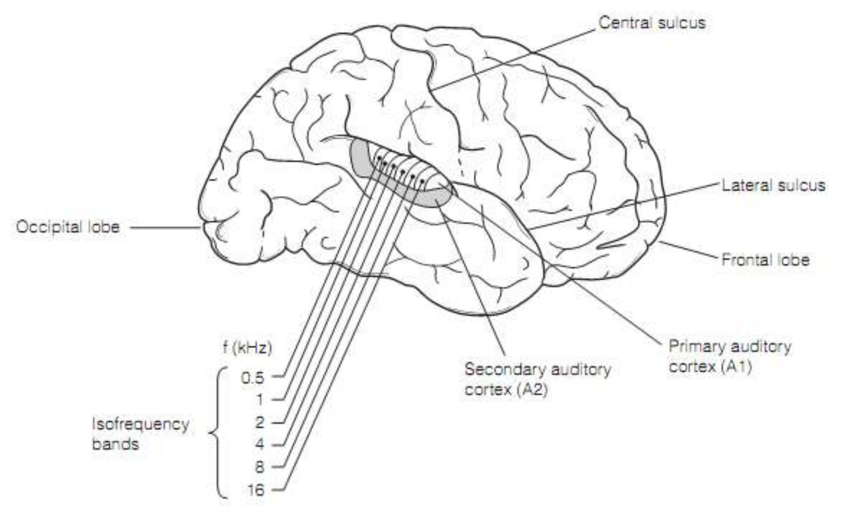
- Based on findings that poor outcomes are associated with long-term deafness and poor residual hearing in **both ears**

Length of Auditory Deprivation

- Proposed biologic explanations:
  - Lack of acoustic stimulation could lead to degeneration of afferent neurons causing spatial smearing of electrical current and broad frequency tuning

Length of Auditory Deprivation

- Proposed biologic explanations:
  - Sound deprivation could cause reorganization of the auditory cortex leading to changes in tonotopic frequency maps



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Length of Auditory Deprivation

- Against this assumption:
  - No clear relationship between reduced spiral ganglion cell density and postoperative speech recognition outcomes
    - In the House series of 16 patients, 2 patients with only 3,000 surviving neurons performed similarly to a patient with 15,000 surviving neurons
    - Minimum density may be quite low

Fayad, Linthicum, Otto,
Galey, & House, 1991

Length of Auditory Deprivation

- Second approach
  - Implant sound-deprived ear to minimize risk of destroying useable hearing

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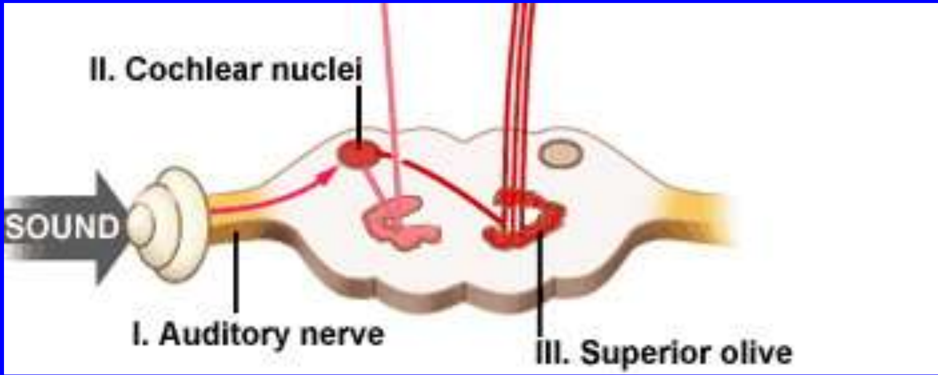
Length of Auditory Deprivation

- Third approach
  - Make recommendations on the basis of speech recognition performance of the non-deprived ear and the desired outcome

Length of Auditory Deprivation

- Loss of cochlear hair cells →
- Impeded release of neurotrophic factors →
- Degeneration of peripheral auditory neurons →
- Reductions in spiral ganglion neurons and their neural activity →
- Reduction of morphological complexity of calyceal synaptic endings projecting into anteroventral cochlear nucleus →
- Superior olivary complex
  - **INTEGRATES BINAURAL INFORMATION**



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Length of Auditory Deprivation

- Input from one ear could maintain synaptic activity within the auditory pathways and cortex
- Thus, might contribute to outcomes obtained with implant in long-term sound-deprived ear

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Length of Auditory Deprivation

- Boisvert thesis, 2012
  - Data from 5 implantation centers
  - 5 retrospective cohort studies
  - Examined speech recognition scores obtained in adult CI recipients with >15 years monaural sound deprivation
    - Bilateral hearing loss, aided monaurally
    - Monaural deprivation = absence of auditory input in one ear in normal listening situations

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Length of Auditory Deprivation

- Boisvert et al., 2011
- Relative importance of monaural sound deprivation and bilateral significant hearing loss in predicting cochlear implantation outcomes
  - adults (18 yr) who received a cochlear implant between January 2000 and February 2008 at the Centre Hospitalier Universitaire de Quebec
  - Included if they had received implant in an ear that for a minimum of 15 yr had severe or greater degree of hearing loss and had not used a hearing aid for that duration

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Length of Auditory Deprivation

- Boisvert et al., 2011
  - adults (18 yr) who received a cochlear implant between January 2000 and February 2008 at the Centre Hospitalier Universitaire de Quebec
  - Included if they had received implant in an ear that for a minimum of 15 yr had severe or greater degree of hearing loss and had not used a hearing aid for that duration
  - N=16

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Length of Auditory Deprivation

- Speech Recognition Scores (sentences) measured:
  – in usual aided condition pre-implant
  – Post implant with CI alone
  – Post implant in usual aided condition
    - Bimodal condition only when participant was using a hearing aid in contralateral ear

Boisvert et al., 2011

Length of Auditory Deprivation

- Results
  - No significant correlation between SRS scores and absolute duration of auditory deprivation

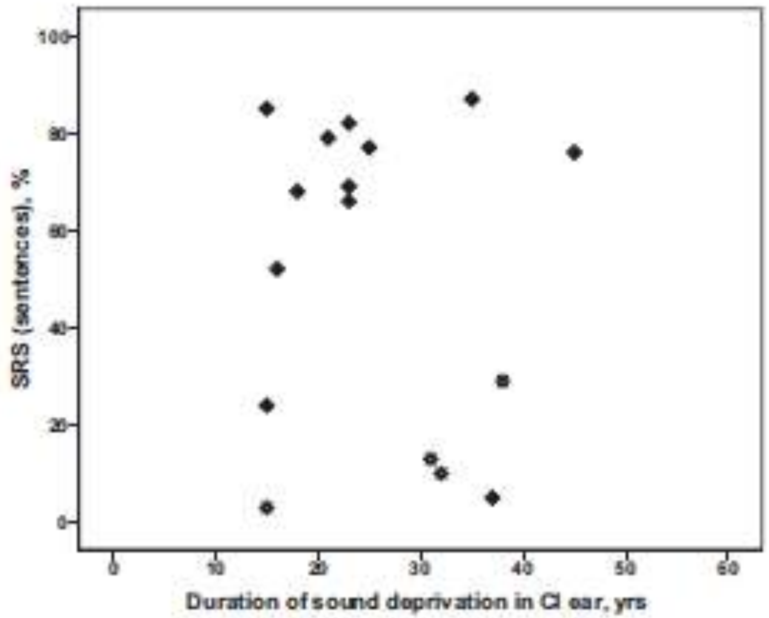

Fig. 1. Best speech recognition score obtained in the first year after cochlear implantation with correctly repeated words in sentences, with the use of the implant alone, compared with the duration, in years, of sound deprivation in the implanted ear. The participants represented with a star are participants with a prelingual hearing loss.

r = -0.02, p = 0.48

Boisvert et al., 2011

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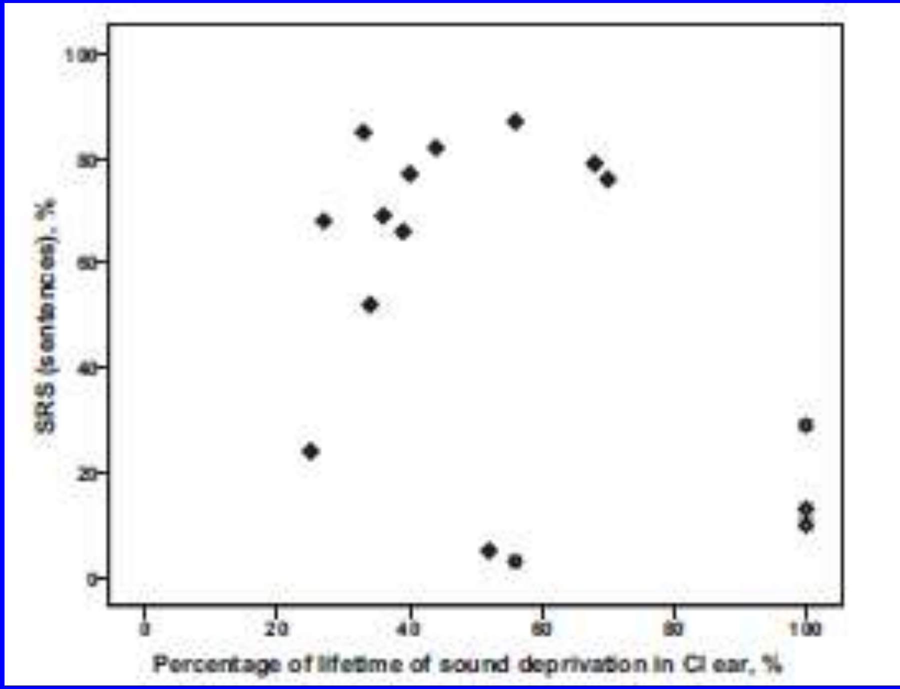
Length of Auditory Deprivation

- Results
  - No significant correlation between SRS scores and length of deprivation as a percentage of lifetime in deprived ear



r = -0.22, p = 0.20

Boisvert et al., 2011

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Length of Auditory Deprivation

- Results
  - Significant negative correlation between SRS and duration of **bilateral** hearing loss

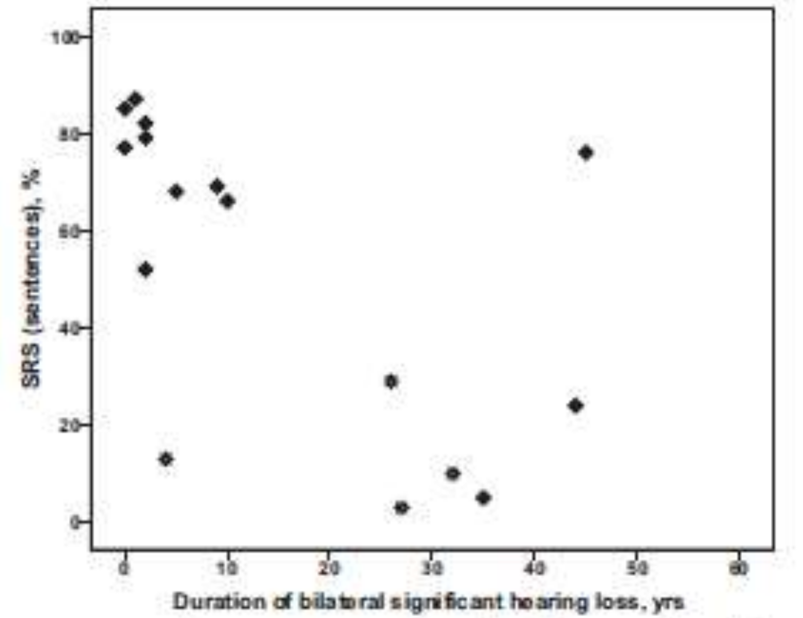

Fig. 3. Best speech recognition score obtained in the first year after cochlear implantation with correctly repeated words in sentences, with the use of the implant alone, compared with the duration of bilateral significant hearing loss, in years, as measured in the only hearing ear before implantation. The participants represented with a star are participants with a prelingual hearing loss.

r = -0.68, p < 0.00

Boisvert et al., 2011

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Length of Auditory Deprivation

- Results
  - Stronger negative correlation when duration expressed as percentage of lifetime

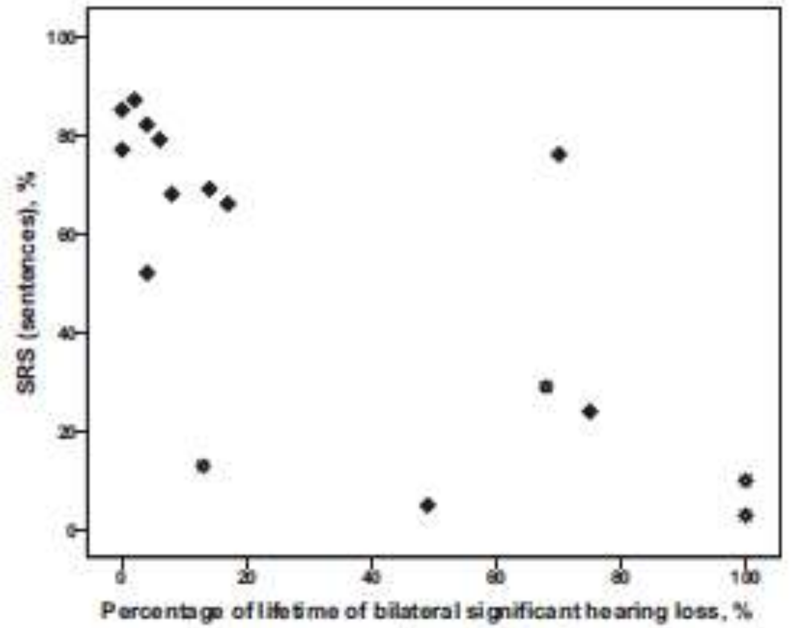

Fig. 4. Best speech recognition score obtained in the first year after cochlear implantation with correctly repeated words in sentences, with the use of the implant alone, compared with the percentage of lifetime of bilateral significant hearing loss, as measured in the only hearing ear before implantation. The participants represented with a star are participants with a prelingual hearing loss.

$r = -0.77$, $p < 0.00$

Boisvert et al., 2011

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Length of Auditory Deprivation

- Results
  - No significant correlation found when comparing SRS with duration of any hearing loss measured bilaterally or in the implanted ear

Boisvert et al., 2011

Length of Auditory Deprivation

- Conclusion
  - Speech perception outcomes not significantly correlated with 3 variables in implanted ear
    - Duration of sound deprivation
    - Percentage of lifetime of sound deprivation
    - Duration of sound stimulation before deprivation

Boisvert et al., 2011

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Length of Auditory Deprivation

- Conclusion
  - Speech perception outcomes strongly correlated with
    - Duration of bilateral significant hearing loss
    - Percentage of lifetime of bilateral significant hearing loss
    - Duration of stimulation before bilateral significant hearing loss

Boisvert et al., 2011

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Length of Auditory Deprivation

- Conclusion
  - Contribution of central processes may be more important in determining functional outcomes of cochlear implantation than contribution of peripheral effects of sound deprivation in the ear-to-be-implanted

Boisvert et al., 2011

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Length of Auditory Deprivation

- Boisvert et al., 2012
- Long-term monaural auditory deprivation and bilateral cochlear implants
  - Background
    - Animal models suggest:
      - Bilateral deafness →
        - » reduction in cochlear nucleus cell size, atrophy of trapezoid body, superior olivary complex, lateral lemniscus, inferior colliculus
      - Unilateral deafness →
        - » synaptogenesis, reinforicing neuronal activity in auditory pathways contralateral to deaf ear →
        - » More symmetrical activation from both cortices

Length of Auditory Deprivation

- Boisvert et al., 2012
  - Question
    - Is bilateral rebalancing of neuronal activity (observed in unilateral deafness) sufficient for obtaining good perceptual outcomes with the implant placed in the deaf ear?

Length of Auditory Deprivation

- Boisvert et al., 2012
  - Retrospective study, 10 patients
  - Compared outcomes obtained in individual ears for adults with long-term monaural auditory deprivation (i.e. unilateral use of HA) who received bilateral cochlear implants
  - Bilaterally implanted sequentially
  - Sound-deprived ear implanted first

Boisvert et al., 2012

Length of Auditory Deprivation

- Boisvert et al., 2012
  - Study
    - Severity of hearing loss determined for each individual ear before implantation as 3 frequency PTA thresholds
    - Duration of severe hearing loss (>70dB) measured for each ear individually
    - Duration of monaural auditory deprivation estimated
    - Duration of bilateral significant hearing loss measured

Length of Auditory Deprivation

- Definitions
  - Duration of severe hearing loss: time since PTA exceed 70 dB hearing loss, for each ear individually before implantation
  - Duration of monaural auditory deprivation: time before implantation for which one ear had at least a severe hearing loss and no hearing aid was used
  - Duration of bilateral significant hearing loss used to measure duration when hearing was significantly degraded in both ears i.e. following criteria were met:
    - hearing loss was at least severe
    - sentence recognition scores below 30%
    - use of telephone was not possible

Boisvert et al., 2012

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Length of Auditory Deprivation

Table 1 Demographics of participants

No.	Age	First implanted ear (sound-deprived): Ear	Etiology	Duration severe hearing loss (years)	Duration sound deprivation (years)	PTA (dB)	Second implanted ear: Etiology	Duration severe hearing loss (years)	PTA (dB)
1	68	Left	Otosclerosis	50	50	120	Otosclerosis	22	108
2	81	Left	Unknown	39	39	110	Unknown	7	88
3	76	Left	Otosclerosis	23	23	120	Otosclerosis	31	118
4	57	Right	Unknown[a]	52	38	108	Unknown	58	100
5	88	Left	Unknown	30	30	120	Unknown	12	98
6	42	Left	Unknown	28	15	120	Unknown	35	102
7	72	Left	Pertussis[a]	72	72	110	Unknown	61	105
8	74	Left	Otosclerosis	23	23	122	Otosclerosis	6	112
9	37	Left	Rubella[a]	37	25	120	Rubella[a]	40	102
10	56	Right	Unknown	35	35	122	Head trauma	17	113

PTA, pure-tone average thresholds 500, 1000, and 2000 Hz.
[a]Prelingual hearing loss in that ear.

Boisvert et al., 2012

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Length of Auditory Deprivation

- Study
  - Outcomes were averaged results obtained after implantation
    - 3 speech recognition tests
    - Preferences reported by participants for implant in one ear as compared with the other

Boisvert et al., 2012

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Length of Auditory Deprivation

- Results
  - Independent variables that could be related to SRS obtained with the CI placed in first and second ear
  - Variable most related to outcomes obtained with the CI in either ear: duration of bilateral significant hearing loss ($r=-.57$, $p<0.05$)

Boisvert et al., 2012

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Length of Auditory Deprivation

Table 2 Correlation coefficients of variables that could be related to speech recognition scores obtained with the cochlear implant placed in the first and in the second ear

	SRS	
	First CI	Second CI
Duration auditory deprivation[a]	−0.44	NA
Duration bilateral significant HL	−0.57**	−0.49*
PTA in respective ear	0.15	−0.18
Duration severe HL in respective ear	−0.40	−0.42
Age at CI in respective ear	−0.21	−0.16
Time between CIs	0.01	−0.32
SRS second CI	0.53*	–

CI, cochlear implant; HL, hearing loss; PTA, pure-tone average thresholds 500, 1000, and 2000 Hz; SRS, speech recognition score.

[a]All participants had the first CI in the sound-deprived ear.

*$P<0.10$.

**$P<0.05$.

Boisvert et al., 2012

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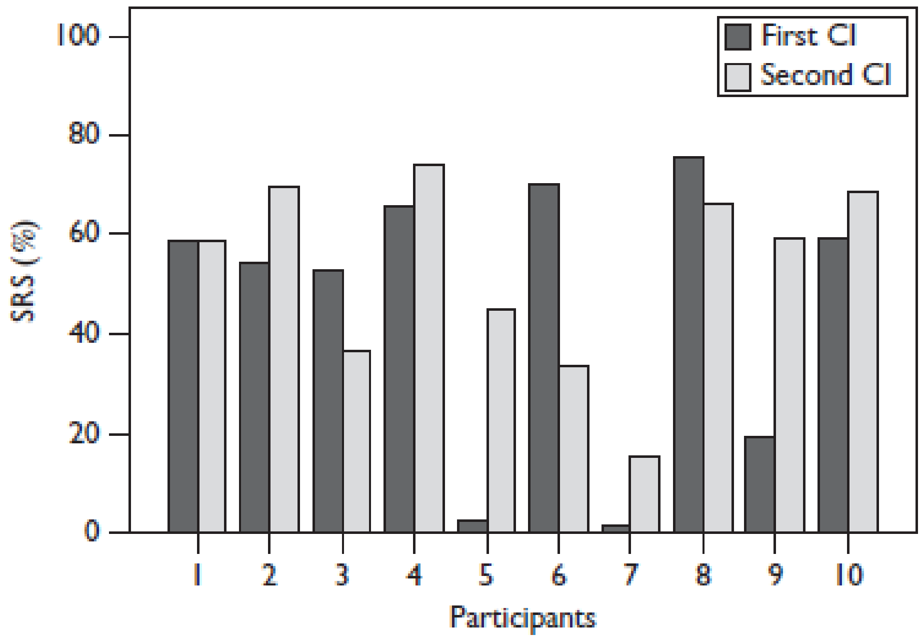
Length of Auditory Deprivation

Fig. 1



Speech recognition score (SRS) obtained by each participant. 1 year after implantation of the first (sound-deprived) and second ear in adults with a long-term monaural sound deprivation who received sequential bilateral implants. CI, cochlear implant.

Boisvert et al., 2012

Length of Auditory Deprivation

- Results
  - Preferences
    - 6/10 participants reported preferring sound quality of first CI, which was placed in auditory-deprived ear
    - 2/10 reported hearing better with first CI
    - 3/10 reported hearing better with second CI
    - 5/10 reported better hearing when both Cis used together

Boisvert et al., 2012

Length of Auditory Deprivation

- Boisvert et al., 2012
  - Conclusions
    - Duration of auditory deprivation, PTA, and duration of severe hearing loss in the implanted ear are not significant predictors of benefits with a CI

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Length of Auditory Deprivation

- Boisvert et al., 2012
  - Proposed explanations
    - Implant devices provide spectral information with relatively low resolution due to current spread within the cochlear
      - May not be necessary for peripheral neurons to be well preserved to convey the information to the central auditory system
    - In unilateral deafness, neural stimulation may occur in the periphery of the sound-deprived ear through efferent fibers that are not significantly affected by auditory deprivation

Length of Auditory Deprivation

- Boisvert et al., 2012
- Choice of ear for cochlear implantation in adults with monaural sound deprivation and unilateral hearing aid

Length of Auditory Deprivation

- Study Design
  - Retrospective matched cohort study
  - Speech recognition results examined in 30 adults with monaural sound deprivation
    - Bilateral hearing loss
    - Minimum 15 years of monaural sound deprivation
  - 15 received implant in sound-deprived ear
  - 15 received implant in aided ear

Boisvert et al., 2012

Length of Auditory Deprivation

TABLE 1. *Age and information about hearing history for each pair of participants*

CI in the sound-deprived ear							CI in the aided ear						
			Duration (yr)[b]							Duration (yr)[b]			
Age (time of tests/time at best SRS)	Onset and/or cause	PTA[a] CI ear	Any HL CI ear	Severe HL CI ear	USD CI ear	BilatSignHL	Age (time of tests /time at best SRS)	Onset and/or cause	PTA [a]CI ear	Any HL CI ear	Severe HL CI ear	USD Contralateral ear	BilatSignHL
56 (6,12, 18,*24)*	Prelingual, viral infection	107	56	≥54	50	25	**59** (6, 12, 24, 36)	Prelingual, unknown, middle ear infections	>98	59	≥19	32	19
59 (3, *12)*	Prelingual (?), heredity, prematurity	>110	≥54	≥54	54	0	**60** (4, 10, *12*)	Prelingual, syndromic.	>107	60	15	60	7
74 (3, 6, 12, *24*)	Trauma	>98	>64	30	30	20	**62** (6, 12, *24*, 36)	Trauma	77	37	4	19	14
82 (6, *9*, 48)	Ménière's, noise induced	>112	42	27	27	2	**70** (6, 12, 18, *24*)	Ménière's	85	10	2	31	2
76 (6, *12*, 24)	Unknown, hereditary (?)	110	26	26	26	10	**75** (3, 6, *12*, 24)	Hereditary	>100	40	10	40	8
69 (6, *12*, 24, 80)	Hereditary	93	39	21	21	5	**59** (6, *12*, 24, 36)	Unknown	98	50	10	18	10
66 (6. *24*)	Ototoxicity, otosclerosis (?)	>110	46	>15	15	0	**59** (6, *12*, 60)	Unknown	83	39	>10	18	0
65 (3, 6, 12, *36)*	Sudden hearing loss, middle ear infections	>115	19	19	19	0	**74** (6, 12, *36*, 60)	Sudden hearing loss	80	4	1	15	1
27 (3, 10, *12*, 24)	Prelingual, unknown	>120	27	27	27	1	**28** (4, 12, *18*)	Prelingual, unknown	106	28	24	28	5
48 (3, 6, *12*, 24)	Prelingual, meningitis	105	47	≥41	41	0	**56** (4, 6, 12, *24*)	Prelingual, viral infection	88	>53	>35	35	0
72 (3, 6, 12, 24)	Multifactorial	103	59	36	36	5	**76** (6, 12, *24*, 36)	Hereditary	>110	70	≥38	38	10
60 (3, 6, *12)*	Otosclerosis (failed stapedectomy)	>120	>38	38	38	0	**48** (3, *12*, 24)	Hereditary	80	38	20	21	1
52 (3, 6, *12*, 30)	Hereditary, middle ear infections	93	37	26	22	0	**65** (6, 12, *24* ,36)	Otosclerosis, middle ear infections	>110	26	12	26	2
71 (6, 12, 24, *36)*	Viral infection	>120	>35	33	33	0	**74** (3, 6, 12, *24*)	Ototoxicity	107	52	33	32	4
76 (3, 6, *12*, 18)	Otosclerosis, (failed stapedectomy)	>120	>38	38	38	0	**79** (4, 12, *24*, 36)	Otosclerosis	110	79	>39	39	0
$\bar{x}$ = 64		$\bar{x}$ = >109	$\bar{x}$ = >42	$\bar{x}$ = >32	$\bar{x}$ = 32	$\bar{x}$ = 5	$\bar{x}$ = 63		$\bar{x}$ = >96	$\bar{x}$ = >43	$\bar{x}$ = >18	$\bar{x}$ = 30	$\bar{x}$ = 6

[a]Pure-tone threshold average, in dB HL, at 500, 1,000, and 2,000 Hz.

[b]Any HL, any hearing loss in CI ear; Bilat Sign HL, bilateral significant hearing loss (very degraded hearing in both ears); CI, cochlear implant; Severe HL, severe hearing loss in CI ear; PTA, pure-tone average; USD, unilateral sound-deprivation (severe hearing loss + no hearing aid use).

SRS indicates speech recognition score.

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Length of Auditory Deprivation

- Outcome Measure
  - Paired comparisons of postoperative monosyllabic word recognition scores obtained:
    - with the implant alone
    - in usual listening condition
      - CI alone
      - CI + hearing aid

Boisvert et al., 2012

Length of Auditory Deprivation

- Results
  - Participants in both groups showed significant improvement of SRS from implantation
  - With use of CI alone, participants implanted in the aided ear perform higher (p=0.01)
  - In usual listening condition, no significant difference between groups (p=0.49)

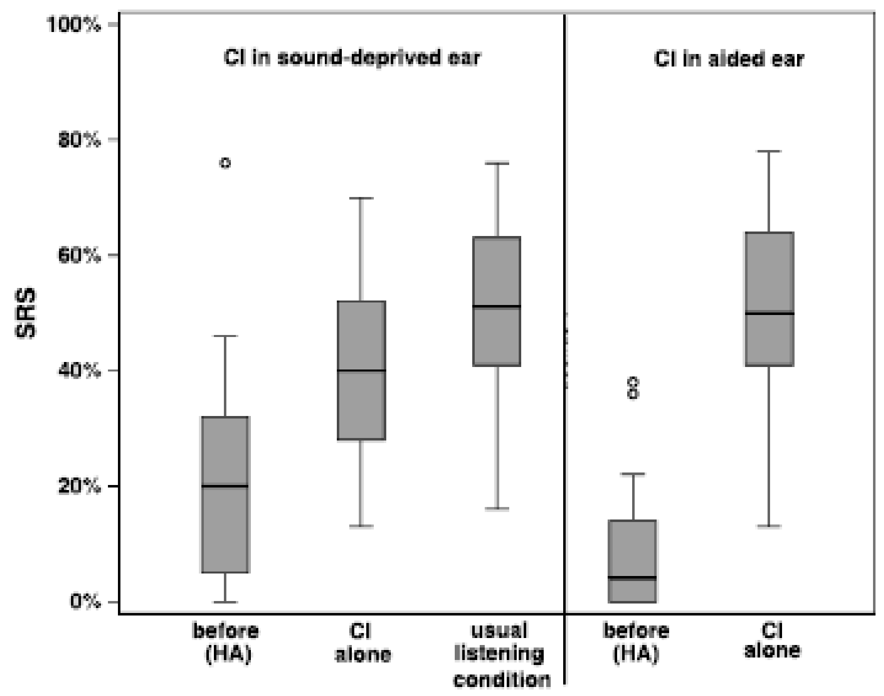

FIG. 1. SRS obtained before and after implantation by individuals who received the implant in the sound-deprived ear, measured with the implant alone and in the usual listening condition, and by individuals who received the implant in the aided ear.

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Length of Auditory Deprivation

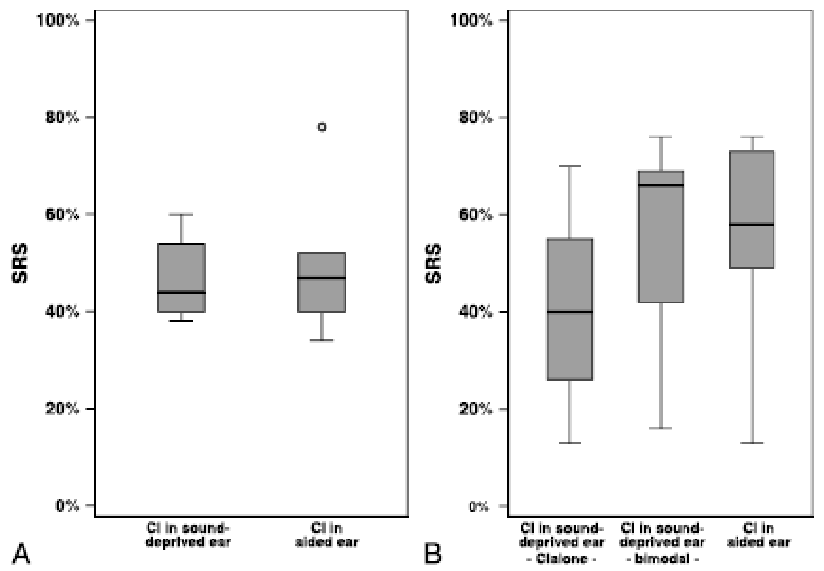

FIG. 2. SRS obtained by individuals who received the implant in a sound-deprived ear and their matched counterpart who received the implant in the aided ear, as a subgroup analysis of individuals implanted in the sound-deprived ear preferring (*A*) the use of the cochlear implant alone, and (*B*) the use of bimodal hearing.

- Results
  - Among participants who preferred using CI alone, no significant difference in scores between groups (p=0.56)
  - Among participants who preferred bimodal hearing, scores were poorer in the participants implanted in the sound deprived ear with CI alone (p=0.03) but results were comparable when SRS was measured in usual listening condition (p=0.74)

Boisvert et al., 2012

Length of Auditory Deprivation

- Conclusions
  - Suggests no significant difference in SRS after implantation in a long-term sound deprived ear compared with implantation in aided ear, when measured in usual listening condition
  - When results are measured with CI alone, poorer results in individuals implanted in sound deprived ear
    - May be related to unfamiliarity of CI alone condition for patients who regularly use bimodal hearing
  - Even with long-term monaural sound deprivation, implanting the deprived ear can achieve good outcomes if hearing aid is used in contralateral ear

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Length of Auditory Deprivation

- Boisvert thesis, 2012
  - Results:
    - For postlingual hearing loss:
      - similar outcomes with implant placed in sound-deprived or aided ear
      - Regardless of duration of sound deprivation in implanted ear
    - For prelingual hearing loss:
      - Poorer outcomes with CI in sound-deprived ear

Length of Auditory Deprivation

- Boisvert thesis, 2012
  - Results:
    - Duration of bilateral significant hearing loss appears to be the most reliable predictor of implantation outcomes in sound-deprived ear

Length of Auditory Deprivation

- Boisvert thesis, 2012
  - Conclusion
    - Perhaps, duration of sound deprivation in the implanted ear should not be considered as a relevant variable for clinical decision-making with regards to speech recognition score outcomes
    - In prelingually deafened patients, implanting the ear with longer duration of sound-deprivation may lead to poorer oucomes

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Length of Auditory Deprivation

- Boisvert thesis, 2012
  - Conclusion
    - Perhaps, duration of sound deprivation in the implanted ear should not be considered as a relevant variable for clinical decision-making with regards to speech recognition score outcomes

Summary

- Contraindications to selecting a particular ear
  - Aplasia of the cochlea or cochlear nerve
- Previously held tenets of ear selection include:
  - Choose the worse hearing ear
  - Choose the better hearing ear
  - Choose the ear with worse vestibular function
  - Choose the ear with shorter auditory deprivation

Summary

- Lack of strong evidence supporting these tenets

- Outcomes tend to be worse when there is significant *bilateral* hearing loss

  – Contribution of central processes may be more important in determining functional outcomes of cochlear implantation than the weaknesses or strengths of the ear-to-be-implanted

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