

# Hearing Preservation and Perioperative Disparities Among Elderly Cochlear Implant Recipients

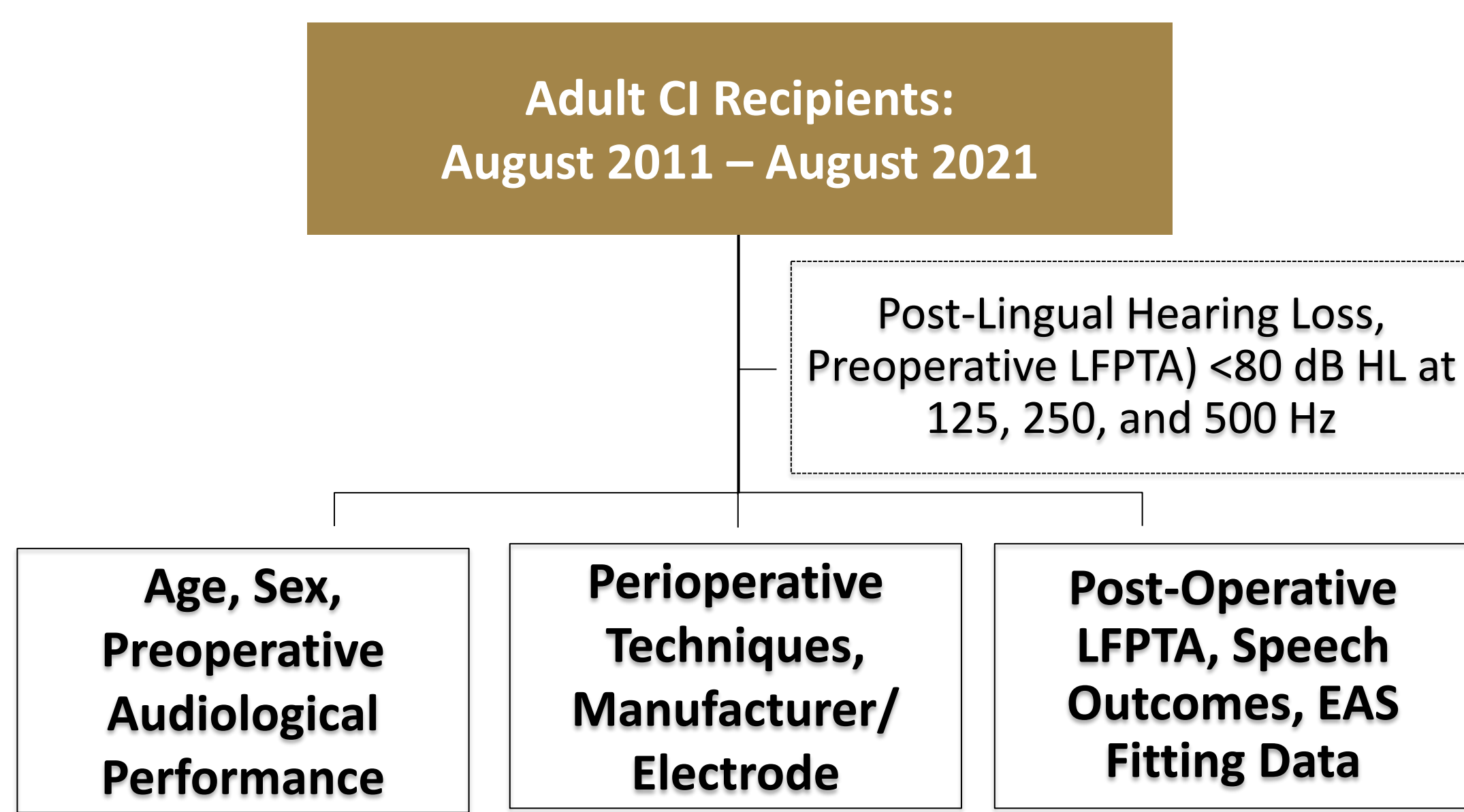
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## INTRODUCTION

Cochlear implants (CI) restore hearing in patients with moderate-to-profound hearing loss who receive little to no benefit from hearing aids. We know that residual low-frequency hearing enables utilization of electro-acoustic stimulation (EAS), which is associated with improved speech understanding, binaural cues, and performance in complex listening environments. A growing body of research suggests that hearing preservation (HP) rates after CI surgery diminish with increasing age of the implant recipient. Herein, we aim to report age-related HP rates and electroacoustic stimulation (EAS) for adult cochlear implant (CI) recipients, with emphasis on those older than 70 years.

## METHODS



## RESULTS

Characteristics	<70 years (n = 207)	≥70 years (n = 197)	p
Age	54.9 (IQR 47.0 - 65.0)	77.7 (IQR 73.0 - 82.0)	<0.0001
Male gender	100 (48.3%)	135 (68.5%)	<0.0001
Laterality			
Left	93 (44.9%)	83 (42.1%)	0.5722
Right	114 (55.1%)	114 (57.9%)	0.5722
Preoperative CNC words (%)	17.4 (IQR 4.0 - 28.0)	19.2 (IQR 6.0 - 30.0)	0.1905
Preoperative AzBio in quiet (%)	27.2 (IQR 7.0 - 44.0)	26.0 (IQR 5.3 - 40.0)	0.6478
History of Diabetes	29 (14.0%)	41 (20.8%)	0.0714
Fragility (mFI-5) Raw	0.6232 (95% CI 0.5141 - 0.7323)	1.102 (95% CI 0.9722 - 1.231)	<0.0001
Fragility (mFI-5) ≥ 2	27 (13.0%)	54 (27.4%)	<b>0.0003</b>
Precurved electrodes	77 (37.2%)	58 (29.4%)	0.099
Hybrid length electrode	18 (8.7%)	12 (6.1%)	0.3194
Steroids			
Preoperative	42 (20.3%)	27 (13.7%)	0.0793
Intraoperative IV	195 (94.2%)	172 (87.3%)	<b>0.0165</b>
Intraoperative ME	53 (25.6%)	29 (14.7%)	<b>0.0066</b>
Postoperative	101 (48.8%)	70 (35.5%)	<b>0.0071</b>
ΔLFPTA shift at 1-month	28.8 (IQR 13.0 - 43.0)	36.9 (IQR 22.0 - 55.0)	<0.0001
%LFPTA preserved at 1-month	58.5 (IQR 42.6 - 80.5)	45.8 (IQR 20.3 - 67.6)	<0.0001
LFPTA preserved ≥50%	144 (69.6%)	108 (54.8%)	<b>0.0023</b>
Fit with EAS	78 (37.7%)	39 (20.0%)	<0.0001

Data are presented as median (interquartile range) or incidence (frequency). AzBio indicates Arizona Biomedical; CI, cochlear implant; CNC, Consonant-Nucleus-Consonant; EAS, electroacoustic stimulation; IV, intravenous; LFPTA, low-frequency pure tone average; ME, middle ear; mFI-5, modified Fragility Index-5. Significant p values are in bold.

Table 1. Patient characteristics.

Table 1 shows characteristics of 404 adult CI recipients eligible for hearing preservation CI surgery stratified by <70 and ≥70 years of age. Patients above 70 years old were more likely to be male and having higher mFI-5 score. Patients in the elderly cohort were less likely to receive intravenous, topical middle ear, and post-operative steroids. This cohort had a significantly greater ΔLFPTA than their younger counterparts (36.9 dB HL vs 28.8 dB HL, p < 0.001) and had lower preservation of LFPTA at 1-month follow-up.

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## RESULTS (CONT.)

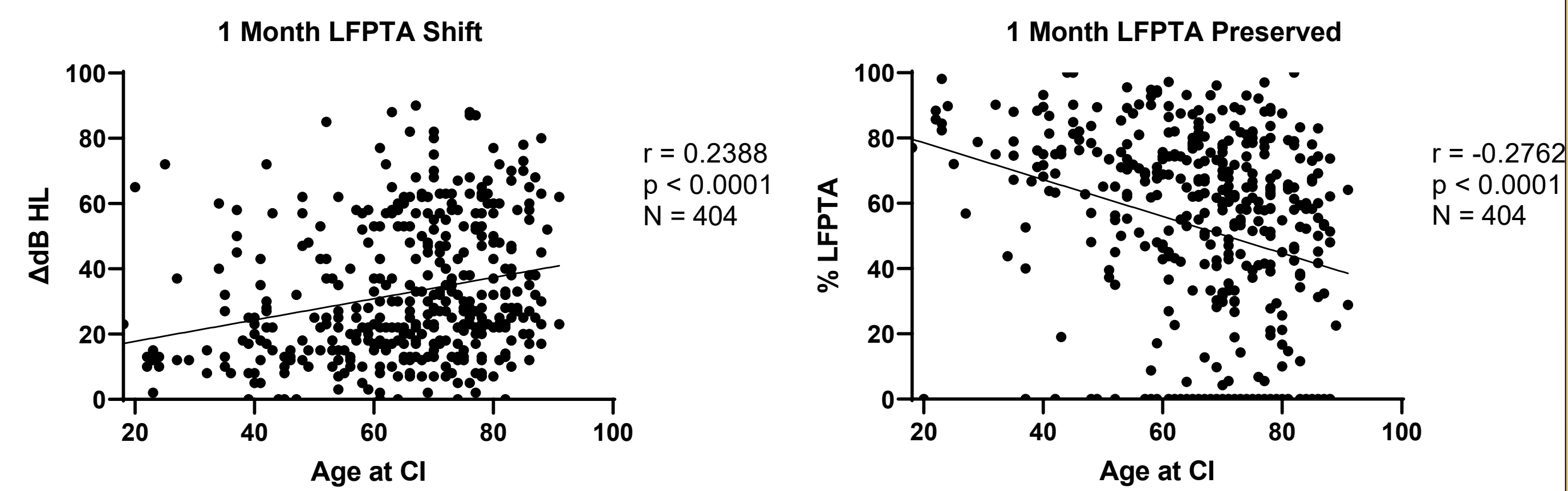


Figure 1. Correlation of age at CI with ΔdB HL shift in LFPTA and %LFPTA preserved.

Figure 1 illustrates that postoperative ΔLFPTA demonstrates a weak positive correlation with age at implantation and %LFPTA preserved demonstrates a weak negative correlation with age.

Among patients with preserved hearing, those over 70 years were less likely to be fitted with EAS (OR 1.835, 95% CI: 1.051–3.188, p = 0.037). All patients fitted with EAS had better 12-month CNC (64% vs. 52%, p = 0.014) and AzBio quiet (83% vs 67%, p < 0.001) scores, however this did not reach significance in subgroup analysis for patients over 70 years old (CNC: 49% vs 44%, p = 0.064, AzBio quiet: 72% vs 62%, p = 0.074).

LFPTA Shift at 1 month		
	Beta (95% CI)	p
Age at CI surgery	0.24 (0.19 to 0.45)	<0.0001
Male gender	-0.04 (-5.84 to 2.48)	0.427
Preoperative LFPTA	-0.25 (-0.58 to -0.25)	<0.0001
Fragility (mFI-5) Raw	-0.01 (-3.07 to 2.82)	0.932
Intraoperative steroids	0.02 (-5.79 to 8.13)	0.741
Postoperative steroids	-0.01 (-4.59 to 3.53)	0.798
Electrode Type	0.09 (-0.36 to 8.12)	0.073
Diabetes	0.10 (-0.77 to 12.01)	0.085
Round window approach	0.04 (-2.63 to 6.61)	0.398
Duration of deafness	0.08 (-0.24 to 0.08)	0.3

Table 2. Multivariate linear regression results predicting shifts in low-frequency acoustic hearing.

LFPTA Preserved ≥50% at 1 month		
	OR (95% CI)	p
Age at CI surgery	0.97 (0.95 to 0.99)	<b>0.001</b>
Male gender	0.76 (0.47 to 1.23)	0.262
Preoperative LFPTA	1.01 (0.99 to 1.03)	0.2
Fragility (mFI-5) Raw	1.26 (0.90 to 1.76)	0.179
Intraop steroids	1.17 (0.54 to 2.52)	0.698
Postop steroids	0.86 (0.54 to 1.37)	0.526
Electrode type	1.56 (0.97 to 2.51)	0.07
Diabetes	0.49 (0.24 to 0.99)	<b>0.047</b>
Round window approach	0.79 (0.24 to 2.68)	0.714
Duration of deafness	1.00 (0.99 to 1.03)	0.424

Table 3. Multivariate logistic regression results predicting degree (%) of hearing preservation.

Figures 2 and 3 demonstrate the results of multivariate regression models. Age at CI surgery is strongly implicated in both amount of LFPTA shift and % HP at 1 month after surgery. Interestingly, comorbid diabetes mellitus is associated with decreased %HP at 1 month.

## DISCUSSION/CONCLUSIONS

Age of implantation significantly impacts rates of HP. Patients older than 70 years of age demonstrate significantly higher ΔLFPTA shift and lower %LFPTA preserved at 1 month. Nonetheless, a majority (55%) of patients older than 70 years still maintain >50% of preoperative LFPTA. Patients with residual hearing over the age of 70 years are less likely to receive preoperative steroids or be fit with EAS, indicating that there may be a decreased emphasis on hearing preservation for this group. Combined EAS may continue to be beneficial for the geriatric CI recipients.

## REFERENCES

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- Anagnostos A, Hamdan N, Lang-Roth R, Gostian AO, Lüers JC, Hüttenbrink KB, et al. Young age is a positive prognostic factor for residual hearing preservation in conventional cochlear implantation. *Otol Neurotol*. 2015 Jan;36(1):28–33.