Combined electro-acoustic stimulation: a beneficial union?

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CRD summary

The authors concluded that electro-acoustic stimulation (EAS) may offer a significant benefit over conventional cochlear implants in people with severe-to-profound high frequency hearing loss, but that there was a significant risk of loss of residual acoustic hearing. The authors' cautious conclusions appeared appropriate, but included studies were small and there were limitations in the reported review process.

Authors' objectives

To compare the effectiveness of combined electro-acoustic stimulation (EAS) to conventional cochlear implants or electrical stimulation alone and evaluate the safety of EAS in patients with severe-to-profound high frequency hearing loss.

Searching

MEDLINE, EMBASE, The Cochrane Library, CINAHL, PsycINFO and AHMED were searched without language restriction from 1950 (or starting date of searchable records) until April 2008; search terms were reported. Retrieved articles and reviews were cross-checked for relevant studies.

Study selection

Studies were eligible if they met the criteria for effectiveness or safety or both in patients with severe-to-profound high frequency hearing loss and residual low frequency acoustic hearing. Studies were eligible for assessment of effectiveness if they compared combined EAS with either electrical stimulation alone in the same patients or against patients with conventional cochlear implants using tests of pitch perception that included reports of significant differences between groups. Studies were eligible for assessment of safety if they made comparisons between the proportion of patients with increased acoustic hearing loss (either total or substantial increase) across all frequencies with the proportion of patients with preserved low frequency acoustic hearing after implementation of a short intracochlear array.

In the included studies for assessment of effectiveness, four different makes of EAS systems were inserted in the cochlea of participants to a depth ranging from 10 mm to 24 mm. Assessments were mostly made using speech recognition in noise tests but a few assessments used speech recognition in multitalker babble and melody recognition. Assessments were mostly made at 12 months after implantation with a few assessments made at one and six months. In the included studies for assessment of safety, nine different makes of EAS systems were inserted to a depth ranging from 6 mm to 26.4 mm.

The authors stated neither how the papers were selected for review nor how many reviewers performed the selection.

Assessment of study quality

The authors assessed the internal validity of the included studies according to the grading system of the Centre for Evidence Based Medicine in Oxford. Cohort studies were graded 2b if three of the following four domains were achieved: a control was used; known and established confounders were identified and controlled; and outcomes were measured objectively and follow up was greater than or equal to three months. Otherwise, the cohort study was graded as 4.

The first author carried out the validity assessments.

Data extraction

Data were extracted on the insertion depth of the cochlear implant, model or manufacturer of the implant, hearing test used to assess auditory performance and findings, and proportions of patients who had either total loss of acoustic
hearing (defined as no response at the maximal level of the audiometer or total loss reported by the authors of the study) or substantial increase in acoustic hearing loss (defined as increased hearing thresholds of >20 decibels (dB) or total loss of acoustic hearing).

The authors stated neither how data were extracted nor how many reviewers performed the data extraction.

**Methods of synthesis**

For assessment of effectiveness, data were combined in a narrative synthesis by counting the number of studies that found a significant difference between groups. For assessment of safety, a quantitative synthesis of the data was performed to determine the outcomes. No 95% confidence intervals were calculated around the proportions with hearing loss.

**Results of the review**

Twelve studies (n=93 with EAS) were included for assessment of effectiveness and 23 studies (n=253 with short cochlear implant) were included for assessment of safety. Four studies contributed data for both effectiveness and safety. For assessment of effectiveness, the size of the studies ranged from one to 14 participants (who had combined EAS). Ten cohort studies had a 2b level of evidence. Two case reports had a 4 level of evidence. For assessment of safety, the size of the studies ranged from one to 48 participants, with most studies having fewer than 20. Fourteen cohort studies had a 2b level of evidence. Six cohort studies and three case control studies had a 4 level of evidence.

Eleven out of twelve included studies reported a significant benefit in pitch perception for patients with EAS when compared to conventional cochlear implants or electrical stimulation alone. Of patients implanted with a short cochlear implant, 13 per cent lost all their residual acoustic hearing and 24 per cent had a substantial increase in acoustic hearing loss.

**Authors’ conclusions**

For patients with severe-to-profound high frequency hearing loss, combined electro-acoustic stimulation (EAS) appeared to offer significant long term everyday benefit, but there were risks of loss of residual acoustic hearing with the implantation of the shorter cochlear implant that is required for EAS.

**CRD commentary**

The review had clearly stated inclusion criteria with respect to participants and treatments, with no restriction for study design. Outcomes relating to effectiveness and safety had separate inclusion criteria, search strategies and assessments. The authors searched six relevant databases without language restriction and efforts were made to find further information by reviewing reference lists. Publication bias was not assessed and no explicit attempts were made to access grey literature. Methods were not used to minimise bias and reviewer error in the selection of studies, data extraction and quality assessment, so bias and error during these processes cannot be ruled out. The included studies were mostly graded with a 2b level of evidence, indicating cohort studies without serious methodological flaws, but most studies had very few participants. Assessment of the effectiveness of EAS, the proportion of studies reporting a significant difference between EAS and either electrical stimulation alone or conventional cochlear implants, did not give a measurement of benefit and confounding factors such as electrode insertion depth. Factors relating to auditory function were not controlled for. Assessment of safety, either substantial or total loss of acoustic hearing, was not explained by insertion depth of cochlear implants. The authors’ cautious conclusions reflected the evidence presented and appeared reliable, although lack of reporting of some aspects of the review process made it difficult to determine if studies were missed or errors made in selection, data extraction and quality assessment.

**Implications of the review for practice and research**

Practice: the authors did not state any implications for practice.

Research: the authors stated that larger trials were required that allowed a greater range of factors to be analysed, such as electrode insertion depth and impact on tests of music appreciation, to determine whether the potential benefit of EAS is consistent. They also stated that longer-term trials were required to determine whether further decline of residual acoustic hearing would impact on the safety of the procedure.
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