Clinical Outcomes in Adult Bilateral Cochlear Implantation

Monica S. Lee1, Eva M. Bero2, Sarah F. Poissant1,3, Daniel J. Lee1,2,4
1University of Massachusetts Medical School, Worcester, Massachusetts, USA
2UMass Memorial Medical Center, Worcester, Massachusetts, USA
3University of Massachusetts Amherst, Amherst, Massachusetts, USA
4Ear-Thomas Laboratory, Massachusetts Eye and Ear Infirmary, Boston, Massachusetts, USA

INTRODUCTION

• Unilateral cochlear implants (CI) can provide improved speech understanding ability in optimal (i.e., quiet) conditions. These auditory perceptual benefits degrade in sub-optimal (e.g., noisy) conditions. In addition, unilateral CI patients do not have significant spatial hearing abilities.

• Bilateral cochlear implants have the potential to improve performance over unilateral implantation through binocular summation (in quiet) and binocular squelch (in noise). Improved spatial hearing is also a possibility due to the potential access to binaural cues (Litovsky, et al. 2004; Laszlo, et al. 2004).

• There may also exist subjective benefits which are not quantifiable by traditional measures, but may be ascertained by a newly developed tool called the Speech, Spatial, and Quality of Hearing scale (SSQ) (Gatehouse & Noble, 2004).

• This investigation seeks to compare (1) speech perception benefits in quiet and in noise (2) subjective spatial hearing benefits in a cohort of adult bilateral sequential CI patients and a matched group of unilateral CI patients.

METHODS

• This study was approved by the Institutional Review Board at the University of Massachusetts Medical School.

• Bilateral CI Subjects: 8 sequentially implanted adult bilateral CI users (5 with pre-lingual hearing loss, 3 with post-lingual hearing loss).

• Unilateral CI Subjects: 8 adult unilateral CI users matched to the bilateral users based upon the following factors that would likely impact performance with a CI: (1) pre- vs. post-lingual onset of hearing loss; (2) length of hearing loss; (3) age at enrollment in the current study; (4) audiometric characteristics

• Speech Perception Measures: Auditory-visual perception was measured using (1) CNC words in quiet and babble (CS CPC 89); (2) HINT sentence recognition in quiet and babble (CS CPC 89), (3) SNR sentence recognition in quiet and babble (CS CPC 89).

• Spatial Hearing Measures: All subjects completed a modified version of the NASS-5, a computerized subjective spatial hearing acuity. Subjects were scored as an unweighted average of individual item scores, or a scale of 0 to 10.

• Medical Record Review: A retrospective medical record review was performed to determine age, sex, history of hearing loss, etiology of hearing loss, and the occurrence of any peri-operative complications resulting from either unilateral or bilateral cochlear implantation.

• Statistical Methods: Statistical analyses were performed with SPSS software. Depending upon the comparison being made, data were analyzed in independent samples t-tests or paired samples t-tests.

RESULTS

demographics

Table 1: Baseline demographics

• No statistically significant differences were found between unilateral and bilateral CI users based on the criteria used to match them.

• Mean length of hearing loss in bilateral CI users was 31.9 years (s.e. 6.75) vs. unilateral, it was 31.1 years (s.e. 6.30). t = 0.08, p = 0.936.

• Mean length of use of first CI in bilateral CI users was 59.5 months (s.e. 19.30) vs. unilateral, it was 52 months (s.e. 19.40). t = 0.40, p = 0.709.

• Mean age at test was 59.5 years (s.e. 4.59) in bilateral subjects and 11.76 years (s.e. 4.16) in unilateral subjects, t = 2.422, p = 0.014.

• All patients had normal pre-operative temporal bone CT scans.

• There were no intraoperative or postoperative complications.

• Bilateral CI users: One subject developed BPPV 3 months following his second CI surgery. He has since improved with vestibular physical therapy.

• Unilateral CI users: One subject experienced facial nerve stimulation following implantation, which has been controlled through programming.

subjective experience in bilateral vs unilateral CI users: the SSQ survey

The SSQ survey is developed by Gatehouse and Noble under the assumption that subjective hearing ability which cannot be evaluated by traditional objective measures.

Studies have found that the response of a patient to all aspects of hearing covered by the SSQ depends on whether the patient has symmetrical hearing (Gatehouse and Noble, 2004).

The SSQ survey explores speech perception in noise and sound location, two aspects of hearing ability which are generally accepted to be benefits of the bilateral condition. It looks at moving sounds and targets everyday situations such as hearing a passenger while driving in a car.

Figure 3. Bilateral use did not result in significantly better performance on HINT sentences in quiet. This is likely due to ceiling effects in most subjects.

Figure 4. In noise, subjects 1, 2, and 5 performed better in the bilateral condition over the best unilateral condition, suggesting a binocular squelch affect.

SUMMARY

• Adult patients with sequential bilateral CIs do at least as well in the bilateral condition compared with performance in the best unilateral condition.

• Bilateral benefits are seen in noise compared with the best unilateral condition, and the magnitude of this improvement varied across subjects.

• The SSQ survey is a potentially useful instrument for subjectively assessing the benefits of bilateral cochlear implantation, and deserves further study.

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References


