Cochlear Implant Outcomes

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

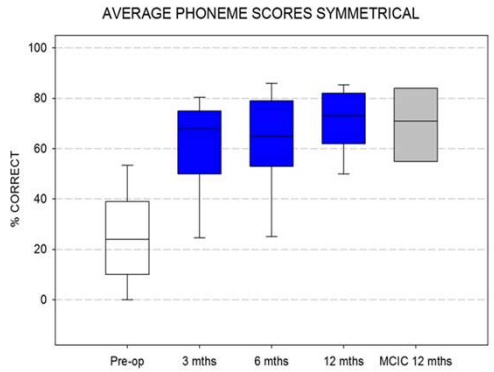
Learning objectives

1. Describe outcomes your client might expect with a Cochlear Implant
2. Outline why your client's Cochlear Implant experience might not be meeting their expectations

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

© Ear Science Institute Australia 2023

What speech perception outcomes should we expect?



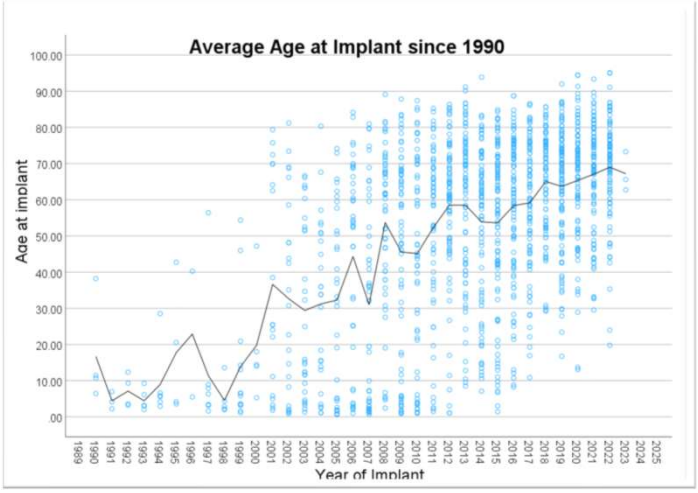
Multicenter analysis

- 3 large CI centers: ESIA, VUMC, and MHH
- 2,735 CI users

- Multivariate analysis explains 13-21% of variance in post-op speech scores
- Greater the HL in the implant ear, poorer outcomes
- Prelingual HL results in poorer outcomes than post-lingual
- Higher pre-op speech perception results in better outcomes post-op
- Right ear CI better outcomes than left ear
- Greater age at implant – significant but mildly associated poorer outcomes post-op
- Native speakers achieve better outcomes than non-native speakers
- Aetiology
  - Meningitis – poorer outcomes post-op
  - Meniere's – better outcomes post-op

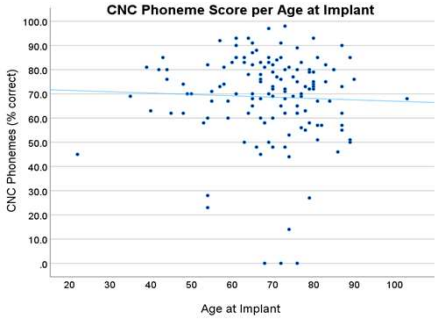
- Goudey et al. MultiCenter Analysis of Factors Associated with Hearing Outcome for 2,735 Adults with Cochlear Implants. Trends Hear. 2021 Jan-Dec;25:23312165211037525. doi: 10.1177/23312165211037525.

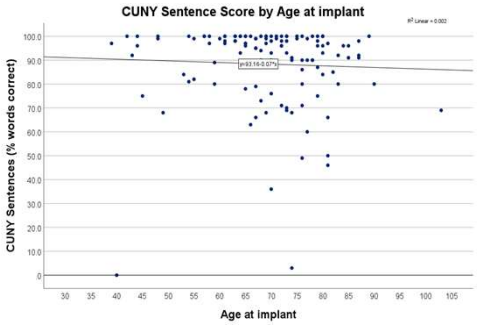
Changes in age of implant over time



© Ear Science Institute Australia 2023

Does age at implant influence speech perception outcomes?

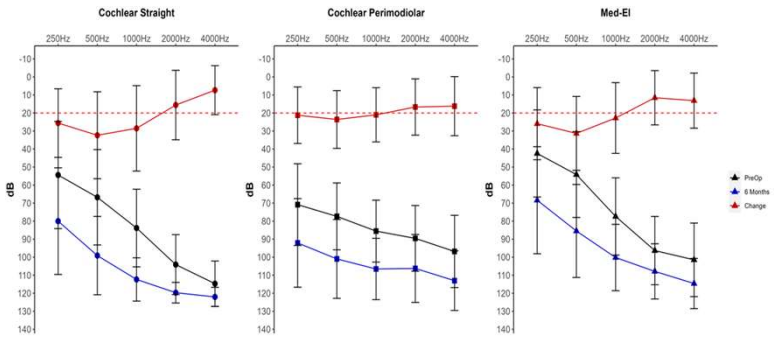




Older CI users **do see significant improvements in hearing** post-implantation, however they may not do quite as well as recipients implanted at a younger age.

- *Schafer et al. Meta-Analysis of Speech Recognition Outcomes in Younger and Older Adults With Cochlear Implants. Am J Audiol. 2021 Sep 10;30(3):481-496. doi: 10.1044/2021_AJA-20-00141.*
- *Zhao et al. Association of Patient-Related Factors With Adult Cochlear Implant Speech Recognition Outcomes: A Meta-analysis. JAMA Otolaryngol Head Neck Surg. 2020;146(7):613–620. doi:10.1001/jamaoto.2020.0662*
- Goudey et al. MultiCenter Analysis of Factors Associated with Hearing Outcome for 2,735 Adults with Cochlear Implants. Trends Hear. 2021 Jan-Dec;25:23312165211037525. doi: 10.1177/23312165211037525.

What about hearing preservation?



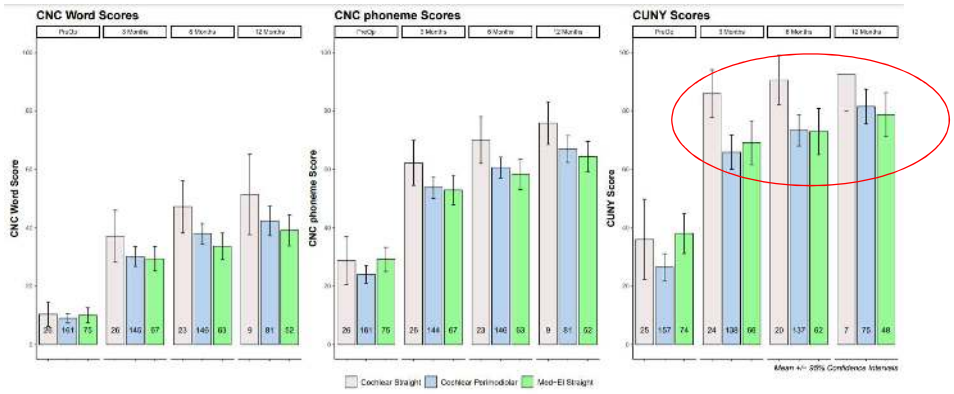
For the newest electrode styles, in most studies there is an average drop in hearing of around 20-30 dB following implantation

6-month review data

Sturm et al. Comparative Performance of Lateral Wall and Perimodiolar Cochlear Implant Arrays. Otology & Neurotology 42(4):p 532-539, 2021. | DOI: 10.1097/MAO.0000000000002997
Sharma et al. Speech Recognition Performance Differences Between Precurved and Straight Electrode Arrays From a Single Manufacturer. Otol Neurotol. 2022. 43(10):1149-1154. doi: 10.1097/MAO.0000000000003703.

© Ear Science Institute Australia 2023

Mean speech perception outcomes for CI recipients with pre-op low frequency hearing

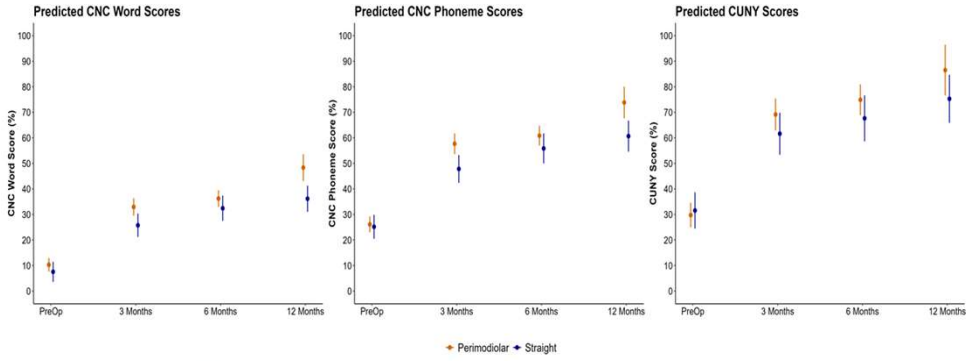


EAR SCIENCE Institute Australia

EAR SCIENCE Implant Clinic

Sturm et al. Comparative Performance of Lateral Wall and Perimodiolar Cochlear Implant Arrays. Otology & Neurotology 42(4):p 532-539, 2021. | DOI: 10.1097/MAO.0000000000002997
Sharma et al. Speech Recognition Performance Differences Between Precurved and Straight Electrode Arrays From a Single Manufacturer. Otol Neurotol. 2022. 43(10):1149-1154. doi: 10.1097/MAO.0000000000003703.

Predicted speech perception outcomes accounting for age and pre-op hearing level: perimodiolar and straight electrodes?



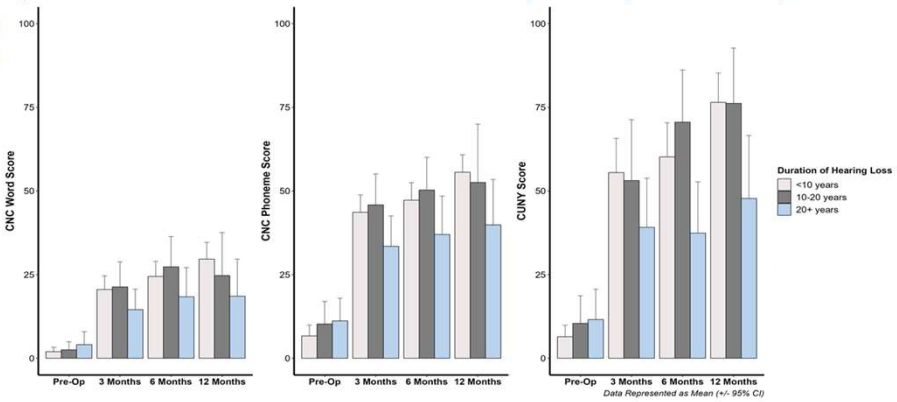
EAR SCIENCE Institute Australia

EAR SCIENCE Implant Clinic

Sturm et al. Comparative Performance of Lateral Wall and Perimodiolar Cochlear Implant Arrays. Otology & Neurotology 42(4):p 532-539, 2021. | DOI: 10.1097/MAO.0000000000002997
Sharma et al. Speech Recognition Performance Differences Between Precurved and Straight Electrode Arrays From a Single Manufacturer. Otol Neurotol. 2022. 43(10):1149-1154. doi: 10.1097/MAO.0000000000003703.

© Ear Science Institute Australia 2023

Does duration of HL influence speech perception outcomes for people implanted for S



EAR SCIENCE Institute Australia

EAR SCIENCE Implant Clinic

But what do the recipients think?

Hearing Performance[1] % satisfied or very satisfied (n=95)	Bilateral hearing aids	Smart bimodal hearing solution (Nucleus 7 Sound Processor & compatible ReSound hearing aid*)
Hearing performance	9%	95%
Hearing performance in background noise	2%	58%
Ability to understand conversations in a small group	8%	79%
Ability to understand people on the phone	6%	71%
Ability to listen to and appreciate music	13%	68%
Ability to understand what is said on TV	13%	76%

1. Preliminary data on file: Clinical evaluation of the Cochlear Nucleus® CI532 cochlear implant in adults (CLTD5685). 2019, Jan. [Sponsored by Cochlear].

EAR SCIENCE Institute Australia

EAR SCIENCE Implant Clinic

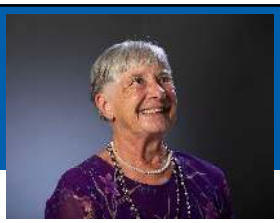
© Ear Science Institute Australia 2023

Case studies

19 February 2023

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

Case Study 1: 78 year old female



Background information:

- Onset approximately 20 years ago. Vision and hearing started to deteriorate at the same time
- Legally blind now
- Cause of hearing loss uncertain, loud noise trauma, had an infection a few years ago, antibiotics
- Right ear always worse
- Slow progressive bilateral hearing loss
- Hearing aid on right initially to suppress tinnitus, stopped wearing as it no longer suppressed the tinnitus
- Diabetic and high blood pressure

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

© Ear Science Institute Australia 2023

Hearing Assessment : Pre-op

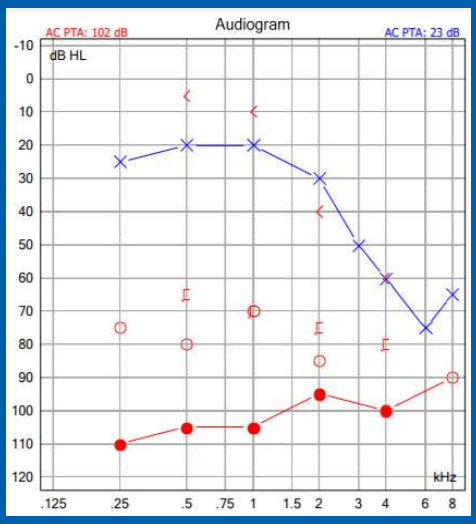
Otoscopy
Right: Clear
Left: Clear

Tympanometry

	TYPE	Canal Vol (mL)	Compl (mL)	PRES (daPa)
Right	A	2.1	1.2	-2
Left	A	2.1	1.3	-11

Speech table

Material AB WORDS						
Ear	Left	Left	Right			
Level dBHL/SPL	50dB	55dB	105dB			
%	84%	91%	0%			



EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

Case Study 1 cont.

- Balance: No concerns
- General health: Diabetes and high blood pressure, under control
- Visual impairment: legally blind
- Very good family support from daughter and son-in-law
- Telephone use: Uses speakerphone on the left ear and finds it difficult at times
- Amplification History:
  - Aided left ear only
  - Wore a right hearing aid until a few months ago
  - Trialed a BiCROS, unsuccessful

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

© Ear Science Institute Australia 2023

Hearing Assessment: Aided Speech Perception (Pre-op)

CNC Words - In Quiet

Listening Condition Recorded 65 dB SPL	Pre-Op 26/2/2021	
	Words	Phonemes
R + L	DnT	DnT
R	0 %	0 %
L	84 %	93 %

CUNY Sentences - In Quiet

Listening Condition Recorded 65 dB SPL	Pre-Op 26/2/2021
R + L	DnT
R	0 %
L	100 %

BKB-SIN - Sentences in Noise (speech and noise to the front)

Condition	Pre-Op (dB SPL) 26/2/2021
Left Device: Hearing Aid (Own) Right Device: Unaided	17 dB S:N

(NB: SNR-50 mean value for a normal hearing adult is -2.5 with SD of 0.8)

BKB-SIN - Sentences in Noise (speech and noise spatially separated)

Condition	Pre-Op (dB SPL) 26/2/2021
Left Device: Hearing Aid (Own) Right Device: Unaided	21 dB S:N

(NB: SNR-50 mean value for a normal hearing adult is -2.5 with SD of 0.8)

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

COSI Goals

- To hear better when she is with a group of people especially at the lunch or dinner table
- To hear her daughter better, especially when she turn around and walks away while talking
- To hear better when they play Bingo, she can't hear them calling the numbers
- To hear better on a bus with background noise

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

© Ear Science Institute Australia 2023

Questions from Audiologist

- **What concerned me is when I blocked her good ear with impression material, she could not hear very well at all which has not been the case with some other clients with Cochlear Implants**
- **I have another client who would have had no trouble hearing me with the non-implant ear blocked**
- **The client reports not hearing anything but "a racket" with her Cochlear Implant**

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

Questions: Management and outcome

How can we support the Audiologist with their concerns?

- Where can the Audiologist find information on her client's progress with her cochlear implant?
- Possible reasons for client's report of limited benefit?
- How can you as the Audiologist counsel or support the client?

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

© Ear Science Institute Australia 2023

Hearing Assessment: Aided Speech Perception (Post-op)

CNC Words in Quiet

Listening Condition Recorded 65 dB SPL	Pre-Op 26/2/2021		Post-Op 3 Mth 5/11/2021		Post-Op 6 Mth 14/1/2022		Post-Op 12 Mth 12/10/2022	
	Words	Phonemes	Words	Phonemes	Words	Phonemes	Words	Phonemes
R + L	DnT	DnT	80 %	93 %	88 %	95 %	DnT	DnT
R	0 %	0 %	8 %	41 %	16 %	40 %	56 %	81 %
L	84 %	93 %	DnT	DnT	DnT	DnT	84 %	94 %

CUNY - Sentences in Quiet

Listening Condition Recorded 65 dB SPL	Pre-Op 26/2/2021	Post-Op 3 Mth 5/11/2021	Post-Op 6 Mth 14/1/2022	Post-Op 12 Mth 12/10/2022
R + L	DnT	100 %	100 %	DnT
R	0 %	49 %	45 %	75 %
L	100 %	DnT	DnT	100 %

BKB/SIN - Sentences in Noise
Speaker Orientation: 0 : 0

Condition	Pre-Op (dB SPL) 26/2/2021	Post-Op 3 Mth (dB SPL) 5/11/2021	Post-Op 6 Mth (dB SPL) 14/1/2022	Post-Op 12 Mth (dB SPL) 12/10/2022
Left Device: Hearing Aid (Own) Right Device: Cochlear Implant	DnT	6 dB S:N	5 dB S:N	7.5 dB S:N
Left Device: Hearing Aid (Own) Right Device: Unaided	17 dB S:N	DnT	DnT	DnT

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

Case Study 2: 41 year old mal

Background information:

- Self referral after attending a cochlear implant picnic with his dad who has bilateral implants
- Strong family history of hearing loss
- Onset age 13, gradual deterioration. Last 5 years been the worst
- Significant tinnitus
- No medical concerns, no balance issues
- Farmer – significant moisture exposure working on the farm
- Concerns about losing residual hearing

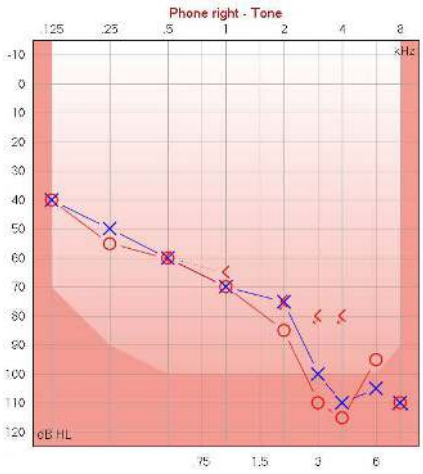
EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

© Ear Science Institute Australia 2023

Hearing Ass: Pre-op

Speech table

Material: AB words						
Ear	R	R	R	L	L	
Level dBHL/SPL	100	110	105	100	105	
%	63%	too loud	70%	63%	87%	



Hearing Assessment: Speech testing Pre-op

CNC Words in Quiet

Listening Condition Recorded 65 dB SPL	Pre-Op 22/2/2017	
	Words	Phonemes
R + L	20 %	65 %
R	30 %	47 %
L	35 %	55 %

CUNY - Sentences in Quiet

Listening Condition Recorded 65 dB SPL	Pre-Op 22/2/2017
R + L	91 %
R	66 %
L	93 %

BKB/SIN - Sentences in Noise
Speaker Orientation: 0 : 0

Condition	Pre-Op (dB SPL) 22/2/2017
Left Device: Hearing Aid (Own) Right Device: Cochlear Implant	DnT
Left Device: Unaided Right Device: Electro-Acoustic Stimulation	DnT
Left Device: Hearing Aid (Own) Right Device: Electro-Acoustic Stimulation	DnT
Left Device: Hearing Aid (Own) Right Device: Hearing Aid (Own)	9.5 dB S:N

© Ear Science Institute Australia 2023

COSI Goals

To increase ability to hear when out with friends socially, become more active socially

To hear what 2.5 year old son is saying and to understand him better

To be able to hear the TV and telephone better

To hear better on the farm in the presence of background noise

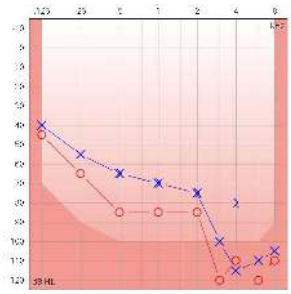
EAR SCIENCE Implant Clinic

EAR SCIENCE Institute Australia

Management

- Discussed at MDT monthly meeting
- Fit the EAS candidacy criteria
- Implanted on the right side in Sept 2017
- Significant post operative residual hearing, suitable for acoustic fitting

9 months post surgery



EAR SCIENCE Implant Clinic

EAR SCIENCE Institute Australia

© Ear Science Institute Australia 2023

Client report following implantation with Electric-Acoustic implant

Client reports the following after 6 months:

- Very frustrated with the sound, poor quality, speech clarity limited
- Can't distinguish voices, just a noise
- Hearing bubbling noises like a fish tank
- Lots of issues with moisture and broken devices
- Cannot hear on the telephone

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

Questions Management and Outcomes

- **How will you counsel this client?**
- **What information do you need?**
- **What about streaming options and bimodal fitting options?**
- **Counselling with regards to device maintenance, moisture control?**

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

© Ear Science Institute Australia 2023

Hearing Assessment: Aided Speech Perception (Post-op)

CNC Words in Quiet

Listening Condition Recorded 65 dB SPL	Pre-Op 22/2/2017		Post-Op Non-review 1/11/2017		Post-Op 3 Mth 12/12/2017		Post-Op 6 Mth 20/3/2018		Post-Op 12 Mth 18/12/2018		Post-Op Non-review 4/10/2021	
	Words	Phonemes	Words	Phonemes	Words	Phonemes	Words	Phonemes	Words	Phonemes	Words	Phonemes
R + L	20 %	65 %	60 %	83 %	48 %	69 %	DnT	DnT	76 %	89 %	80 %	90 %
R	30 %	47 %	52 %	77 %	12 %	29 %	36 %	56 %	60 %	80 %	72 %	82 %
L	35 %	55 %	DnT	DnT	DnT	DnT	DnT	DnT	36 %	62 %	16 %	29 %

CUNY - Sentences in Quiet

Listening Condition Recorded 65 dB SPL	Pre-Op 22/2/2017	Post-Op 3 Mth 12/12/2017	Post-Op 6 Mth 20/3/2018	Post-Op Non-review 4/10/2021
R + L	91 %	96 %	DnT	100 %
R	66 %	82 %	92 %	100 %
L	93 %	DnT	DnT	67 %

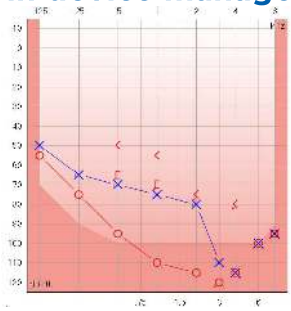
BKB/SIN - Sentences in Noise
Speaker Orientation: 0 : 0

Condition	Pre-Op (dB SPL) 22/2/2017	Post-Op 3 Mth (dB SPL) 12/12/2017	Post-Op 6 Mth (dB SPL) 20/3/2018	Post-Op 12 Mth (dB SPL) 18/12/2018	Post-Op Non-review (dB SPL) 4/10/2021
Left Device: Hearing Aid (Own) Right Device: Cochlear Implant	DnT	DnT	DnT	7.5 dB S:N	8.5 dB S:N
Left Device: Unaided Right Device: Electro-Acoustic Stimulation	DnT	DnT	6.5 dB S:N	DnT	DnT
Left Device: Hearing Aid (Own) Right Device: Electro Acoustic Stimulation	DnT	11.5 dB S:N	DnT	DnT	DnT
Left Device: Hearing Aid (Own) Right Device: Hearing Aid (Own)	9.5 dB S:N	DnT	DnT	DnT	DnT

EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

Final outcome to date

- **3 years post surgery**
- **Interested in second side implant, report excellent hearing from cochlear implantation the right side**
- **Significant improvement in device management**



EAR SCIENCE Implant Clinic
EAR SCIENCE Institute Australia

© Ear Science Institute Australia 2023