

A Unique Perspective: Intra-Patient Comparison of Perimodiolar and Lateral Wall Cochlear Implant Electrodes

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Introduction:

The debate between perimodiolar (PM) and lateral wall (LW) electrode arrays for cochlear implantation (CI) has recently intensified. This consideration is likely due to the advent of slim PM arrays and emerging data to support improved speech understanding and pitch specificity while permitting hearing preservation. One potential reason that superiority of one design over another has not been clearly demonstrated is the inherent variability between patients. Our group identified this gap in the literature and sought to explore this question by analyzing patients who have received a PM array in one ear and a LW array in the other.

Methods: Following Institutional Review Board approval (IRB_00045048), a retrospective review of a database containing patients implanted with a PM electrode in one ear and a LW electrode in the other. Patient demographics, clinical data, and audiologic data were recorded. Outcome variables included four frequency pure tone average (PTA), consonant-nucleus-consonant (CNC) scores, and AzBio scores in quiet and noise. Outcomes were compared using Wilcoxon Signed Ranks Test with SPSS version 27.

Results:

A total of 32 patients met inclusion criteria; 50% were male. Median age at time of PM implantation was 64.5 (Q1-Q3: 46.8-71.9) years; for LW implantation it was 69.6 (50.6-76.3) years. Seventy-five percent of implants were manufactured by Cochlear, and 25% by Advanced Bionics; a variety of PM and LW arrays were utilized. The median duration of deafness for PM implants was 54.3 (42.0-67.7.9) years and it was 56.9 (40.8-69.1) years for LW implants ($p = .278$). The median time interval between implants was 65 (31-98) months. PM electrodes were placed first in 68.8% of subjects, LW electrodes were first in 28.1%, and in one subject PM and LW electrodes were placed at the same time. There was a statistically significant difference in speech perception as assessed by CNC word testing: PM 66 (51-71) %, LW 42 (26-70) %, $p=0.008$). There was no statistically significant difference in AzBio scores in quiet: PM 75 (54-93) %, LW 67 (30-89) % ($p = 0.082$); or in noise: PM 59 (50-79.5), LW 63 (50-89) %, $p = 1.000$). Battery life was longer in the PM group (33.5 vs 30 hours), but the difference was not statistically significant ($p = 0.819$).

Conclusion:

PM arrays offer improved speech understanding when compared to LW arrays when assessed by CNC word testing, but do not offer a significant improvement in battery life or AzBio scores. This is the first study to compare these outcomes using each patient as their own control, thereby controlling for the majority of patient factors that could influence performance. The interval between implantations may influence performance and will be explored in larger series including data from multiple manufacturers.

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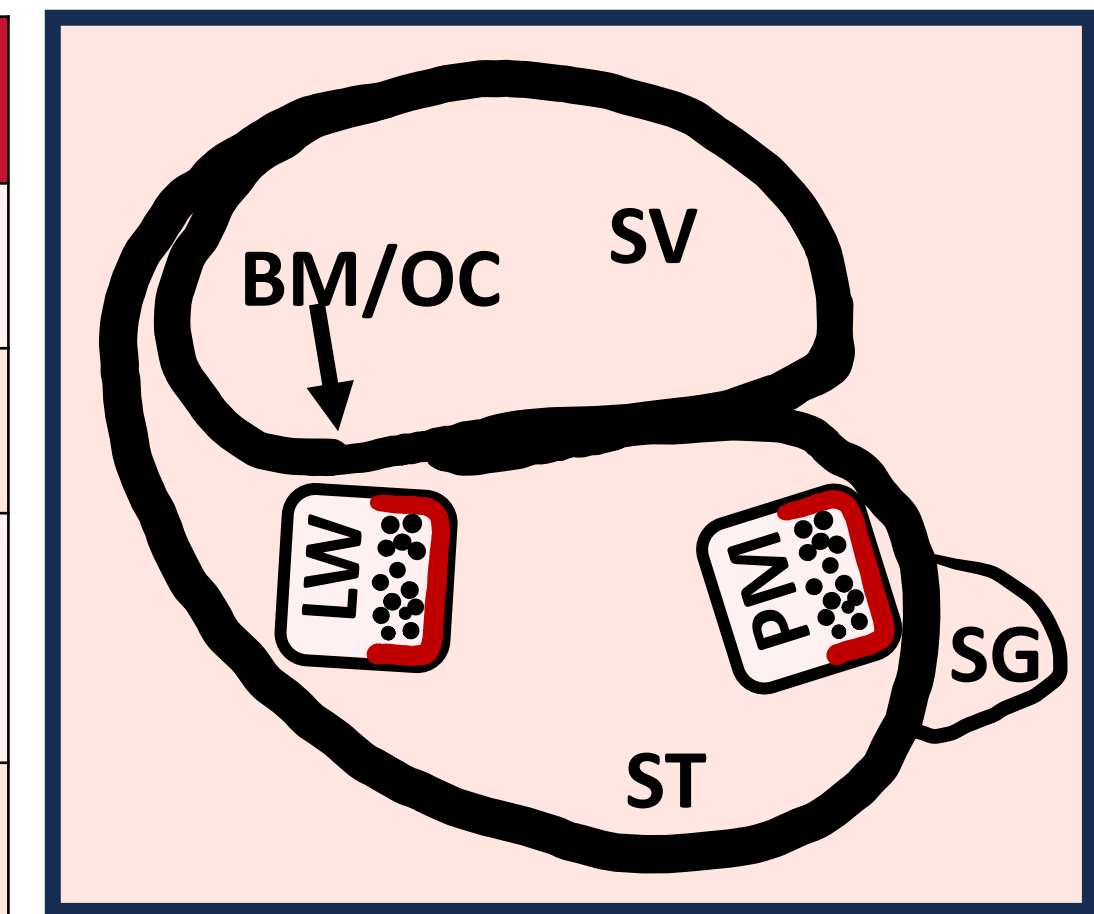
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Introduction

- The evolution of cochlear implantation (CI) has led to a debate between the benefits of perimodiolar (PM) and lateral wall (LW) electrode arrays
- Most studies compare PM and LW outcomes between groups of subjects rather than within subjects

	PM	LW
Shape	Curved	Straight
Length/Location	Shorter; Near modiolus	Longer; Away from modiolus
Insertion & Scarar Translocation¹	More traumatic – higher rates of scarar translocation	Less traumatic – lower rates of scarar translocation
Tip Fold-over¹	Higher rates	Lower rates
Speech Outcomes^{2,3,4}	Better	Worse
Melodic Contour Identification³	Better	Worse
Hearing Preservation⁵	Equivalent in immediate postoperative period	Equivalent in immediate postoperative period



LW= lateral wall;
PM = perimodiolar;
SV = scala vestibuli;
ST = scala tympani;
BM = basilar membrane;
OC = organ of Corti;
SG = spiral ganglion

Study objective: Investigate the comparative efficacy of PM and LW cochlear implant electrodes in patients bilaterally implanted with both electrode types

Methods

- Retrospective chart review at tertiary academic center of patients with bilateral CIs – one PM and one LW
- Variables: Demographics, audiometric data, battery life, data logging
- Comparative analysis performed with Wilcoxon Signed Ranks Test

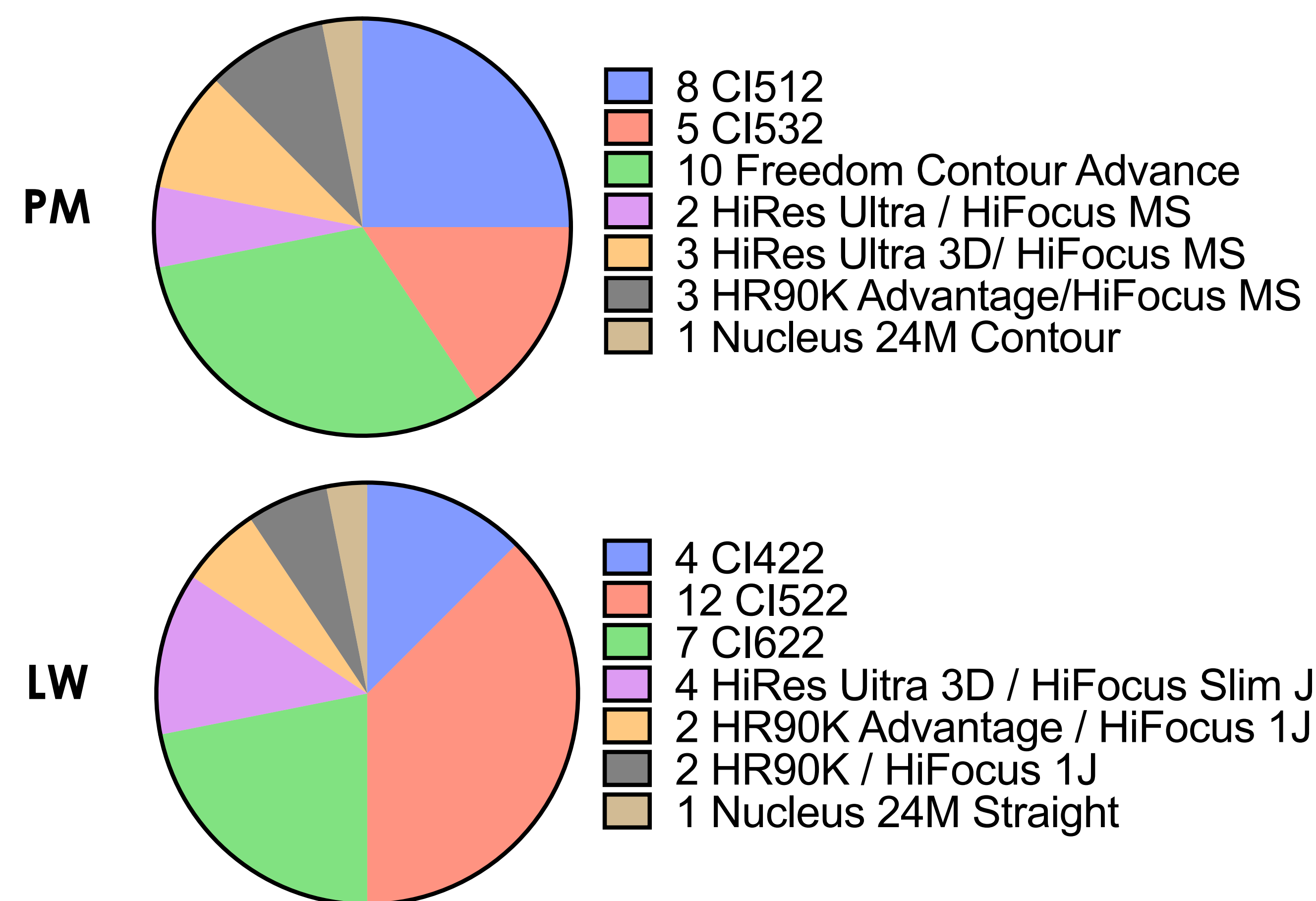
Results

- N = 32, 50% female, 87% Caucasian

Characteristics and Outcomes based on Electrode Type

	PM	LW	p
Age at Implantation (years)	64.5 (46.6-71.8)	69.7 (50.2-77.1)	0.001
First Implant (%)	68.8 ⁺	28.1 ⁺	-
Duration of Deafness (years)	43.3 (32.4-62.3)	41.5 (35.3-69.1)	0.204
Duration of Follow Up (years)	7.72 (3.2-10.9)	3.09 (0.9-7.2)	0.009
PTA 0.5, 1, 2, 3 kHz (dB HL)	27.5 (26.3-32.5)	28.75 (25.9-31.25)	0.844
CNC Word (%)	66 (51-71)	42 (26-70)	0.008
AzBio Quiet (%)	75 (54-93)	67 (30-89)	0.082
AzBio Noise +10 dB SNR (%)	59 (50-79.5)	57 (39-83)	0.375
Data Logging (hours)	13.6 (12.1-15.5)	13.2 (11.9-15.1)	0.519
Battery Life (hours)	33.5 (22.8-42.5)	30 (22.75-40.75)	0.819

Results reported as median (interquartile range: Q1-Q3) or percentages. dB HL = decibels hearing level. SNR = signal to noise ratio. ⁺One patient underwent bilateral simultaneous.



Outcomes based on Chronological Order of CI

	1 st implant	2 nd implant	p
PTA 0.5, 1, 2, 3 kHz (dB HL)	27.5 (25.9-32.5)	28.8 (25.9-31.3)	0.909
CNC Word (%)	61 (46-68)	48 (26.0-70.5)	0.101
AzBio Quiet (%)	73 (53-90)	68.5 (30.8-89)	0.047
AzBio Noise +10dB SNR (%)	57 (49-78)	65 (44.5-82.3)	0.125

Conclusions

- PM electrode arrays show improved speech understanding compared to LW arrays in CNC word testing
- 1st implant had better performance on AzBio in quiet, but absolute difference was only 4.5%
- No significant difference in battery life or AzBio scores between PM and LW arrays
- Future directions: Prospective study, investigate patient reported outcome measures such as CIQOL-35

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