Bone-anchored hearing aids (BAHAs) for people who are bilaterally deaf: a systematic review and economic evaluation

CRD summary
This well conducted systematic review concluded that there may have been improvements with bone-anchored hearing aids compared with no hearing aid and compared with conventional bone-conduction hearing aids, for people who are bilaterally deaf, but the evidence was of poor quality. These cautious conclusions are appropriate.

Authors' objectives
To assess the clinical and cost effectiveness of bone-anchored hearing aids for people who are bilaterally deaf. This DARE abstract focused on the assessment of clinical effectiveness.

Searching
Nineteen electronic databases (including MEDLINE, EMBASE and sources of ongoing and unpublished studies) were searched from inception to November 2009; search terms were reported. The authors also searched reference lists of relevant papers and contacted clinical experts and manufacturers in an attempt to identify further relevant studies.

Study selection
Prospective studies and cross-sectional studies of bone-anchored hearing aids compared with conventional hearing aids, unaided hearing or ear surgery, or that compared unilateral and bilateral bone-anchored hearing aids were eligible for inclusion. Participants were adults or children with bilateral deafness. Outcomes of interest were hearing measures, aided hearing thresholds, speech recognition scores, validated measures of quality of life and patient satisfaction and adverse events. Studies that compared different models of bone-anchored hearing aids were excluded.

The included studies were primarily conducted in adults, but a few studies were conducted in children, or adults and children. Patients suffered from a range of hearing loss conditions, both congenital and acquired. The models of bone-anchored hearing aid used were the Classic, Classic 300, Compact, Cordelle, Divino, Superbass, Intenso, HC200, HC220 and HC300. Studies were conducted in the UK, Sweden, Netherlands, Switzerland and Mexico.

Two reviewers independently assessed studies for inclusion.

Assessment of study quality
The quality of the included studies was assessed based on the following criteria: selection bias, study design, confounders, blinding, data collection methods, withdrawals and dropouts, integrity of the intervention and analysis. The assessment was undertaken by one reviewer and checked by a second reviewer; disagreements were resolved through discussion or arbitration by a third reviewer.

Data extraction
Data were extracted on audiological outcomes and self reported outcomes. Data extraction was undertaken by one reviewer and checked by a second reviewer; disagreements were resolved through discussion or arbitration by a third reviewer.

Methods of synthesis
A narrative synthesis was presented.

Results of the review
Twelve studies were included in the review (number of participants unclear); seven cohort pre-post test studies and five cross-sectional studies. The quality of the included studies was poor.

Seven studies compared bone-anchored hearing aids with conventional hearing aids. Some outcomes were better with bone-anchored hearing aids, some outcomes were better with conventional hearing aids and some results were
inconsistent between studies. Statistical analysis was seldom reported in the included studies. Improvements in quality of life were found for bone-anchored hearing aids when using a hearing-specific instrument (one study), but not with generic quality of life measures.

Four studies compared bone-anchored hearing aids with unaided hearing; improvements were found in sound field thresholds and speech audiometry with bone-anchored hearing aids compared with unaided hearing.

Four studies compared unilateral and bilateral bone-anchored hearing aids. Improvements were found in sound field average tone thresholds in adults, speech recognition thresholds and localisation of sound with bilateral bone-anchored hearing aids. Similar results were found for unilateral and bilateral bone-anchored hearing aids for most items of the Meaningful Auditory Integration Scale and Meaningful Use of Speech Scale and the International Outcomes Inventory for Hearing Aids.

No studies were identified that compared bone-anchored hearing aids with ear surgery.

Limited data were reported on adverse events.

**Cost information**
A systematic review identified no relevant economic evaluations of bone-anchored hearing aids, so the authors developed a decision-analytic model. The incremental cost per user who received a bone-anchored hearing aid, compared with a bone conduction hearing aid, was £16,409 for children and £13,449 for adults. The cost per case successfully treated with a bone-anchored hearing aid was estimated at £18,681 for children and £15,785 for adults, over a 10-year time horizon. The incremental cost per quality adjusted life year (QALY) was between £55,642 and £119,367 for children and between £46,628 and £100,029 for adults for bone-anchored hearing aids compared with bone conduction hearing aids. The authors cautioned that owing to the paucity of evidence on the benefits of bone-anchored hearing aids and overall impact on quality of life, these results should be interpreted with caution.

**Authors' conclusions**
The available evidence was methodologically weak, so there was a high degree of uncertainty about the conclusions of this systematic review. The findings suggested that hearing was improved with bone-anchored hearing aids compared with no hearing aid. Limited data suggested an improvement in quality of life with bone-anchored hearing aids compared with conventional hearing aids. The evidence also suggested that there were some benefits of bilateral bone-anchored hearing aids compared with unilateral bone-anchored hearing aids.

**CRD commentary**
The review question and inclusion criteria were clearly reported. The search strategy was extensive, including attempts to identify unpublished studies. The process used for study selection, data extraction and quality assessment minimised the risk of reviewer bias and error. The validity of the included studies was assessed using appropriate criteria, however the included studies were generally small and of poor quality. A narrative synthesis was presented, which was appropriate. This was a well conducted systematic review. The authors' conclusions are appropriately cautious and are likely to be reliable.

**Implications of the review for practice and research**
**Practice:** The authors did not state any implications for practice.

**Research:** The authors stated that a national audit of bone-anchored hearing aids was required to provide clarity on the many areas of uncertainty surrounding bone-anchored hearing aids. Further research was required to assess the non-audiological benefits of bone-anchored hearing aids, such as quality of life. Good quality trials were required to establish the benefits of bilateral bone-anchored hearing aids compared with unilateral bone-anchored hearing aids in people who are bilaterally deaf.

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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.