THE 'REAL-LIFE' BENEFITS OF HEARING PRESERVATION COCHLEAR IMPLANTATION IN THE PAEDIATRIC POPULATION

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Introduction

- Cochlear implant (CI) candidacy criteria have been expanding to include individuals with residual hearing
- Improvements in electrode design and surgical technique have made hearing preservation cochlear implantation (HPCI) possible
- Electroacoustic stimulation (EAS) utilize a hearing aid alongside the CI to amplify residual hearing
- Research has shown some benefits from residual low-frequency hearing after HPCI
- More understanding of the 'real-life' benefits of HPCI in the paediatric population is needed to guide clinical decision-making

Aims:

1) To meaningfully evaluate the 'real-life' benefit of preserved low-frequency acoustic hearing in children with CI using a test battery
2) To evaluate the effect of accounting for hearing preservation in CI programming on real-life benefit in children with HPCI

Participants

19 ears (≥6 and <18 years old) who underwent CI with the aim of hearing preservation

Table 1. Participant demographics

Demographic	Summary
Age at test (years)	Mean = 11.37 SD = 2.43
Age at implantation (years)	Mean = 7.58 SD = 3.11
Duration of CI use (years)	Mean = 3.58 SD = 2.76
Sex	13 Males (68.4%) 6 Females (31.6%)
CI configuration	17 Bilateral (89.5%) 2 Unilateral (10.5%)
Side tested	10 Right (52.6%) 9 Left (47.4%)
Latest post-op LFPTA (dBHL)	Mean = 53.3 SD = 18.8
CI programmed according to LF thresholds	8 CI set (42.1%) 11 CI not set (57.9%)
EAS use	2 Yes (89.5%) 18 No (10.5%)

LFPTA: Average thresholds at 125, 250 and 500Hz; CI set: CI programmed with reference to residual hearing thresholds.

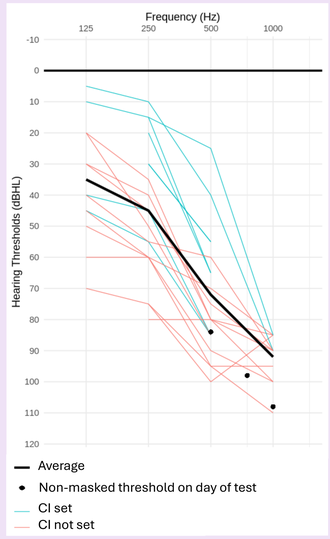

Figure 1. Combined audiogram.

Methods

Test battery

1) **Speech-in-noise perception –** BKB-SIN test with speech and noise collocated and then spatially separated
2) **Complex pitch direction discrimination** – 2-alternative forced choice, participants asked to identify the higher-pitched tone
3) **Melodic identification** – 12 melody clips of well-known songs, participants asked to identify song presented
4) **Prosody perception –** 10 sentences, participants asked to the stressed word in each sentence
5) **Threshold equalizing noise (TEN) test**

Protocol

Participants underwent test battery in two conditions:

1) **Test condition (HPCI)**: CI + use of natural hearing or electroacoustic stimulation
2) **Control condition (CI-only)**: CI with ear canal plugged

Results (1)

Results trended in the expected direction for all tests (more so in music perception tests) but differences were not statistically significant

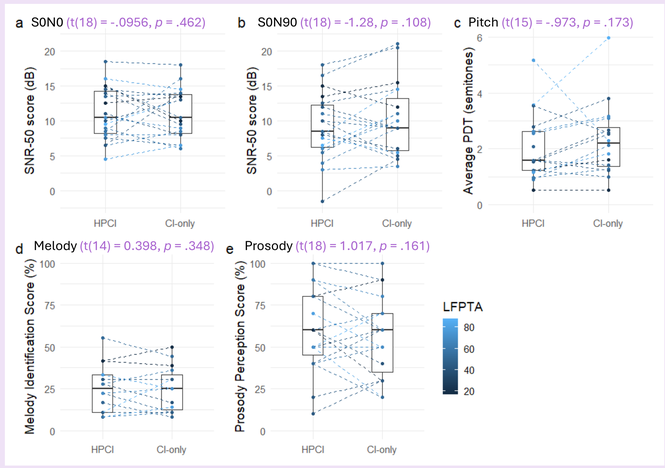

Figure 2. Scores in the HPCI and CI only conditions for (a) speech perception in collocated noise, (b) speech perception in spatially separated noise, (c) pitch discrimination, (d) melody identification, and (e) prosody perception. PDT: pitch discrimination threshold.

Results (2)

Unable to meaningfully compare the 'CI set' group to the 'CI not set' group as LFPTA was significantly better in the former (40.1 vs 63.0 dBHL, p = .005)

Discussion

- Study limited by small sample size
- Wide range of LFPTA (17-88 dBHL) with only two ears using amplification with EAS
- Excitation patterns show that the "average" participant (001) was not receiving much LF acoustic information
- Thresholds on day of test were ~10dB worse than latest clinical thresholds
- Residual low-frequency hearing after HPCI not enough to give meaningful benefit on the outcome measures used

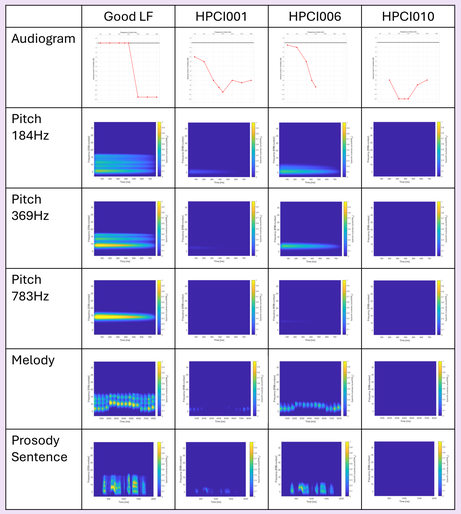

Figure 3. Excitation patterns for three subjects alongside a hypothetical ear with normal low-frequency thresholds

Directions for future research

- Determine if proper amplification would lead to better outcomes children with HPCI
- Explore the use of other outcome measures that mimic other 'real-life' listening situations (e.g. localisation, emotion perception)
- Investigate why the EAS is not well-utilized in children with HPCI through qualitative studies

References

Bruce, I., Schaefer, S., Kluk, K., Nichani, J., Odriscoll, M., Rajai, A., & Sladen, M. (2023). 'Real-life'benefit of hearing preservation cochlear implantation in the paediatric population: a single-site case–control study. BMJ open, 13(5), e067248.

Schaefer, S., Sahwan, M., Metryka, A., Kluk, K., & Bruce, I. A. (2021). The benefits of preserving residual hearing following cochlear implantation: a systematic review. International journal of audiology, 60(8), 561-577.

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