Longitudinal EEG potentials evoked by visual pattern reversal (VEP) as an outcome prediction marker for cochlear implant users

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Objectives

1) Cross-modal plasticity occurs in the deaf population due to a deprived sense of hearing.

2) The issue of either adaptive or maladaptive effects of the cross-modal plasticity on cochlear implant (CI) recipients is still on debate, highlighting the need of a closer look at long-term modal-specific changes in CI users.

3) Vision, for instance, might have been enhanced as compensation of lost hearing. Despite the abundance of rigorous research, however, it is still arguable about the visual dependency on speech intelligibility after CI.

4) In the current study, we hypothesized that greater dependence on vision would impede auditory processing and slow down the improvement in speech intelligibility.

Methods

Patient summary

CI01 (M, 34 y), CI on the left ear, Cochlear, 7
CI02 (F, 29 y), CI on the right ear, Cochlear 7

Speech intelligibility score

One-syllable number words were used to measure speech intelligibility

Pattern-reversal visual evoked potential (VEP) recording

An epoch of 2 checkerboards with alternating patterns in a 600 ms inter-stimuli interval with average 160 epochs presented.

Artifact reduction

Eye: ICA + visual inspection
CI-related: CIAC + visual inspection (unlike AEP, VEP seemed least affected)

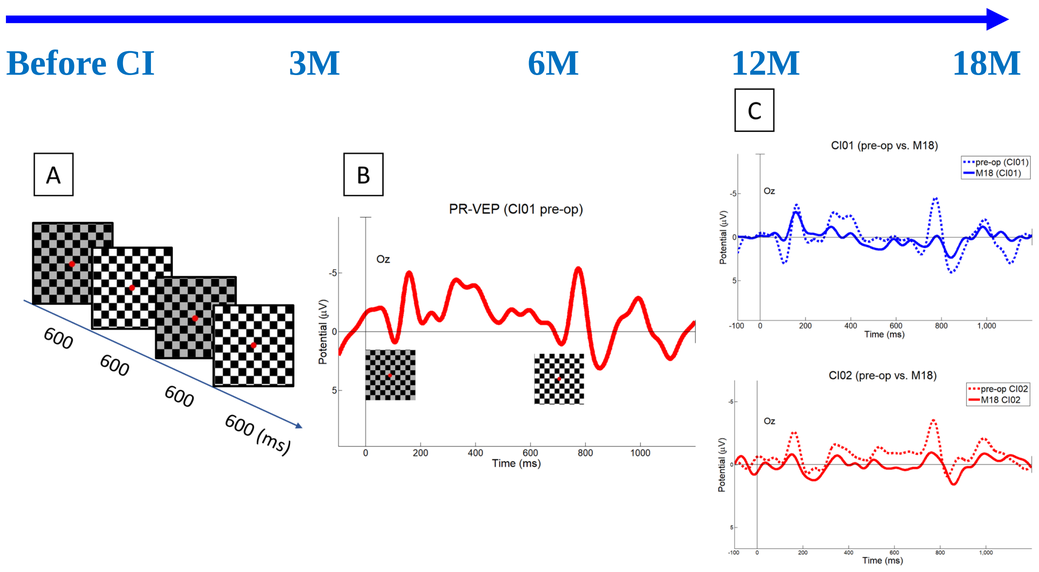

Figure 1. Study plan. VEP paradigm (A), Sample VEP (B), and Sample comparisons between pre-op and 18 months after CI in the good (upper) and the poor/fair (lower) performers (C)

Results

Behavioral & cortical results

- All the patients revealed gradual enhancement in speech intelligibility.
- They showed an overall decrease in VEP amplitude and latency at 18 months after CI.
- However, the good performer revealed faster entrance to the phase of decrease both in latency and amplitude, unlike the poor performer. Definition of a good or poor (or fair) performer was based on the speech intelligibility score at 3 and 6 months after cochlear implant (CI) (cutoff = 60%).

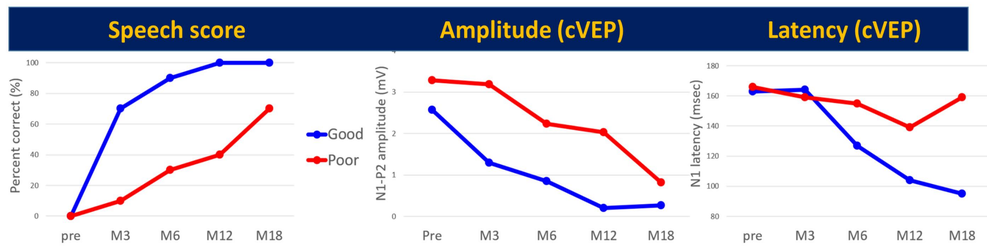

Figure 2. Summary of behavioral speech intelligibility score (left), and cortical visual evoked potential in amplitude (middle) and in latency (right) by the function of time (pre-op, 3, 6, 12, and 18 months after cochlear implantation) in good (blue) and in poor (red) performers.

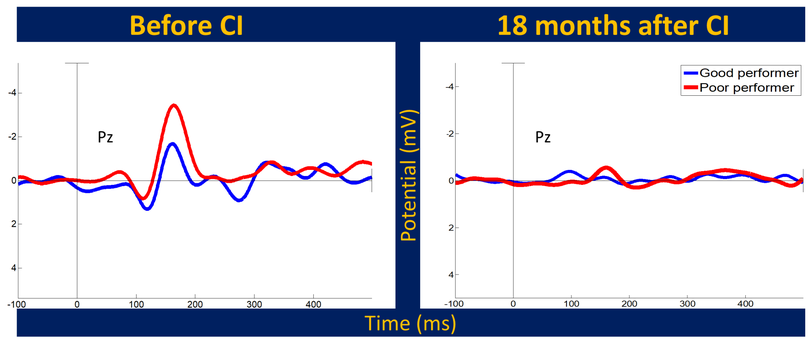

Figure 3. Visual evoked potentials in the good (blue) and poor (red) performers before, at 3, at 6, at 12, and at 18 months after cochlear implant (CI).

Conclusions

- Based on the results of this case study, we speculate that the enhancement of speech intelligibility in CI recipients is strongly related to their vision processing patterns.
- This was evidenced in our correlation results of longitudinal observations up until 18 months after CI.
- Efficient use of vision is suggested to contribute to enhanced speech processing decreasing the visual dependence.
- Our results offer new perspectives on cross-modal plasticity in the deaf population and contribute to the development of prognosis and rehabilitation for CI recipients.
- We need a larger sample size to generalize our current findings.

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