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MAIN ARTICLE

Bone-anchored hearing aids and unilateral sensorineural hearing loss: why do patients reject them?

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Abstract

Objectives: This study aimed to report the bone-anchored hearing aid uptake and the reasons for their rejection by unilateral sensorineural deafness patients.

Methods: A retrospective review of 90 consecutive unilateral sensorineural deafness patients referred to the Greater Manchester Bone-Anchored Hearing Aid Programme between September 2008 and August 2011 was performed.

Results: In all, 79 (87.8 per cent) were deemed audiologically suitable: 24 (30.3 per cent) eventually had a bone-anchored hearing aid implanted and 55 (69.6 per cent) patients declined. Of those who declined, 26 (47.3 per cent) cited perceived limited benefits, 18 (32.7 per cent) cited reservations regarding surgery, 13 (23.6 per cent) preferred a wireless contralateral routing of sound device and 12 (21.8 per cent) cited cosmetic reasons. In all, 32 (40.5 per cent) suitable patients eventually chose the wireless contralateral routing of sound device.

Conclusion: The uptake rate was 30 per cent for audiologically suitable patients. Almost half of suitable patients did not perceive a sufficient benefit to proceed to device implantation and a significant proportion rejected it. It is therefore important that clinicians do not to rush to implant all unilateral sensorineural hearing loss patients with a bone-anchored hearing aid.

Key words: Hearing Aids; Adult; Prostheses and Implants; Hearing Loss, Unilateral

Introduction

Bone-anchored hearing aids (BAHAs) are bone-conducting hearing devices comprising a vibration transducer, microphone and power source in a single housing, which is directly coupled to the skull via a titanium fixture implanted into the mastoid bone. This allows sound to be directly transmitted to the cochlea via the skull, thus bypassing the tympanic membrane and ossicular chain. This route circumvents external and middle-ear pathology, and is the rationale for using a BAHA for conductive and mixed hearing loss, where the use of conventional hearing aids is contraindicated.[1] BAHAs also confer more efficient bone conduction compared with transcutaneous coupling of conventional bone conduction devices by up to 15 dB, particularly at the higher frequencies.[2] Direct bone conduction also requires less energy and is a more comfortable option for patients.[3]

Since Tjellström *et al*. first developed the procedure in the 1980s[4], the indications have changed.[1] BAHAs were first used in patients with conductive and mixed loss hearing, particularly in those with chronic discharging ears. They were later used in adults and children with congenital ear malformations, for whom fitting a mould is not possible, and in patients for whom previous ear surgery rendered them unable to wear conventional hearing aids.[1] Most recently, they have been used in unilateral sensorineural hearing loss (SNHL) patients for the contralateral routing of sound from the opposite side of the skull to the functional cochlea (circumventing the head-shadow effect), thereby improving directional hearing and sound recognition.[5,6] However, less than 20 per cent of this subgroup of hearing loss patients seem to take up BAHA after successful trialling.[7] This study aimed to investigate the reasons for BAHA rejection in this patient subgroup.

The original two-stage technique was described by Tjellström in 1989.[4] It involved an initial step of implanting a titanium screw into the temporal bone,

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with the periosteum in situ. After a period of three months, the titanium fixture was uncovered, its osseointegration was checked and subcutaneous soft tissue reduction of the skin flap was carried out prior to attachment of the abutment. The fixture was left for another month to allow the wound to heal before fitting the transduction aid. Some centres still specifically employ this technique for groups at a higher risk of failure of primary integration, in part because of an increased risk of abutment trauma and a tendency to use the shorter 3 mm fixtures for thinner, immature skulls.[8]

Tjellström and Ganström later described a one-stage technique for BAHA insertion in 1993, in which both the fixture and abutment were inserted simultaneously.[9] They went on to show that both techniques had similar success rates.[10] Kohan *et al.* reported similar findings, and also showed the one-stage procedure to be more cost-effective and to facilitate earlier hearing rehabilitation.[11] This helps minimise the risks associated with undergoing general anaesthesia twice, which is especially important because a significant proportion of these patients had syndromes involving craniofacial deformities associated with higher anaesthesia risks. This technique could also be carried out effectively under local anaesthetic.

A later, single-stage FAST technique described by the BAHA manufacturers (Cochlear Bone Anchored Solutions, Mölnlycke, Sweden) includes similar soft tissue reduction steps to the techniques described previously, but utilises a motorised dermatome, a 3- or 4-mm drill, and motorised abutment inserter to simplify the BAHA implantation surgery. A biopsy punch is then used to accurately expose the abutment through the skin flap.[12] A more recent linear incision technique which does not use skin flaps has also been described. This technique involves a small linear incision through the skin into the periosteum, without soft tissue reduction, thus avoiding morbidities associated with the use of longer abutments.[13]

To allow for sufficient osseointegration (the key to implant stability), 12 weeks has been the recommended time before sound processor loading in the single-staged technique.[11] A more recent implant which utilises a wider fixture and titanium oxide blasting to increase the bone–metal contact area and osseointegration has reduced the implant loading time to three weeks, and is especially suitable for patients with thin or compromised bone.[14]

The present study aimed to investigate the BAHA uptake rate in unilateral SNHL patients. In those who rejected this technology, we also investigated the reasons behind rejection.

Materials and methods

The cohort consisted of 90 consecutive unilateral SNHL patients referred to the Manchester BAHA Programme between September 2008 and August 2011. These patients were identified from the electronic database at the Audiology Department, Manchester Royal Infirmary. This retrospective review was performed on prospectively collected data.

All patients were referred from the Greater Manchester region and assessed in the Audiology Department, Manchester Royal Infirmary. The initial assessment included an interview, physical examination and audiological assessment. Those patients deemed audiologically suitable were offered a subsequent two-week BAHA trial with a Softband®, as well as a wireless contralateral routing of sound aid, at home. They were seen again approximately one month later to assess the results of the trial. Those who expressed an interest in BAHA implantation were subsequently referred to the implantation team. Those who declined were offered a wireless contralateral routing of sound aid or Softband.

The patients' clinical notes were then reviewed and data including patient demographics, hearing loss aetiology, date and outcomes of initial audiology assessments, outcomes of their BAHA or wireless contralateral routing of sound device trial, subsequent BAHA surgery, and, if applicable, the reasons for rejection were recorded.

Results

A total of 90 unilateral SNHL patients were included in this study, comprising 46 women and 44 men with an age range of 18–88 years (mean 51 years). Unilateral SNHL aetiologies are listed in Table I. Of the total, five patients (5.6 per cent) failed to attend their assessments at some stage and were excluded. In all, 79 (87.8 per cent) were deemed audiologically suitable for BAHA at the initial assessment. Of these, 77 patients subsequently underwent the BAHA trial and 2 rejected BAHA outright before trialling. Twenty-four suitable patients (30.4 per cent) eventually underwent BAHA

TABLE I
AETIOLOGY OF UNILATERAL SNHL

Aetiology	Patients (*n* (%))
Vestibular schwannoma surgery	27 (30.0)
Childhood dead ear (unknown aetiology)	9 (10.0)
Head injury	8 (8.9)
Vestibular schwannoma (watchful waiting)	7 (7.8)
Sudden onset SNHL	5 (5.6)
Mastoidectomy	3 (3.3)
Stapedectomy	3 (3.3)
Labyrinthectomy	1 (1.1)
Vestibular neurectomy	1 (1.1)
Other otological/cranial surgery	4 (4.4)
Otosclerosis	2 (2.2)
CSOM	1 (1.1)
Labyrinthitis	2 (2.2)
Mumps, childhood	1 (1.1)
Herpes oticus	1 (1.1)
Septicaemia	1 (1.1)
Idiopathic	14 (15.6)

CSOM = chronic suppurative otitis media; SNHL = sensorineural hearing loss

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TABLE II
EVENTUAL TREATMENT OF UNILATERAL SNHL PATIENTS*

Treatment	*n*	Suitable patients (%)
BAHA	24	30.4
Wireless CROS device	32	40.5
None	23	29.1

*n = 79. SNHL = sensorineural hearing loss; BAHA = bone-anchored hearing aid; CROS = contralateral routing of sound

TABLE III
REASONS FOR REJECTING BAHA IMPLANTATION

Reason for rejection	*n*	Percentage of rejections (%)	Percentage of suitable patients (%)
Perceived limited benefit	26	47.3	32.9
Anxiety about surgery	18	32.7	22.8
Prefer wireless CROS device	13	23.6	16.5
Cosmetic reason (including rejecting an abutment and implant)	12	21.8	15.2
Found headband uncomfortable; trial not completed	2	3.6	2.5
Prefer Softband	1	1.8	1.3
Unfit for surgery	1	1.8	1.3

BAHA = bone-anchored hearing aid; CROS = contralateral routing of sound

implantation; 55 (69.6 per cent) patients declined BAHA after the trial.

Table II shows the eventual outcome of all patients who were audiologically suitable for BAHA. Table III lists the reasons provided by suitable patients who declined surgery. Some patients gave multiple reasons; hence, the total was more than 55.

The main reason for rejection was a perception of limited benefit during the trial ($n = 26$; 47.3 per cent). The second most common reason was a reluctance to undergo surgery ($n = 18$; 32.7 per cent). Thirteen patients (23.6 per cent) preferred the wireless contralateral routing of sound system to the BAHA and 12 patients (21.8 per cent) cited cosmetic concerns, including rejection of the abutment, the appearance of the device itself and hair loss. A further two patients (3.6 per cent) found the headband uncomfortable enough to abandon the trial. One patient (1.8 per cent) preferred the Softband and another was unfit for surgery (1.8 per cent).

Of the patients who declined BAHA implantation, 32 (58.2 per cent) accepted the wireless contralateral routing of sound system.

Discussion

BAHA for single-sided deafness is a relatively new indication for this technology. The first series was reported in 2000, with 2 cases initially reported and a 29 patient series reported the following year.[15,16] Various studies have shown the BAHA to improve sound recognition and, to a lesser extent, directional hearing.[7,17–19]

This study indicates an overall uptake rate of 30.4 per cent in audiologically suitable patients. A recent study in Nijmegen showed that only 3 out of 10 patients (30 per cent) with single-sided deafness took up BAHA after trialling.[20] Andersen *et al*. showed that only 25 per cent (14 out of 59 patients) who had undergone previous vestibular schwannoma excision proceeded with BAHA insertion.[21] Schroder reported a 19 per cent uptake rate in post-operative vestibular schwannoma excision patients.[7] Hence, our uptake rates are consistent with those of other reported series.

It is notable that nearly half of the eligible patients in our study who declined BAHA cited limited or insufficient benefit from the trial. Although no direct comparisons have been reported, this rate does appear high, especially when multiple studies have shown the benefits of the device in this subgroup of patients.[7,17–19]

Sixteen out of 26 (61.5 per cent) patients who cited an insufficient benefit from the BAHA trial subsequently accepted the wireless contralateral routing of sound system. This group found contralateral routing to be beneficial and may have preferred a non-invasive solution to hearing improvement.

When comparing the functional benefit of BAHA across different auditory profiles, van Wieringen *et al*. and Tringali *et al*. showed that single-sided deaf patients perceived less benefit from the device compared with other subgroups, including those with single and bilateral conductive or mixed hearing loss.[22,23]

For this patient subgroup, alternative technologies could be considered. Recently, cochlear implants have been trialled for unilateral SNHL treatment in Germany. Arndt *et al*. reported a series of 11 patients who underwent cochlear implantation for unilateral SNHL of varying aetiology.[24] All patients were trialled with a BAHA Intenso on a Softband or tension clamp as well as a contralateral routing of sound hearing aid prior to cochlear implantation. The authors reported that cochlear implantation improved hearing outcomes in these patients and was superior to the alternative treatment options. Furthermore, the use of cochlear implants did not interfere with speech understanding in the normal hearing ear. Although the study numbers are small, the results are certainly encouraging. However, cochlear implants would only be suitable for those with an intact cochlea and auditory nerve, which would rule out almost half of our cohort, particularly those with previous vestibular schwannoma surgery.

In this study, 32.7 per cent of audiologically suitable patients refused any surgical intervention; most of these accept the wireless contralateral routing of sound system. We postulate that although they perceived

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benefits from the trial, the benefits were insufficient to outweigh their anxiety of surgery and the potential associated complications, that is, patients' risk–benefit analysis did not favour surgery.

A further 23.6 per cent of BAHA-rejecting patients preferred the wireless contralateral routing of sound system (all of our patients trialled a BAHA Softband and a wireless contralateral routing of sound device as part of their assessment). This might have been because the contralateral routing of sound system confers a hearing benefit without the need for a surgical procedure involving a percutaneous fixture and associated time costs and subsequent rehabilitation. This is a device that is available very quickly and patients can see more immediate tangible benefits.

- **Bone-anchored hearing aids bypass external and middle-ear pathologies**
- **Out of 90 unilateral sensorineural hearing loss patients, only 27 underwent bone-anchored hearing aid implantation**
- **Of the suitable patients, 41 per cent had the wireless contralateral routing of signal aid fitted**
- **Thorough patient assessment and selection is needed to ensure that patients are not pushed towards implantation**

Only 21.8 per cent of BAHA-rejecting patients cited cosmetic concerns. Most had concerns regarding the abutment size; other concerns were hair loss and the appearance of the BAHA device itself. Interestingly, male patients mostly reported this as a reason for declining BAHA implantation (male-to-female ratio of 3:1). It may be that men find it more difficult to disguise the device and its cosmetic effects. The linear incision technique without soft tissue reduction may help to address such concerns by minimising hair loss and skin necrosis. Newer transcutaneous devices which negate the need for an abutment, such as the MED-EL Bonebridge™ and Sophono Alpha™ devices, may also alleviate these aesthetic concerns.

Conclusion

BAHA is not a solution for every unilateral SNHL patient. Our study highlights an uptake rate of 30.4 per cent in audiologically suitable patients. Almost half of all suitable patients did not perceive a sufficient benefit from the device to proceed with implantation. In all, 40.5 per cent of patients were satisfied with the conventional wireless contralateral routing of sound system.

A significant proportion of BAHA rejections were based on a reluctance for any surgical intervention and for cosmetic reasons. The use of alternative surgical techniques such as the linear incision without soft tissue reduction and the use of transcutaneous devices may help address these concerns in this patient subgroup.

Only a minority of patients eventually chose BAHA implantation. It is therefore important for the clinician to appreciate this and not to rush to implant BAHAs in all unilateral SNHL patients.

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