

The Ear Foundation

deaf children hearing and communicating



Implantable Bone Conduction Aids, also known as Bone Anchored Hearing Aids

A review of publications

**The Ear Foundation for Cochlear Europe
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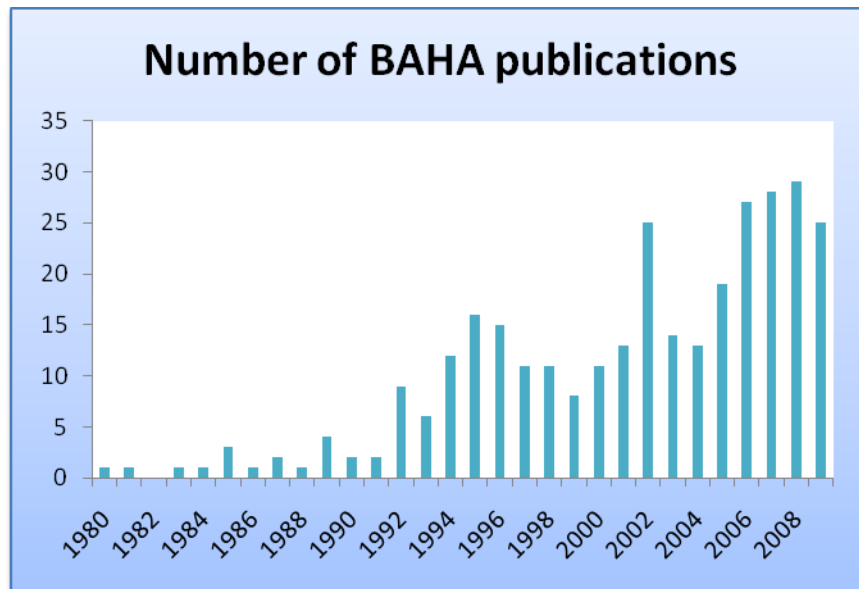
Introduction

Implantable Bone Conduction Aids, also known as Bone Anchored Hearing Aid (BAHA) the term which will be used for ease in this report, are hearing aids which, as the name suggests, are anchored to the bone. They facilitate hearing through bone conduction. It became possible when it was realised that titanium could be used which allows successful bone implantation. BAHAs were originally intended for people with chronic infection of the ear canal who could not wear in-the-ear aids based on air conduction, and people with malformed or absent outer ears or ear canals. More recently the use of BAHAs with people with unilateral losses has developed, the aim being to provide bilateral hearing for this group.

In order to carry out a review of research in this area, a search was carried out of 2009 of five biomedical data bases, specifying the following terms: (hearing AND aid*) OR (hearing AND device*) OR (hearing AND instrument*) AND (bone anchor* OR BAHA).

Three hundred and eleven papers were identified, the earliest being published in 1980, which followed the first fitting of a BAHA in 1977. As one might expect, there were fewer papers in the early days, 15 in the 1980s increasing to 92 in the 1990s. However by 2001 there were at least 13 papers a month were being published, and by 2006, more than 25 a month. It seems likely that in 2009 the total number will eventually exceed the 29 month per published in 2008, indicating the ever growing interest in this topic.

Figure Number of publications concerning BAHA from 1980 until the present



Early publications

The very first papers published in the early 1980s were largely concerned with the technology and particularly the use of titanium. Tjellstrom and his colleagues in the USA reported on a group of 14 patients and found that the implants were integrated with the living bone tissue and remained so for a period of at least 53 months (260, 261, 262). This is attributed in part at least to the use of the titanium implant and titanium screws. The importance of the use of titanium to the whole BAHA project is apparent from the fact that titanium is a focus of 20% of all papers considered in this review (61/311), although it is less of a focus as time goes on, being 67% of all papers published in the 1980s, 30% of those published in the 1990s and only 11% of papers published in the 2000s. More recent papers discussing titanium have been more concerned with the value of different implants and different patterns of implantation, (74, 76, 113, 161, 296)

Early studies reflected a concern with the safety of the device and issues around infection. Thirteen papers considered this, (4%) and the general conclusion was that these devices were safe. Problems that emerged were reported in only a relatively small number of situations. In most instances further treatment meant these problems could be resolved, though in a small minority, the BAHA could not be used successfully. There was also an interest in the efficacy of the BAHA compared with other possible aids, with many findings endorsing the use of the BAHA in many different situations and for many different types of hearing loss.

Failure of the device was also an issue, either failure in the implantation process, or failure to implant and achieve osseointegration. Studies reported very low failure rates, and some studies had none at all. Where there was a

more significant number there was a specific reason, such as failure to integrate related to previously irradiated bone. (2) .

Studies involving children

Only 20% of the studies reviewed (63 out of 311) included children, some looking at children only and others including children in a wider study of adults. Papers concerned with children did not really begin to be published until the mid 1990s although there were two isolated examples, one in 1992 and one in 1993. However, these two specifically focussed on surgical factors. Seven of the studies of children (11%) were published by the Birmingham group. As with studies of adults, the earliest studies of children were concerned with surgical and practical issues of using the BAHA with children, although later studies did include consideration of the changes that the BAHA could make to the ability to make use of hearing and changes in quality of life.

Speech perception, recognition and intelligibility

In general, for both adults and children, fewer papers among those reviewed addressed issues concerning the impact of the BAHA on daily life or patient satisfaction with the BAHA compared with those considering surgical and medical issues. The major emphasis in this general area of impact on patients' lives was aspects of speech perception, recognition and intelligibility as well as sound localisation. Forty five of all papers (14%) considered or reported on one or more of these aspects. These areas were often considered through audiological measures, though some papers reported on patient reports of experience usually based on questionnaires.

Many of the publications considering this topic compared the BAHA, with conventional air conduction aids. (15, 29, 49, 138, 179, 181, 183, 216, 231, 232, 233, 234, 249, 300) Overall the BAHA was found to be better in most areas of speech, although the papers suggested that conversation in situations where there were high levels of background noise was not improved. Also, while one to one conversations were easier with a BAHA, conversations in groups remained difficult.

Sound localisation

The issue of sound localisation was also a focus of research. Many papers suggested that localisation and, in addition, conversation in noise could be improved by the use of two BAHAs, or a BAHA in conjunction with another hearing aid. . Many papers made strong recommendations for the use of two BAHAs where appropriate. The evidence on the use of a BAHA for patients with a unilateral hearing loss to give binaural hearing has been less conclusive and more controversial. While some papers suggested that sound localisation could be improved in this way, others did not obtain such clear cut results, particularly with more profound unilateral losses.

Patient satisfaction and dissatisfaction

Among those papers looking expressly at patient satisfaction or dissatisfaction with the BAHA there was overwhelming support for this aid. Twenty one papers mentioned patient satisfaction (10%), while only four mentioned aspects of the BAHA which lead to dissatisfaction (1%).

Areas of satisfaction that were described included 'a high degree of satisfaction was expressed as regards sound implication, listening to the radio or television news, listening to music, speech perception in quiet situations' (60), improvements were found in 'practical arrangements, wearing comfort, aesthetic appearance and sound quality, although improvements in speech reception were not verified by discrimination tests' (88, 89, 90, 96) 'the use of a bone anchored hearing aid significantly enhanced general well being, improved the patient's state of health and was finally consider a success by patients and families' (62, 169) 'Results revealed improvement in speech discrimination, sound quality and comfort for all patients. Improvements in confidence, self-image and socialisation were also experienced' (100). 'Overall, patients were satisfied with their BAHA and would still elect to have the procedure if given a second chance' (190) 'Our patients report a high level of satisfaction and continued use of their devices' (224) 'Improved subjective hearing clarity, reduced ear discharge rates and extended BAHA usage accounted for the high satisfaction with the BAHA system.' (244) 'The most commonly reported benefits include hearing better and clearer, ease of use, inconspicuousness, and the fact it made the individual more confident' (252) Dissatisfaction was expressed in one paper about 'localisation abilities, phone usage and lack of availability of ongoing service and support' (100). Often it was only a minority of patients in a study who expressed dissatisfaction, 'only one patient (out of 40) expressed dissatisfaction with the device' (157)

Quality of life

In medicine in general there has recently been an increased focus on the impact of procedures and interventions on patient quality of life. Very few of the papers considered in this review looked specifically at quality of life. Only 26 of the 311 papers (8%) mentioned this in connection with BAHAs and of these 26 papers, four just reviewed or stated the conclusions of other studies with regard to quality of life and two were concerned with the development and validation of quality of life scales. Thus only 20 (6%) of all publications were concerned to look at patients quality of life.

The 6% of studies looking at quality of life all took place since the year 2000. All used questionnaires though some supplemented this by the use of interviews, or inspection of records. Most of those using a specific questionnaire used the Glasgow Benefit Inventory or the Glasgow Children's Benefit Inventory (8). This addresses some important factors, but is a rating scale which does not allow for exploration of the ways in which these factors affect the patient's life and thus the impact on quality of life. Thus, while the results for the BAHA were overwhelmingly positive much of the focus was on the implications for quality of life through discreet specific factors: e.g. the

greater comfort of the device, less problem from discharge from the ear or improved speech perception.

Comment

In general, the studies reported in this review rarely or never looked at the wider implications of the BAHA for quality of life, including communication in general, relationships with family and friends, impact on working and social life, feelings following implant and some time later and the extent to which expectations were met by the BAHA. There would seem to be a need for such studies to clarify and elaborate further on the success and positive benefits that have been brought about for many users of the BAHA.

With the current challenges in health-care provision and the demand for evidence of benefit from such interventions this is an area which is in need of urgent investigation and reporting.

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