Is visual temporal processing related to speech perception performance after cochlear-implantation?

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INTRODUCTION

Although cochlear implants (CIs) are considered to be the most effective neuroprosthetic device, there can be substantial differences in outcomes amongst individual CI recipients, particularly related to communication and speech intelligibility. Several studies have attempted to characterize the cross-modal gain in individuals with CIs and have demonstrated that audiovisual integration appears to be an important factor in the CI rehabilitation process (e.g., Hay-McCutcheon et al., 2009, Lachs, 2001, Kaiser et al., 2003). The present study represents one of the first attempts to characterize audiovisual processing in a CI population and to relate performance on multisensory tasks to clinical auditory measures of CI outcomes. Understanding how visual cues can facilitate auditory comprehension and how audiovisual integration abilities differ from patient-to-patient presumably has important implications for developing predictions about CI outcomes and can help to optimize rehabilitation strategies that could enhance post-implantation speech perception abilities.

METHODS

Subjects:
- N = 31 Cochlear implant recipients
  - Mean age = 60.65 years
  - Mean duration of hearing loss = 30.51 years
  - Implanted Ear: right n = 10, left n = 6, bilateral n = 15

Multisensory tasks:
1. Simultaneity Judgment (SJ) Speech
2. Flashbeep Illusion
3. McGurk Effect
4. Original Order Judgment (TOJ) Flashbeep
5. SJ Flashbeep

Unisensory Tasks:
1. Auditory TOJ
2. Visual TOJ

Clinical data compiled:
1. Age of implantation
2. Duration of hearing loss
3. Audiometric configurations
4. Speech perception scores*: Aud, HINT, BKSB-SIN, CNC words

RESULTS

Speech Perception:
1) vTOJ scores were related to cochlear implant proficiency with CNC word recognition (Stevenson, unpublished data).
2) Better visual temporal processing abilities were associated with better performance on clinical measures of sentences and word recognition abilities.

DISCUSSION

- Initial data analyses indicated that vTOJ scores were related to cochlear-implant proficiency. Proficient CI users performed similarly to moderately non-proficient CI users on clinical CNC word tests. However, severely non-proficient users performed significantly worse than these other two groups, suggesting that visual temporal processing abilities are related to speech perception performance following cochlear-implantation (Stevenson, unpublished data).
- Subsequent analyses revealed that performance on the vTOJ task was related to several clinical measures. Better visual temporal processing abilities were associated with better performance on sentence recognition and word recognition clinical tasks measured at 3-4 months, 6-7 months, and 9-10 months post-implantation.
- Shorter duration of hearing loss was also associated with better vTOJ performance.
- This negative trend suggests a global decline in sensory processing abilities, since auditory timing is better than visual timing and auditory development helps guide visual development.
- So, poor visual timing abilities may be related to overall global sensory processing deficits due to degraded sensory inputs.

SUMMARY

These results suggest that:
1) Better visual timing abilities may improve an individual’s ability to learn speech after cochlear implantation,
2) There is potential for vTOJ scores to predict clinical measures such as Aud, HINT, and CNC words.
3) In general, better speech perception abilities, particularly sentence recognition, are related to better visual temporal processing abilities.
4) It is crucial to gather consistent and thorough clinical data

Future Directions:
1) Can the addition of auditory information (i.e., through cochlear implantation) improve an individual’s vTOJ performance, and therefore his or her visual timing abilities?
2) Do individuals with poor vTOJ performance take longer to become proficient CI users?
3) Can vTOJ be improved with training?

REFERENCES


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