Cochlear Implant in Older Patients

HEALTH UNIVERSITY OF UTAH

Thoughts by
Richard K. Gurgel, MD, MSCI

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DISCLOSURES

- NIH/NIA R03 GEMSSTAR grant
- Surgical Advisory Board
  - Med-El
- Institutional Research Support
  - Cochlear Corp
  - Advanced Bionics

2

OVERVIEW

- Unique medical surgical aspects in older adults
  - Candidacy
  - Screening
- Cochlear implants and cognition
- Cochlear implants and QoL

3

CASE PRESENTATION

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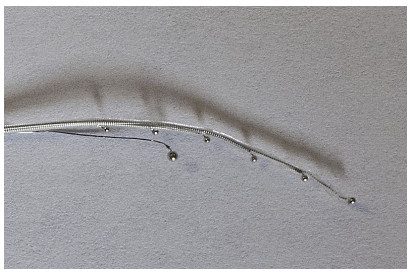
INERAID MULTICHANNEL COCHLEAR IMPLANT



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Laryngoscope 98: March 1988

MULTICHANNEL COCHLEAR IMPLANTATION: UTAH-DESIGN*†§

JAMES L. PARKIN, MD, MS
BRUCE EDWIN STEWART, MD
Salt Lake City, UT

ABSTRACT

The Utah-design multichannel cochlear implant consists of six intracochlear monopolar electrodes, one promontory electrode, and an indifferent electrode. Connection of the intracochlear system to the external sound processor is via a percutaneous pedestal system. Four of the intracochlear electrodes receive simultaneous stimulation. Twenty patients implanted at the University of Utah with more than 1 year of sound processor use were evaluated for the study. All patients wear their sound processors on a daily basis. Seven of the 20 are able to use the telephone without special devices. Nineteen patients were tested with open set CID sentences with an average 42.5% response. A comparison was made between live voice and taped voice open-set spondee word list performance, showing slightly better overall performance with live voice.

Four patients were implanted with the Utah-design multichannel cochlear implant between 1975 and 1977. Between 1977 and 1984, sound processing strategies and microengineering design led to the development of the current device. Between April 1984 and September 1986, 23 additional patients have been implanted. The cochlear implant utilized consists of six monopolar intracochlear electrodes, one promontory electrode, and one indifferent elec-

month intervals for testing, trouble shooting, and question answering.

The patients qualify for cochlear implantation by meeting the following criteria: adult, postlingually deaf, pure tone averages of 90 dB or greater, no measurable speech discrimination ability by auditory input, no measurable speech benefit with a hearing aid, patent cochlea by CT scan, medical clearance for surgery, psychological clearance for participation,

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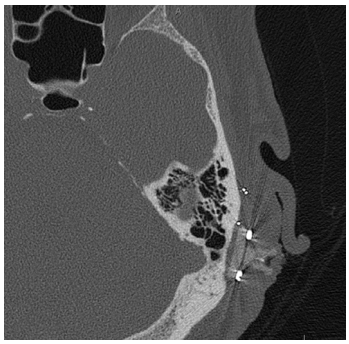
CASE PRESENTATION



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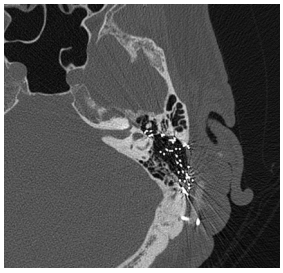
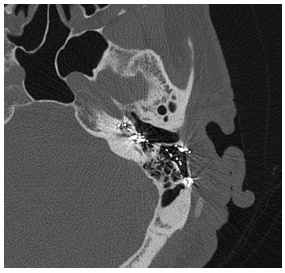
INERAID





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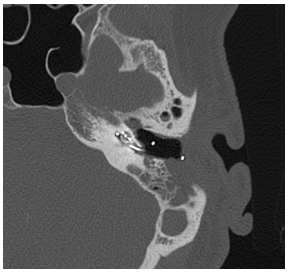
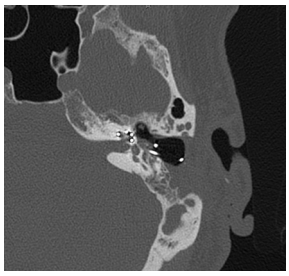
MED-EL STANDARD ELECTRODE (31MM)





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HAPPY PATIENTS

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HOW DO I KNOW WHO IS A CI CANDIDATE?

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TYPICAL CANDIDATES

- Post-lingually deafened adults
  - Age, noise, genetic, toxins
  - Medicare – speech testing <40% (AzBio, can test in noise), 70dB pure tone average or worse

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SCREENING

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Annals of Internal Medicine | CLINICAL GUIDELINE

Screening Adults Aged 50 Years or Older for Hearing Loss: A Review of the Evidence for the U.S. Preventive Services Task Force

Roger Chou, MD; Tracy Dana, MLS; Christina Bougatsos, BS; Craig Fleming, MD; and Tracy Beil, MS

- US Preventative Service Task Force:
  - Screening increased hearing aid use at 1 year post-screen
  - Did not show improved hearing-related function
- Limitations:
  - 1 randomized controlled trial (SAI-WHAT)
  - 50 y/o+, VA, mainly men

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Age-Related Hearing Loss Measurement Set

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QUALITY MEASURE #1

Patients who were screened for hearing loss

All patients age 60 years and older.

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SCREENING

- Clinical tests (e.g., detection of a whispered voice, finger rub, or watch tick), a single question (e.g., "Do you have difficulty with your hearing?")
- questionnaires (e.g., Hearing Handicap Inventory for Elderly-Screening (HHIE-S))
- Online screening
- NHANES survey questions
- Handheld audiometric devices (e.g., the AudioScope)

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QUALITY MEASURE #2

Patients who either received, were ordered, or were referred for comprehensive audiometric testing.

All patients who failed screening

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QUALITY MEASURE

Patients or their caregiver(s) who participated in shared decision making (SDM) regarding treatment options for symmetric sensorineural hearing loss.

All patients age 60 years and older with a diagnosis of symmetric sensorineural hearing loss.

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CMS SUBMISSION

- Submitted Centers for Medicare & Medicaid Services for the 2018 Qualified Clinical Data Registry
- 3 approved, with the screening measure not approved as a stand-alone measure.
- After a year of testing in the Reg-ent registry with data pulled from electronic health records, modifications were necessary to capture the necessary data.
- Subsequent consultation with the CMS Center for Clinical Standards and Quality resulted in modifications that would meet CMS measure requirements for the 2019 Qualified Clinical Data Registry.

Reg-ent
ENT CLINICAL DATA REGISTRY

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SURGICAL CANDIDACY

- How old is too old?

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SURGICAL CANDIDACY

- How sick is too sick?
  - Medical conditions that are contraindicated for surgery
  - Uncontrolled CHF, Pulm HTN, hospice, advanced staged cancer
  - Need to be able to get pre-operative clearance
  - Frailty

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UNIQUE CONSIDERATIONS

- Medical issues
- Thin skin – healing?
- Anti-coagulation
- Audiology – activation, managing technology

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ANTICOAGULATION

Original Research—Otology and Neurotology

Cochlear Implantation in the Setting of Perioperative Anticoagulation and Antiplatelet Therapy

Jacob B. Hunter, MD[1], Matthew L. Carlson, MD[2], Alex D. Sweeney, MD[1], Nicole M. Tombers, RN[2], George B. Wanna, MD[1], Colin L. W. Driscoll, MD[2], and David S. Haynes, MD[1]

FOUNDATION
Otolaryngology—Head and Neck Surgery
2016, Vol. 154(3) 513–517
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DOI: 10.1177/0194599815621738
http://otojournal.org
SAGE

Table 1. Patients Who Continued Antithrombotic Therapy during Cochlear Implantation.

Therapy	Patients, n
Aspirin	29
Aspirin and warfarin	5
Warfarin	4
Aspirin and clopidogrel	4
Clopidogrel	2
Subcutaneous heparin	1
Aspirin, clopidogrel, warfarin	1
Total	46

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CI in Older Adults

- Only 5-10% of adult cochlear implant candidates in the US have received cochlear implants
- Average delay from time of profound ARHL to CI is 10 years
- Fastest growing segment of CI users = older adults

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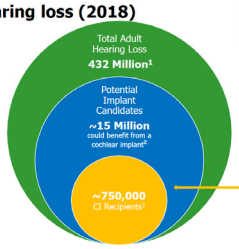
Global Adult Hearing loss (2018)

Delphi Consensus Meeting
Cochlear Implant Use
Los Angeles
30 March 2019



~ 5% penetration

1. World Health Organization. Over 5% of the world's population – or 466 million people – has disabling hearing loss (432 million adults and 34 million children). It is estimated that by 2050 over 900 million people – or one in every ten people – will have disabling hearing loss. Available from: http://www.who.int/features/factfiles/deafness/en/
2. Cochlear internal data
3. Market penetration estimate based on Cochlear sourced data.

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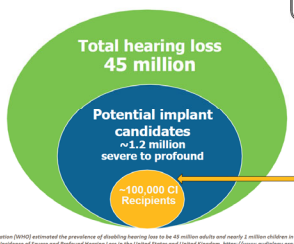
U.S Adult Hearing loss (2018)

Delphi Consensus Meeting
Cochlear Implant Use
Los Angeles
30 March 2019



~8.4% penetration

1. In 2018, the World Health Organization (WHO) estimated the prevalence of disabling hearing loss to be 45 million adults and nearly 1 million children in the United States (WHO, 2018).
2. American Academy of Audiology. Incidence of Severe and Profound Hearing Loss in the United States and United Kingdom. https://www.audiology.org/news/incidence-severe-and-profound-hearing-loss-united-states-and-united-kingdom
3. Market penetration estimate based on Cochlear sourced data.

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Otology & Neurotology
39:e660–e664 © 2018, Otology & Neurotology, Inc.

Evolving Trends in Cochlear Implantation: A Critical Look at the Older Population

*Bora Agabigum, *Ahsan Mir, *Khashayar Arianpour, *Peter F. Svider, †Erika M. Walsh, and *†Robert S. Hong

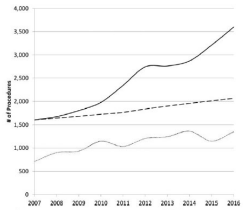

FIG. 1. Number of billed cochlear implant (CI) (*solid line*), bone-anchored implants (*fine-dashed*) procedures nationally, and CI growth projection (*long-dash line*).

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Otology & Neurotology
31:1343–1349 © 2010, Otology & Neurotology, Inc.

Cochlear Implantation in the Octogenarian and Nonagenarian

Matthew L. Carlson, Joseph T. Breen, Rene H. Gifford, Colin L. W. Driscoll, Brian A. Neff, Charles W. Beatty, Anna Mary Peterson, and Amy P. Olund

Department of Otolaryngology Head and Neck Surgery, Mayo Clinic School of Medicine, Rochester, Minnesota, U.S.A.

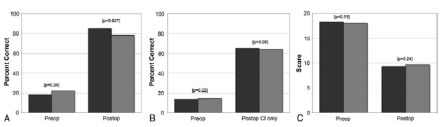

FIG. 3. Preoperative and postoperative (≥6 mo) audiometric results using AzBio (*A*), CNC (*B*), and BKB-SIN testing (*C*) among patients between the ages of 18 and 79 years (*black*) compared with those 80 years or older (*gray*).

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Original Study

Postoperative Healthcare Utilization of Elderly Adults After Cochlear Implantation

Mallory J. Raymond, Andy Dong, Samir Ballestas Naissir, and Esther X. Vivas

Department of Otolaryngology–Head and Neck Surgery, Emory University School of Medicine, Atlanta, Georgia

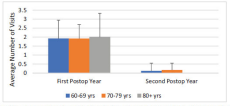

FIG. 1. Comparison of the average number of surgical visits in the first and second postoperative year between patients aged 60 to 69, 70 to 79, 80+ years.

Otology & Neurotology, Vol. 41, No. 2, 2020

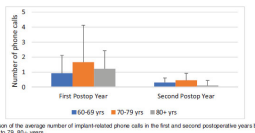

FIG. 3. Comparison of the average number of implant-related phone calls in the first and second postoperative years between patients aged 60 to 69, 70 to 79, 80+ years.

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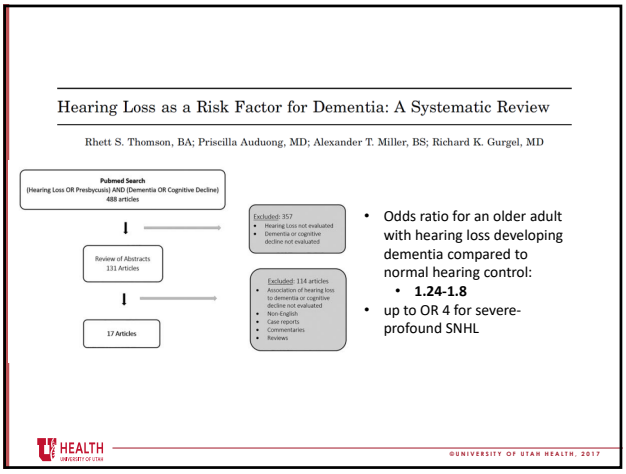

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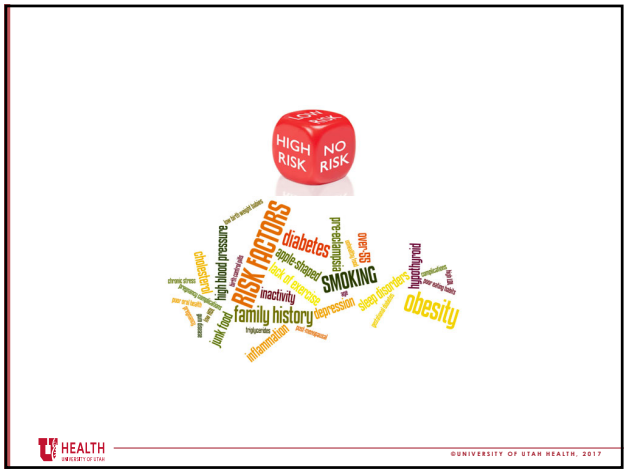

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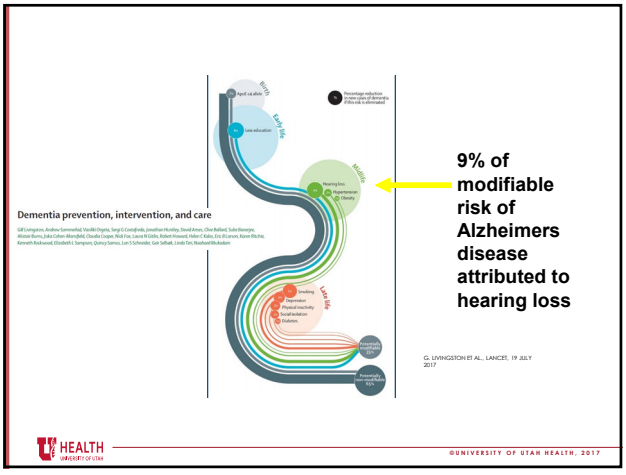

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- 94 patients
- Ave. age 72, range, 65-85 years; median, 71 years
- Neurelec, 29 patients MED-EL, 26; Cochlear, 23; andAdvanced Bionics, 17

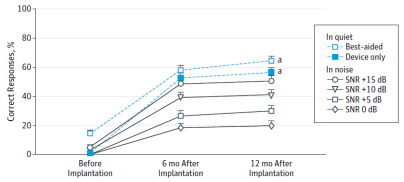

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Table 2. Effect of Cochlear Implantation on Mean Cognitive Test Scores in 94 Patients

Cognitive Test	Before, Mean (SD)	Group (No.)[a]	6-mo Mean (SD)	Differences, Mean (95% CI)	P Value[b]	12-mo Mean (SD)	Differences, Mean (95% CI)	P Value[b]
MMSE	22.1 (3.4)	Abnormal (13)	25.8 (2.7)	3.7 (0.6 to 6.8)	.02	26.3 (2.7)	3.8 (1.0 to 6.6)	.01
	27.8 (1.7)	Normal (81)	27.9 (1.8)	0.04 (−0.4 to 0.5)	.85	28 (1.8)	0.2 (−0.3 to 0.6)	.45
FWT[c]	8.2 (3.2)	Abnormal (22)	9.6 (0.1)	1.4 (0.5 to 2.3)	.004	9.4 (0.7)	1.3 (0.6 to 1.9)	<.001
	10.0 (0.0)	Normal (72)	9.7 (0.1)	−0.4 (−0.6 to −0.1)	.002	9.7 (0.8)	−0.7 (−0.7 to −0.2)	.002
Clock-drawing test[d]	2.5 (0.6)	Abnormal (4)	3.3 (0.6)	0.7 (−0.8 to 2.1)	0.18	4 (2.6)	1.3 (−6.3 to 9.0)	.53
	6.1 (0.9)	Normal (90)	6.1 (1.0)	0 (−0.3 to 0.3)	1.0	6.3 (0.9)	0.2 (0.03 to 0.4)	.046
d2 Test (errors)[e]	27.7 (9.0)	Abnormal (11)	21.0 (14.6)	−6.6 (−18.3 to 5.0)	.23	9.4 (7.1)	−18.3 (−25.3 to −11.3)	<.001
	6.2 (4.7)	Normal (80)	6.2 (6.2)	−0.2 (−1.8 to 1.4)	.82	5.7 (5.6)	−0.6 (−2.1 to 0.8)	.37
d2 Test of attention (speed)[e]	276 (62.8)	Abnormal (39)	321 (79.0)	46.4 (13.0 to 79.8)	.008	342 (81.7)	60.1 (30.5 to 89.6)	<.001
	429 (81.2)	Normal (52)	411 (82.0)	−19.3 (−44.4 to 4.7)	.11	409 (76.5)	−19.6 (−42.8 to 3.6)	.09
TMT-A[f]	77.3 (43.0)	Abnormal (19)	60.2 (14.1)	−17.9 (−39.7 to 3.8)	.09	52.2 (11.3)	−25.1 (−46.3 to −3.9)	.02
	41.8 (10.9)	Normal (74)	43.1 (12.8)	0.01 (−2.1 to 2.2)	.99	44.1 (12.6)	1.2 (−1.9 to 4.4)	.43
TMT-B[f]	181 (56.0)	Abnormal (23)	152 (64.7)	−29.5 (−55.9 to −3.9)	.03	142 (65.9)	−32.5 (−61.5 to 3.6)	.03
	105 (33.9)	Normal (68)	106 (41.2)	2.7 (−5.9 to 11.3)	.52	111 (46.7)	4.9 (−4.6 to 14.5)	.30

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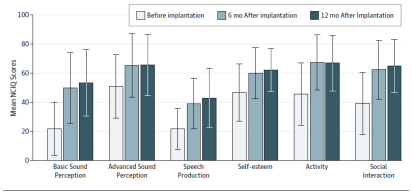
Figure 3. Mean Scores of the 6 Subdomains of the Nijmegen Cochlear Implant Questionnaire (NCIQ) Before and After Cochlear Implantation



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Journal of Clinical Medicine

MDPI

Review

Does Treating Hearing Loss in Older Adults Improve Cognitive Outcomes? A Review

Hélène Amieva * and Camille Ouvrard

Inserm U1219 Bordeaux Population Health Center, Université de Bordeaux, 33076 Bordeaux, France; camille.ouvrard-brouilloud@u-bordeaux.fr

* Correspondence: Helene.Amieva@u-bordeaux.fr

J. Clin. Med. 2020, *9*, 805

Table 2. Main studies assessing the association between cochlear implantation in older adults and cognitive outcomes.

Study	Length Follow-Up after Cochlear Implantation	Sample Size	Cognitive Tools	Main Result
Cruy et al. 1982 [63]	1 year	46	WAIS, Graham–Kendall Memory for Designs, TMT, Bender Visual Motor Gestalt	Improved performance in a subsample of participants by descriptive data only
Castiglione et al. 2015 [65]	1 year	15	MOCA	Improved performance
Mosnier et al. 2015 [66]	1 year	94	MMSE, Five-Word Test, Clock drawing test, d2 test of attention, TMT	Improved performance
Cosetti et al. 2016 [67]	3.7 years in average	7	WAIS, TMT, controlled oral word association test, Boston naming test, RBANS	Improved performance reported in some participants by descriptive data only
Ambert-Dahan et al. 2017 [68]	1 year	18	CODEX, MOCA	Improved performance reported in some participants by descriptive data only
Jayakody et al. 2017 [69]	1 year	39	CANTAB	Improved performance
Sonnet et al. 2017 [70]	1 year	16	MMSE, Rey complex figure test, TMT, Five-Word Test, oral naming test DO80	No difference
Saraat et al. 2019 [71]	1.5 year	59	Corsten Maze Learning Test from CogState battery	Improved performance in a subsample of participants

WAIS, Wechsler abbreviated scale of intelligence; TMT, trail making test; MOCA, montreal cognitive assessment; MMSE, mini mental state examination; RBANS, repeatable battery for the assessment of neuropsychological status; CODEX, cognitive disorders examination; CANTAB, Cambridge neuropsychological test automated battery.

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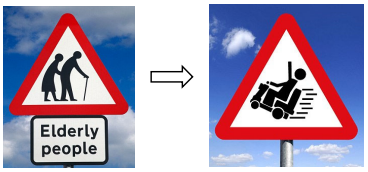
COCHLEAR IMPLANTS IN OLDER ADULTS

- Move past "safe and effective." No longer research
- How do we improve access?



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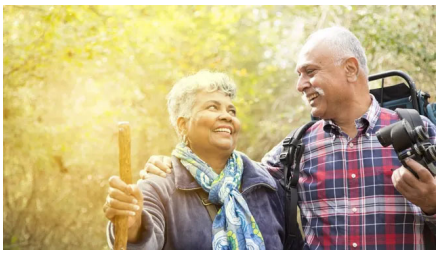
QUALITY OF LIFE IN OLDER CI PATIENTS



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WHY STUDY QUALITY OF LIFE?

- Hearing as a subjective experience
- Find ways to improve outcomes
- Demonstrate efficacy (payors)

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QOL WORK

Development and application of a health-related quality-of-life instrument for adults with cochlear implants: The Nijmegen Cochlear Implant Questionnaire

JOHANNES B. HINDERINK, MD, PAUL F. M. KRABBE, PhD, and PAUL VAN DEN BROEK, MD, PhD, Nijmegen, The Netherlands

Research Article

Cochlear Implant Quality of Life (CIQOL): Development of a Profile Instrument (CIQOL-35 Profile) and a Global Measure (CIQOL-10 Global)

Theodore R. McRackan,[a] Brittany N. Hand,[b] Cochlear Implant Quality of Life Development Consortium, Craig A. Velozo,[c] and Judy R. Dubno[a]

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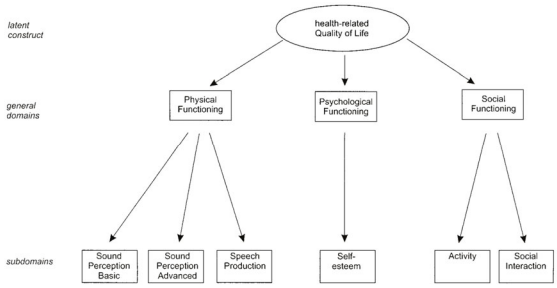
NIJMEGEN QOL INSTRUMENT



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OBJECTIVES

- Find predictors of improved quality of life
- Examine relationship between patient and caregiver quality of life
- Investigate frailty in older adults and its correlation with CI outcomes

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METHODS

- Adults over age 65 receiving cochlear implants at our institution between 7/13/2000 and 4/3/2019 – 380 patients total
- Surveys
  - Nijmegen Cochlear Implant Questionnaire (NCIQ)
  - Significant Other Scale for Hearing Disability (*SOS-HEAR*)
- Chart review: modified frailty index

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MODIFIED FRAILTY INDEX

- History of diabetes mellitus
- Functional status 2 (not independent)
- History of chronic obstructive pulmonary disease or pneumonia
- History of congestive heart failure
- History of myocardial infarction
- History of percutaneous coronary intervention, stenting, or angina
- History of hypertension requiring medication
- History of peripheral vascular disease or ischemic rest pain
- History of impaired sensorium
- History of transient ischemic attack or cerebrovascular accident
- History of cerebrovascular accident with neurological deficit

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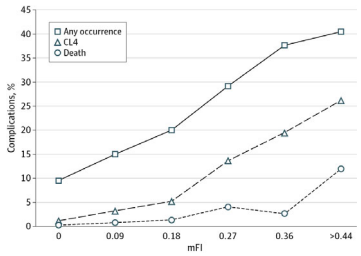
FRAILTY AND SURGERY

Complications With Increasing Modified Frailty Index
CL4 indicates Clavien-Dindo grade IV; mFI, modified frailty index.



Adams P, Ghanem T, Stachler R, Hall F, Velanovich V, Rubinfeld I. Frailty as a Predictor of Morbidity and Mortality in Inpatient Head and Neck Surgery. JAMA Otolaryngol Head Neck Surg. 2013;139(8):783-789. doi:10.1001/jamaoto.2013.3969

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RESULTS

- 38% response rate

N=143	Type/Level	Summary
Age at Time of Survey	[mean (SD)]	80.7 (7.4)
Frailty Index (0-100)	[mean (SD)]	0.11 (0.1)
Duration of Hearing Loss	[mean (SD)]	27.8 (17.7)
Hearing Aid Use Before Implant	No	17 (12%)
	Yes	123 (88%)
Laterality	Bilateral	28 (20%)
	Unilateral	115 (80%)

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RESULTS

QOL - Activity Limitations	[mean (SD)]	66.3 (20.6)
QOL - Advanced Sound Perception	[mean (SD)]	73.2 (19.2)
QOL - Basic Sound Perception	[mean (SD)]	57.9 (20.4)
QOL - Self Esteem	[mean (SD)]	55 (20.9)
QOL - Social Interactions	[mean (SD)]	55.4 (15.9)
QOL - Speech Production	[mean (SD)]	45 (17.5)
QOL	[mean (SD)]	57.9 (14.8)

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RESULTS

Variable	Univariate Estimate (95% CI)	p-value	Multivariate Estimate (95% CI)	p-value
Frailty Index (0-100)	-0.38 (-0.63, -0.13)	0.003	-0.24 (-0.51, 0.03)	0.085
Duration of Hearing Loss	0.15 (0.01, 0.29)	0.039	0.03 (-0.12, 0.17)	0.69
Difference in Hearing (Pure Tone Average)	-0.13 (-0.23, -0.03)	0.011	-0.14 (-0.24, -0.03)	0.012

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RESULTS

- Not significant:
  - Laterality
  - age at implantation
  - time since implant

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HOW ARE CAREGIVERS AFFECTED?

- "Third-party" disability
- Significant Other Scale for Hearing Disability (SOS-HEAR)
- 5 Themes:
  - Communication
  - Everyday Activities
  - Emotions
  - Relationship
  - Social Factors

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CAREGIVER STUDY

- "Caregiver" – a spouse/significant other, child, neighbor, "other"
- 124 surveys collected

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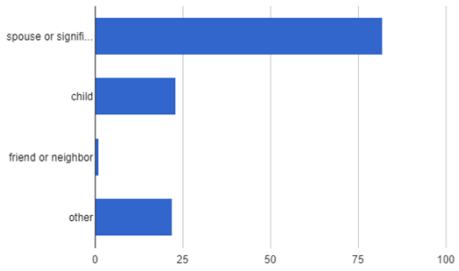
RELATIONSHIP TO THE CI RECIPIENT



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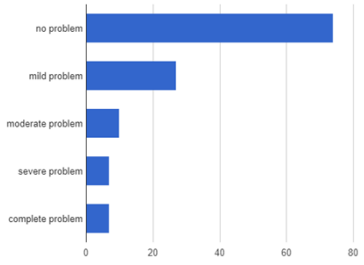
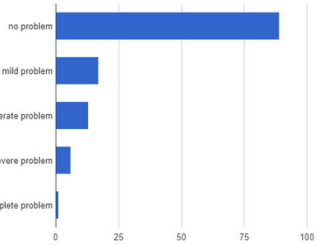
IT MAKES ME UPSET THAT I HAVE TO ADAPT TO MY FAMILY MEMBER'S HEARING DIFFICULTIES



57

IT MAKES ME ANGRY WHEN I HAVE TO TOLERATE THE LOUD VOLUME OF THE TELEVISION. (EVERYDAY ACTIVITY)



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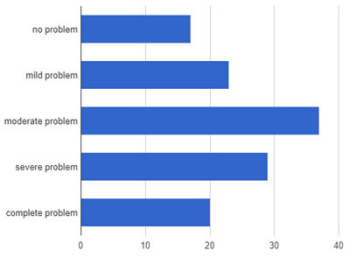
I WORRY THAT HE/SHE DOESN'T HEAR WARNINGS, SUCH AS SHOUTS OR ALARMS.



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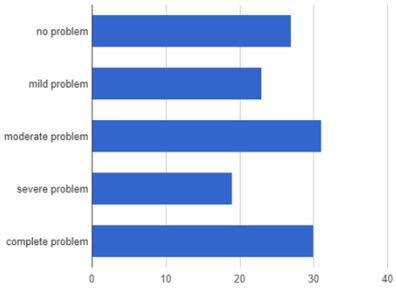
I HAVE TO ANSWER THE PHONE FOR HIM/HER.



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SUMMARY

- Older adults are an important patient population of CI candidates and recipients
- Unique aspects to surgery in older adults
- QoL is an important measurement of CI outcomes
- Improved hearing leads to improved QoL
- Impact on caregivers is another important outcome

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Thank you

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