Surgical Outcome of Bone Anchored Hearing Aid (Baha) Implant Surgery: A 10 Years Experience

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Abstract Bone anchored hearing aid (Baha) implant is an option for patient with canal atresia, single sided deafness (SSD) and chronically discharging ears despite treatments. This retrospective study was conducted from 2001 to 2011 to evaluate the surgical outcome of Baha implant surgery. Thirty-three patients were identified during this study period. Their age at implantation ranged from 5 to 40 years. Of 33 patients, 29 (87.9 %) patients had bilateral microtia and canal atresia, 3 (9.1 %) patients had unilateral microtia and canal atresia and 1 (3.0 %) patients have SSD following labyrinthitis. One patient (3.2 %) had major complication which is loss of implant due to failure of osseointegration. Soft tissue reactions were seen in 7 patients (21.1 %). Of these 7 patients, 4 patients required 3–4 procedures as day care operation for excision of the skin overgrowth surrounding the abutment. Recurrent antibiotic treatment was required in 3 patients (9.7 %). None of our patient had history of intra-operative or peri-operative complication following Baha surgery. The commonest complications are local infection and inflammation at the implant site. None of our patient had history of intraoperative or peri-operative complication following Baha implant surgery.

Keywords Bone anchored hearing aid · Canal atresia · Microtia · Hearing loss · Single sided deafness

Introduction

Baha implant consists of two parts that are the titanium fixture and the sound processor. The processor is attached to the titanium fixture by a skin penetrating abutment. The sound processor has been recently manufactured as a more compact device thus improving its aesthetic appearance. The concept of titanium osseointegration in bone conduction hearing aids was initially introduced by Tjellstrom in 1977 [1].

Previously bone conduction hearing aid is the main option to patients who need hearing rehabilitation during infancy. It can be used effectively by pediatric and adult patients who are not suitable surgical candidates for canal-plasty. Baha implant has to be surgically implanted to obtain skin penetrating coupling [2, 3]. The indications for Baha implant are classified as otological or audiological. Otological indications include congenital malformations of the external ear canal and middle ear, acquired canal stenosis, otosclerosis who are unfit surgical candidates. It also includes those with chronically discharging ear or recurrent otitis externa [4, 5]. Audiological indications comprise of those with conductive or mixed hearing loss and those with single sided sensorineural deafness whereby the device picks up sound on the deaf side and transmit via bone conduction to the contralateral intact cochlea [4, 5]. Relatively little has been published about the difficulties encountered during the insertion of osseointegrated implants for the attachment of bone anchored hearing aids (Baha) or the complications encountered after surgery [6]. Snyder et al. [7] identified the complicating medical factors for graft loss. They include

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smoking, steroid use and diabetes. However, they had a small study size which did not allow statistical correlation. However, the health of the titanium implant and the ultimate success of the Baha depend heavily upon meticulous surgical care and cleaning of the abutment.

Materials and Methods

Data from patients who underwent Baha implant surgery at A Medical Center from December 2001 until December 2011 were collected. The demographic data, age of surgery, indications, surgical complications and device used were studied. The implantation required two stages of surgery in pediatric patient patients and a single stage implantation was performed in older children (above 12 years old). Preoperatively an audiological assessment was conducted. Patients were informed about the risks of surgery. The Baha implant surgery is performed under daycare surgery. The surgical procedure followed the standard surgical guideline. During the first surgery a 3 to 4 mm threaded flange fixture was carefully inserted 55–60 mm behind and 30 mm above the external ear canal. The skin was closed over the fixture. The second stage surgery was performed at least 4 months later to allow osseointegration to take place. In the second surgery the skin flap around the fixture was raised and trimming of subcutaneous fat was performed. The skin covering the fixture was then punched and the fixture exteriorized. The abutment was subsequently fixed to the fixture and dressing done with antibiotic soaked ribbon gauze. At 1 month postoperatively the sound processor was fitted by our audiologist. In a single stage implantation the surgical procedures described above were done sequentially in one surgery. The patients were then followed up a week later to assess healing of the wound and to remove the suture material.

Result

A total of 33 patients had implantation of bone anchored hearing aid within the study period. They consist of 21 (64 %) males and 12 (36 %) female. Their age at implantation ranged from 5 to 40 years as shown in Table 1. All procedures were done under general anesthesia. Twenty-nine (87.9 %) patients had bilateral microtia and canal atresia, 3 (9.1 %) patients has unilateral

microtia and canal atresia and 1 (3.0 %) patients had single sided deafness following labyrinthitis.

The implantation of bone anchored hearing aid was done in single stages in 12 (36.4 %) patients whereas the others have two stage Baha procedures. The time period between the first and second procedure was between 3 to 6 months with the mean of 4.3 months. The patient who required 6 months before the second surgery was a patient who had Pierre Robin syndrome. His age at surgery was 6 years. He was noted to have abnormal bone intraoperative during the first and second operation. He had multiple skin reaction after the first surgery. A few months after the second surgery he had implant failure. All patients had their hearing aid fitted at 1–2 months after application of abutment without post operative complications occurred. The type of sound processor used is shown in Table 2. In this series, patients were followed up from 6 to 44 months postoperatively with a mean follow up period of 32 months.

Soft tissue reactions were seen in 7 patients (21.2 %). Of these 7 patients, 4 patients (12.1 %) required three to four procedures as day care operation for excision of the skin overgrowth surrounding the abutment (Holgers's Grade 3). Finally a good margin of skin surrounding the abutment was excised and split skin graft was laid to cover the exposed mucoperiosteum of the skull bone. This technique was successful to prevent further overgrowth of the skin into the abutment. Recurrent antibiotic treatment was required in 3 patients (9.1 %) Holgers's Grade 2. Mild skin reaction found in 3 patients which does not required any antibiotic. (Table 3). None of our patient had history of intraoperative or peri-operative complication following Baha surgery. Those patients without skin overgrowth were happy with Baha and they used for more than 8 h a day.

Discussion

The complication of Baha implant surgery can occur intraoperatively or postoperatively complications. Intraoperative complications such as bleeding can occur in children as the skull is thin. Bleeding from the injury of the durra can easily be controlled by plugging bone wax. Sometimes the surgeon needs to do 3–4 drilling in order to get proper placement of the fixture. Post-operative complications are few. The commonest complications are local infection and inflammation at the implant site as well as a failure to osseointegrate.

Table 1 Distribution of patient age at the time of Baha implant surgery

Age (years)	0–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40
No. of patient	6	12	5	5	1	2	0	2

Table 2 Types of sound processor device of Baha implant

Model of sound processor device			
Classic	Compact	Divino	BP100
2	10	5	16

Table 3 Postoperative complications

Post operative complication	Skin reaction was based on Holgers et al. [12] Grade	No. of patients	Percentage (%)
No irritation	0	22	66.7
Slight redness	1	3	9.1
Red and moist, no granulation tissue	2	3	9.1
Red and moist with granulation tissue	3	4	12.1
Failure of osteointegration		1	3.0

Majority of our patients (87.9 %) has Baha for bilateral microtia and canal atresia. The minimal age of Baha implant operation is 5 years old. However a study by Dutt et al. [8] showed that the earliest age for implant fixture is possible at 2 years old. As the thickness of the temporal bone is critical for implant integration, many authors suggest to have high resolution computed tomography of the temporal bone before planning for fixture implant at 2 or 3 years of age [1]. The thinner skull will limit the length of titanium fixture that can be safely placed. Papsin et al. [9] reported that shorter fixture length is associated with higher failure rate of osseointegration. Concerns were raised with regards to the impact of bony skull growth towards the implant whereby the implant may become more deeply positioned with time. The first child that was implanted by the Gothenburg team was a 13 year old with mandibulo-facial dysostosis who still uses the same implant after more than 20 years [1]. This shows that the implant does not interfere with the bony skull growth. Most our patients (63.6 %) had two stage surgeries. Some authors even advocate the implantation of sleepers that is more than one titanium fixture implant in cases of probable failed osseointegration [9, 10]. There was only one patient where we put sleeper. He has Pierre Robin Syndrome with multiple skin overgrowth. The hearing outcome of our local data was reported by Mazita A et al. [11] showed the overall mean functional gain with Baha implant was 35.2 dB.

Holgers et al. [12] classified the skin reactions into grade 0 for no irritation, grade 1 for slight redness, grade 2 for red and moist, no granulation tissue, grade 3 for red and moist

with granulation tissue and grade 4 for revision of skin penetration necessary. Loss of the osseointegrated fixture from the skull is a serious complication. Many cases of fixture loss have been reported as a result of trauma, especially in pediatric patients and those with poor hygiene [13]. Recent paper reported implant loss occurred in two patients (4.2 %) after a two-stage surgery. Overall, the local complication rate was not different in the one-stage and in the two-stage group [14]. Soft tissue overgrowth or sagging with gravity may interfere with the mating of the Baha transducer to the abutment. This can be avoided by generous soft tissue reduction especially in the superior part. Partial loss of graft can be handled by local wound care consisting of wet-to-dry dressings, and the open wound around the implant eventually heals by secondary intention. The other option which can be considered in case of big defect or total loss of the graft is to repeat the skin graft which can be harvested from the nearby region after shaving or from a distal hair-free area. Pelosi S and Chandrasekhar SS suggest using 8.5 mm abutment in preventing the need for additional surgical intervention with post-implantation soft tissue overgrowth [15]. The Baha implant related pain is a rare complication and none of our series has chronic pain post Baha implant surgery.

The risks associated with Baha implantation are failure of osseointegration and local skin infection or overgrowth into the abutment. There has been no previous report of osteomyelitis. A study of their first 100 children with osseointegrated implants for Baha or auricular prostheses quoted a 5.8 % implant failure rate¹. Therefore the implantation of Baha is justifiable in terms of low risk surgery. Previous study reported that traumatic revision of fixture loss is greater in the pediatric population than the adult population [16]. Other study reported that no significant difference in the rate of trauma between the younger (<5 years old) and older (>5 years old) groups. The mean $\pm$ SD inter stage interval was 7.72 ± 3.81 months for the younger children, which was significantly longer than for the older children (4.41 ± 2.51 months) [17].

Conclusion

The commonest complications are local infection and inflammation at the implant site. None of our patient had history of intraoperative or peri-operative complication following Baha surgery.

¹ Implant failures were 5.8% of 170 inserted fixtures. Adverse skin reactions appeared in 9.1% of patients over a 21-year follow-up period. Revision surgery was undertaken in 22% of patients because of appositional growth of the temporal bone.

References

1. Granstrom G, Bergstrom K, Odersjo M, Tjellstrom A (2001) Osseointegrated implants in children: experience from our first 100 patients. *Otolaryngol Head Neck Surg* 125(1):85–92
2. Snik AFM, Bosman AJ, Mylanus EAM, Cremers CWRJ (2004) Candidacy for the bone- anchored hearing aid. *Audiol Neurotol* 9:190–196
3. Van Der Pouw CTM, Snik AFM, Cremers CWRJ (1999) The BAHA HC 200/300 in comparison with conventional bone conduction hearing aids. *Clin Otolaryngol* 24:171–176
4. Wazen JJ, Caruso M, Tjellstrom A (1998) Long term results with the titanium bone-anchored hearing aid: the US experience. *Am J Otol* 19(6):737–741
5. Lustig LR, Arts HA, Brackmann DE, Francis HF, Molony T, Megerian CA, Moore GF, Moore KM, Morrow T, Potsic W, Rubenstein JT, Srireddy S, Syms CA, Takahashi G, Vernick D, Wackum PA, Niparko JK (2001) Hearing rehabilitation using the BAHA bone-anchored hearing aid: results in 40 patients. *Otol Neurotol* 22:328–334
6. Abdulrahman H (2007) BAHA: bone-anchored hearing aid. *Int J Health Sci (Qassim)* 1(2):265–276
7. Snyder MC, Moore GF, Johnson PJ (2003) The use of full-thickness skin grafts for the skin-abutment interface around bone-anchored hearing aids. *Otol Neurotol* 24(2):255–258
8. Dutt SN, McDermott A-L, Jelbert A, Reid AP, Proops DW (2002) The Glasgow benefit inventory in the evaluation of patient satisfaction with the bone-anchored hearing aid: quality of life issues. *J Laryngol Otol* 116(28):7–14
9. Papsin BC, Sirimanna TKS, Albert DM, Bailey CM (1997) Surgical experience with bone-anchored hearing aids in children. *Laryngoscope* 107:801–806
10. Zeitoun H, De R, Thompson SD, Proops DW (2002) Osseointegrated implants in the management of childhood ear abnormalities: with particular emphasis on complications. *J Laryngol Otol* 116(2):87–91
11. Mazita A, Wan Fazlina WH, Abdullah A, Goh BS, Saim L (2009) Hearing rehabilitation in congenital canal atresia. *Singapore Med J* 50(11):1072–1076
12. Holgers KM, Tjellstrom A, Bjursten LM, Erlandsson BE (1998) Soft tissue reactions around percutaneous implants: a clinical study of soft tissue conditions around skin-penetrating titanium implants for bone-anchored hearing aids. *Am J Otol* 9(1):56–59
13. Tjellstrom A, Granstrom G (1994) Long-term follow-up with the bone-anchored hearing aid: a review of the first 100 patients between 1977 and 1985. *Ear Nose Throat J* 73(2):112–114
14. Marsella P, Scorpecci A, Pacifico C, Presuttari F, Bottero S (2012) Pediatric BAHA in Italy: the “Bambino Gesù” children’s hospital’s experience. *Eur Arch Otorhinolaryngol* 269(2):467–474
15. Pelosi S, Chandrasekhar SS (2011) Soft tissue overgrowth in bone-anchored hearing aid patients: use of 8.5 mm abutment. *J Laryngol Otol* 125(6):576–579
16. Tjellstrom A, Hakansson B, Granstrom G (2001) Bone-anchored hearing aids: current status in adults and children. *Otolaryngol Clin North Am* 34:334–337
17. Taryn D, Karen AG, Doug C, Blake CP (2007) Bone-anchored hearing aids in infants and children younger than 5 years. *Arch Otolaryngol Head Neck Surg* 133(1):51–55