

청각신경종양 제거술 후 발생한 일측 청력저하 환자들에서 Baha Attract를 이용한 청각재활 효과

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Hearing rehabilitation with Baha Attract in patients with single-sided deafness after vestibular schwannoma removal

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Background : Single-sided deafness (SSD) is defined as a unilateral sensorineural deafness in the poorer ear, and vestibular schwannoma itself, or treatment of it can cause patients SSD. So there were many treatments for SSD, such as hearing aids, bone-anchored hearing devices, but which had many disadvantages. Now newly developed system, Baha Attract have some advantages.

Methods : As a case series study, retrospective chart review was conducted for 4 patients who had undergone Baha Attract implantation after removal of vestibular schwannoma for rehabilitation of SSD by one senior surgeon (M.I.S.) at a single tertiary hospital in 2021. We analyzed the clinical features, radiologic findings (computed tomography [CT], magnetic resonance imaging [MRI]), hearing tests (pure tone audiogram), and surgical outcomes of the patients.

Results : All patient took postoperative temporal MRI of schwannoma removal, temporal bone CT, pure tone audiogram. During 2-5 months outpatient follow-up, of course there should be further long period observation, we concluded there were some advantages of patient's hearing level.

Conclusions : There should be a lot of further studies in Baha Attract implant model, it can be one of useful treatments for SSD patients to improve hearing levels

Key Words

Correction of hearing impairment, Hearing loss unilateral, Schwannoma, Bone conduction

INTRODUCTION

Vestibular schwannoma (VS) is slowly growing tumor which originated from eighth cranial nerve. So VS itself or treatment of VS can cause single-sided deafness (SSD).[1]

SSD is defined as a unilateral sensorineural deafness in the poorer ear. It has been proved that patients with unresolved SSD experience significant problems using only monoaural listening.[2,3] They have problems in understanding speech, and of course they are very frustrated when receiving important speech information from both sides.[2,3]

In the past, patients with SSD had limited options, with the most prevalent choice being to simply to do nothing. In the year 1965, a new type of the hearing aid for SSD called contralateral routing of signals (CROS) was introduced.[3] But CROS has certain drawbacks such as discomfort to wear in both sides and relatively low-quality sound.

The bone-anchored hearing device (BAHD) was first introduced 30 years ago for a treatment of ears with a conductive or mixed hearing loss.[4] BAHD for SSD was first used at the beginning of this century. Since that time, a number of studies have proved the efficacy of BAHD, the treatment of SSD. The BAHD can be used for patients regardless of the cause of SSD and in all age groups, for toddlers and young children as a softband

and from the age of approximately 6 years to the old age as an implantable system.[4] There is available BAHD from different companies and Baha is one of the most frequently used systems for SSD compensation. Despite this success, several shortcomings are known.[5] Percutaneous abutment results in possible complications include infection, skin overgrowth and loss of implants.[5] The aesthetic appearance is also a problem due to low-grade infections around the abutment, personal preference, and skin-penetrating implants.[5] Several solutions have been proposed in which the skin remains intact. A new system, the Baha Attract, was developed in 2013.[5] A sound processor with vibrator is attached to the outside of the intact skin and can solve skin problem. Surgery can be performed under local or general anesthesia and lasts from 30 to 40 minutes.

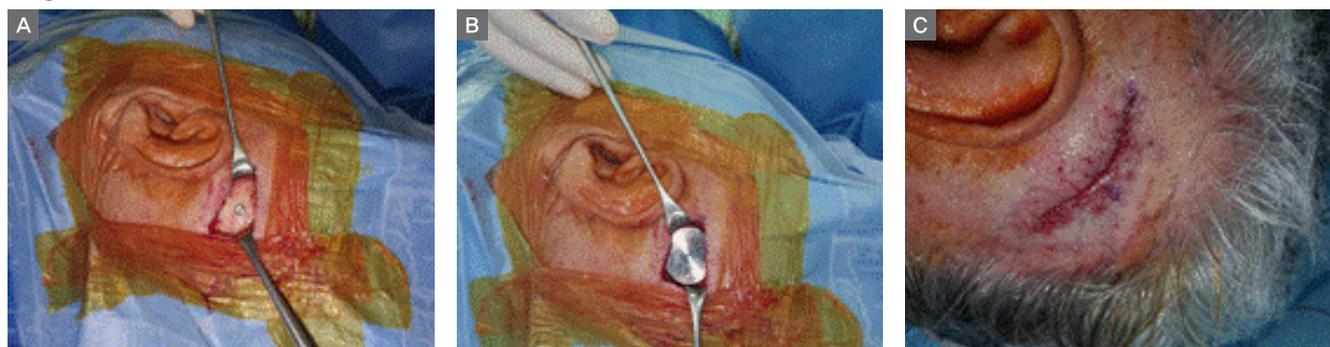
We report preliminary results from 4 patients who underwent Baha Attract implantation after removal of VS for rehabilitation of SSD.

MATERIALS AND METHODS

1. Patients

As a case series study, retrospective chart review was conducted for 4 patients who had undergone Baha Attract implantation after removal of VS for rehabilitation of SSD

Fig. 1



Baha Attract implantation procedure + round shape 2–3 cm incision in retroauricular area/drilling and implantation/closure (from left to right). 20–30 mm linear incision after lidocaine + epinephrine injection, mastoid drilling and periosteum dissection done (A). Of course incision should not be across midline of the magnet. After mastoid drilling, BI 300 implant was inserted to attach magnet, implant were fixed with driver and magnet attached (B). Periosteum, subcutaneous tissue were sutured with vicryl thread, skin applied Exofin bond (C).

by one senior surgeon (M.I.S.) at Severance Hospital, Yonsei University College of Medicine in 2021. We analyzed the clinical features, radiologic findings, functional outcomes, and surgical outcomes of the patients. This study is now ongoing process by the Institutional Review Board of Yonsei University (reception No. 2021-3274-001).

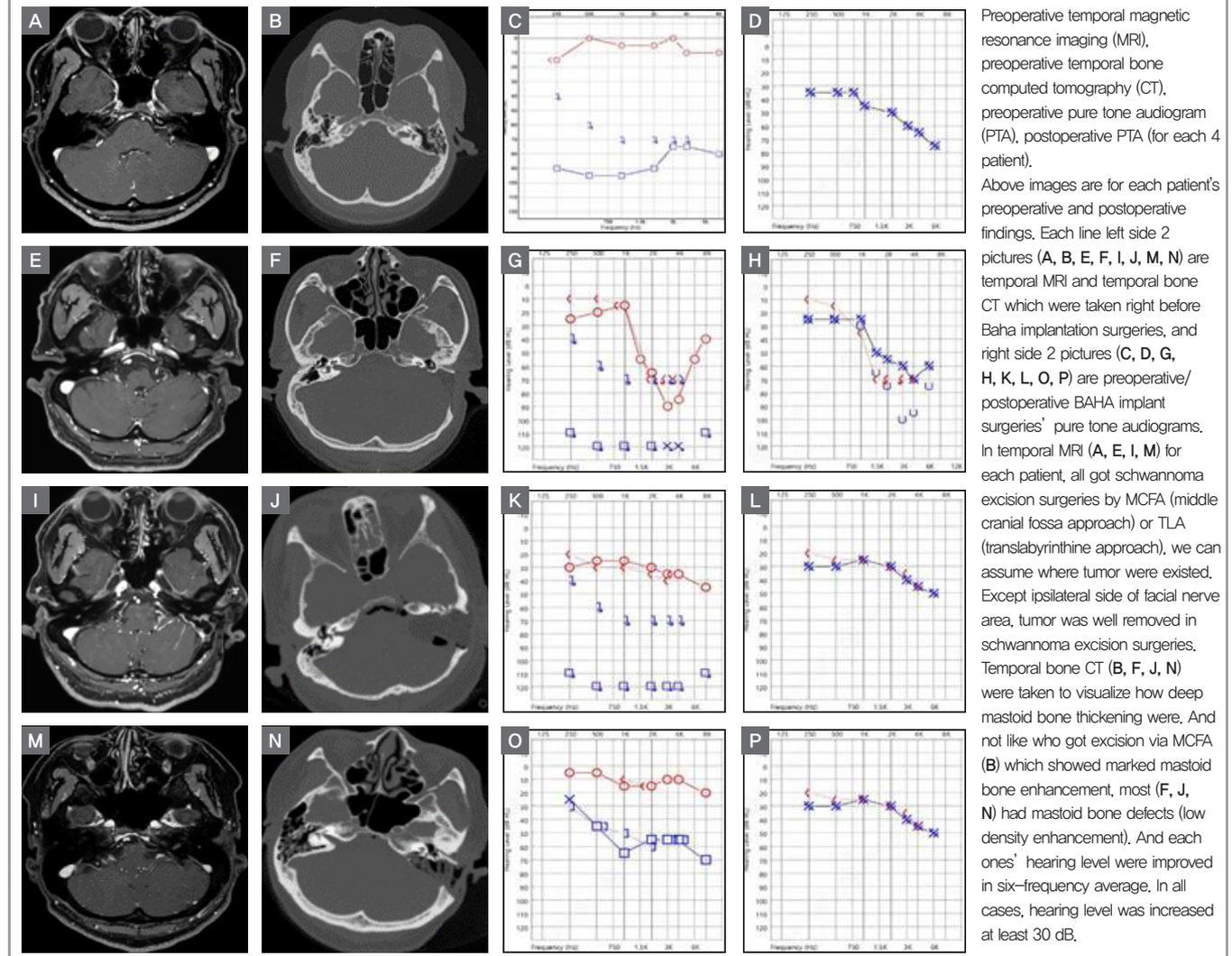
The patients' initial symptoms from VS were hearing loss, tinnitus, dizziness and their main complaints which drove them to implantation were SSD and tinnitus. Pure tone audiogram, Speech discrimination test, computed tomography (CT) were conducted. Thickness of skull where implant should be placed were measured using PACS system. Surgical complications including facial palsy were also analyzed.

2. Surgical procedure

Three patients underwent surgeries under local anesthesia. One patient underwent under general anesthesia because she got schwannoma removal and BAHA Attract implantation simultaneously. The position were supine and head-rotated position.

Most steps followed the recommended procedures described in the company's surgery guide. First, the lines of the imaginary temporal line, hairline, and the contours of the magnetic dummy were drawn.[5] Then, the site of the linear incision, 20-30 mm in length and following the hair line, was determined (Fig. 1A).[5] Linear incision after a local anesthesia is made down to the periosteum,

Fig. 2



[5] Next, dissection of the periosteum over the temporal bone was needed to ensure adequate space for the magnet, [5] The template of the implant magnet was placed on the periosteum to ensure good positioning of the implant magnet.[5] After drilling with the Guide drill and the widening drill on the planned spot, the implant was placed, [5] No bumps were permitted around the implant in the flat optimal surgical site.[5] The bone bed indicator was checked and rotated to ensure it did not contact the bone.[5] Before attaching the implant magnet, we confirmed with a soft tissue gauge that the flap was 6 mm thick (Fig. 1B).[5] The flap was placed over the implant magnet and sutured through the periosteum (Fig. 1C).[5] Last, subcutaneous tissue sutured with vicryl thread and skin applied with skin bond.

3. Hearing test

Preoperative and postoperative hearing function was evaluated by unaided and aided pure tone audiogram; the average threshold was calculated by the mean of 500, 1,000, 2,000, and 4,000 Hz. And all patients' hearing level were evaluated by six-average frequencies [(500 Hz + 2 × 1,000 Hz + 2 × 2,000 Hz + 4,000 Hz)/6]. And we used ear plug or headphone in non-surgical side ear to mask not making real noise, which is globally used.

RESULTS

Patients' age were patients from 44 to 71. Initially patients had schwannoma in one side and showed small

to medium sized tumor; 5 to 26 mm (15 ± 11 mm). Their initial hearing level were average 88 ± 30 dB (ipsilateral) and 20 ± 5 dB (contralateral) in six-frequency average in pure tone audiogram. Schwannoma excision were performed via translabyrinthine approach (TLA) or middle cranial fossa approach (MCFA) (Fig. 2). After schwannoma surgeries, all hadn't have any complications such as intracranial hemorrhage, cerebrospinal fluid leakage, or facial palsy.

Pure tone audiogram tests were done at several months after and revealed test their contralateral hearing were preserved to same level initial visit. All patient informations are summarized below (Table 1).

But they complained continuous hearing problems, and all wanted to get improvements so we planned Baha Attract implantations under local anesthesia, except one who did it with schwannoma excision simultaneously under general anesthesia.

Total Baha Attract implantation surgery time were from 30 minutes to 1 hour including tissue closing. And discharge was accomplished that day, 4-6 weeks outpatient clinic follow-up done with postoperative pure tone audiogram tests. And the hearing results were successful. Every patient got at least 30 dB (61 ± 27 dB, ipsilateral), 5 dB (5 ± 10 dB, contralateral) hearing advantages compared to initial tests. All have not had any postoperative complications such as wound dehiscence, inflammation, infection and bleeding until 4-5 months. Of course, further long time follow-up should be done.

Table 1. Characteristics of the patients

Patient No.	Age (yr)	Sex	Tinni	Dizzy	Excision approach	Tumor size (mm)	Pre-BAHA hearing (dB)	Post-BAHA hearing (dB)	Follow-up (mo)
1	44	F	+	-	MCFA	5 × 4	89	49	3
2	71	M	+	+	TLA	26 × 19	108	44	1.5
3	71	F	-	-	TLA	17 × 13	120	32	5
4	53	F	+	-	TLA	13 × 5	55	20	4.5

F: female, M: male, MCFA: middle cranial fossa approach, TLA: translabyrinthine approach, BAHA: bone anchoring hearing aids. Used six-frequency average.

■ DISCUSSION

There are many treatments for SSD patients, such as hearing aids, cochlear implants, middle ear implants, ossicular surgeries (ossiculoplasty, stapedotomy), bone anchoring hearing aids (BAHA), and so on. Among those we chose BAHA implant for 4 patients who are diagnosed with VS.

As we noticed above results in this study, 4 patients' hearing outcomes after Baha Attract implant surgeries are improved in six-frequency average method in pure tone audiogram. Every patient got at least 30 dB (61 ± 27 dB) hearing advantages. In other types of transcutaneous bone conduction hearing aids (tBCHA) study, Siegert and Kanderske [6] studied 21 patients who got Sophono implants and their hearing level improved 31 ± 8 dB. We also used ear plug or headphone in non-surgical side ear to mask not making real noise, and we should do Hearing In Noise Test (HINT) for patients.

Especially we used 'Baha Attract model (BI 300 and BIM 400; Cochlear, Sydney, Australia)', a newly developed type of tBCHA, which is different from original percutaneous type BCHA (pBCHA). As we mentioned above, pBCHA can cause some complications, such as infection problems, abnormal skin overgrowth, cosmetic problems and implant's disappearance. And also other previous type of tBCHA, Bonebridge and Sophono, demand wide bone area to insert the devices, they are not suitable for patients who got schwannoma excision via TLA (wide mastoid bone drilling required). But Baha Attract model, it is much better to improve patient's hearing levels as you see, it doesn't have skin problems, it has only processor with vibrator attached to small area of skin and 30–40 minutes short total operation time.

In conclusion, there should be a lot of further studies in Baha Attract implant model, it can be one of useful treatments for SSD patients to improve hearing levels. But in Jansson et al., [7] it has wide range of artifact, about 11.5 cm from the center of implant, comparing 5–10 cm

in Sophono, [8–10] In schwannoma patients, preventing facial nerve injuries are important, regular follow-up magnetic resonance imaging is imperative. [10,11] But Baha Attract can effect in magnetic resonance imaging scan, there must be studied some further ways to resolve, for example, implantation surgery must be done in several years after schwannoma excision and so on.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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