

Case Report

Volume 14 Issue 4 - April 2018
DOI: 10.19080/GJO.2018.14.555892

Glob J Otolaryngol

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Conversion of the Percutaneous Bone Anchored Hearing Aid System to a Transcutaneous One - A Straight Forward Surgical Solution



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Submission: March 21, 2018; **Published:** April 10, 2018

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Abstract

Bone-anchored hearing aids have become more and more popular nowadays, and have been used for multiple types of hearing loss both in paediatric and adult cases respectively. In the last decades, skin penetrating percutaneous BAHA® Connect System was substituted by the fully implanted transcutaneous, magnet-based BAHA® Attract System. Since the implantable part of the Attract device is fully covered with soft tissue, skin complications frequently discernible in the percutaneous system, that formerly prevented the use of the device, could be eliminated. According to this important advantage of Attract System, conversion of the percutaneous into a transcutaneous system should be considered. In the following methodology report, a possible surgical technique is demonstrated. The method can be easily adopted in different situations, where replacement of the percutaneous device is necessary.

Keywords: Bone-Anchored Hearing Aid; BAHA® Attract; BAHA® Connect; Percutaneous; Transcutaneous

Introduction

Using direct bone conduction, osseointegrated implant systems have provided hearing rehabilitation with good clinical outcome for over 100.000 patients with conductive or mixed type hearing loss and single-sided sensorineural deafness [1,2] since it has been introduced in 1977 by Tjellström [3]. Bone Anchored Hearing Aid system (BAHA® Cochlear) is one of the most frequently applied device nowadays. Both the implanted device and the surgical technique of implantation have improved significantly in the last decades [4]. The surgery of the initial skin-penetrating Connect System with titanium abutment was based on the skin flap formation and soft tissue reduction [4-6]. This relatively invasive technique was necessary to reduce periaabutment pocket formation and soft tissue hypertrophy [5,6], which has often resulted in the deterioration of sound processor usability [4,7,8].

In the new era of Connect Systems, because of the tissue-adherent hydroxyl-apatite-coated abutments, no tissue reduction became necessary. Moreover, the minimal-incision-line technique with soft tissue preservation [9-11], as published previously also by our team, has reduced the postoperative

complication rates via keeping the microcirculation intact around the implant area [12]. However, hearing amplification of the Connect System was satisfactory, the possible complications due to direct trauma or infection of the uncovered part of the abutment and the patient's esthetical aversion about their "screw-in-the-head" look [13-15], need for a more discreet system started to evoke. This has led to the development of the BAHA® Attract system. An obvious advantage of the transcutaneous system compared to the percutaneous one is that the skin over the implant is left intact [16]; thus, patients are more likely to accept the cosmetic results and the adverse events can be prevented effectively (e.g. tissue overgrowth, peri-implant skin necrosis, or extrusion of the device).

However, the direct drive of the Connect System provides more favourable sound amplification - recognised also in BAHA® guidelines and other clinical studies [17-20] - with the newly developed speech processors, the Attract System is also applicable even at a 65dB hearing level. Because of its aesthetic advantages and lower skin complication rates with closely similar audiological efficiency, the Attract System is the preferred bone conductive hearing aid nowadays. According

to all the above listed information, in certain cases, where the recurrent soft tissue complications prohibit the use of the device, conversion of the percutaneous into a transcutaneous

system should be considered. Authors present their innovative surgical solution for such a conversion procedure.

Case Report

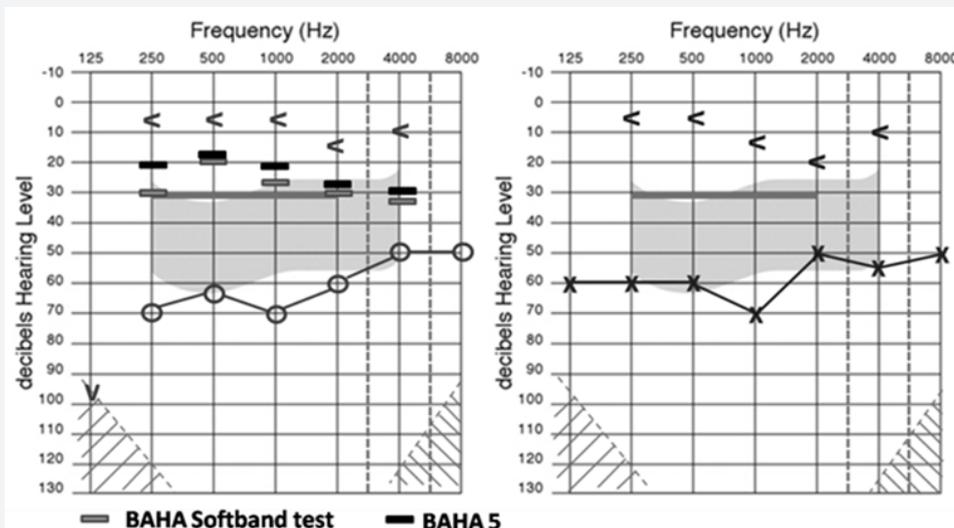


Figure 1: Preoperative pure tone audiometry results. Diagram A- right side, diagram B- left side.

13-year-old child with bilateral Grade III. microtia and complete atresia of the external ear canal had been aided with BAHA® BIA 300 implant with titanium abutment and BP 100 sound processor in 2010. According to the official surgical protocol, the soft tissue around the peri-implant area had also been reduced to prevent soft tissue hypertrophy. In the last two years, the usability of the hearing aid became gradually

deteriorated due to recurrent infection of the peri-implant soft tissue and granulation. As the child had minor signs of mental disorders, implant malfunction has also led to under-development in his education. On admittance to our department, audiology control examination was carried out with BAHA® Softband (BP 110 processor), as by this time he was unable to use his own device. Figure 1 shows the audiology test result.

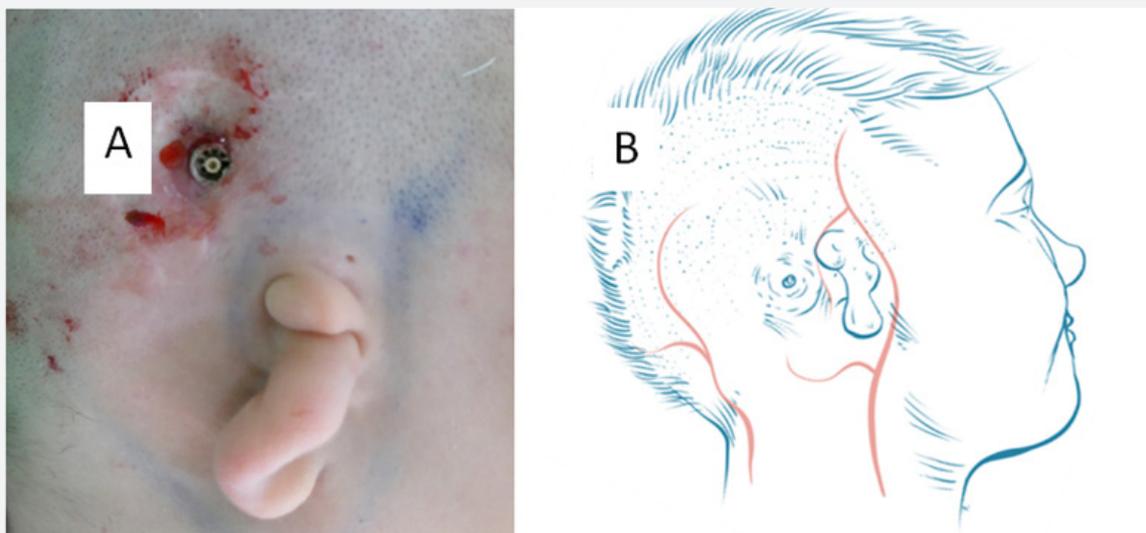


Figure 2: A. Immediate preoperative picture, bleeding granulation tissue and atrophic scabby skin around the abutment is visible. B. Schematic drawing of the temporal region (abutment, peri-implant scar tissue and main arteries).

Air-bone gap (ABG) indicates medium-major conductive hearing loss in both side, while bone conduction is relatively preserved. Since the child is right handed, right side was aided previously with BAHA® BIA300-BP 100 sound processor. Result of BAHA® Softband (BP110) test marked with dark rectangle

on diagram A. Locally, the abutment was placed 5cm supero-posteriorly from the suspected position of the external auditory canal entrance, as recommended by the official surgical guideline. Peri-implant soft tissue was previously thinned around the abutment in a 1.5x1.5cm area (2mm thickness). The adjacent

tissue around the abutment was hypertrophic. Mild erythema and soreness was also present around the abutment, however, no massive wound infection or discharge was observed (Figure 2). Microbiological sample was taken from the peri-implant soft tissue pocket, with negative result.

Based on the details above we decided on surgery. As the patient fulfilled the audiology criteria for BAHA® Attract and it is known to have a much lower complication rate related to traumatic dislocation or wound healing disorders, we decided to convert the BAHA® Connect system to the more sophisticated

transcutaneous BAHA® Attract system. Preoperative planning: In the BAHA® Attract system, the implanted magnet must have thick, well-vascularized soft tissue coverage. Therefore, in case of our patient we had to remove the scabby, reduced peri-implant skin and the granulation tissue around the abutment. The generated tissue defect was closed by an occipitally pedicled temporo-parietal galea-skin rotation flap. For the better intraoperative bleeding control and to be able to plan the best flap configuration, preoperative ultrasonography was carried out.

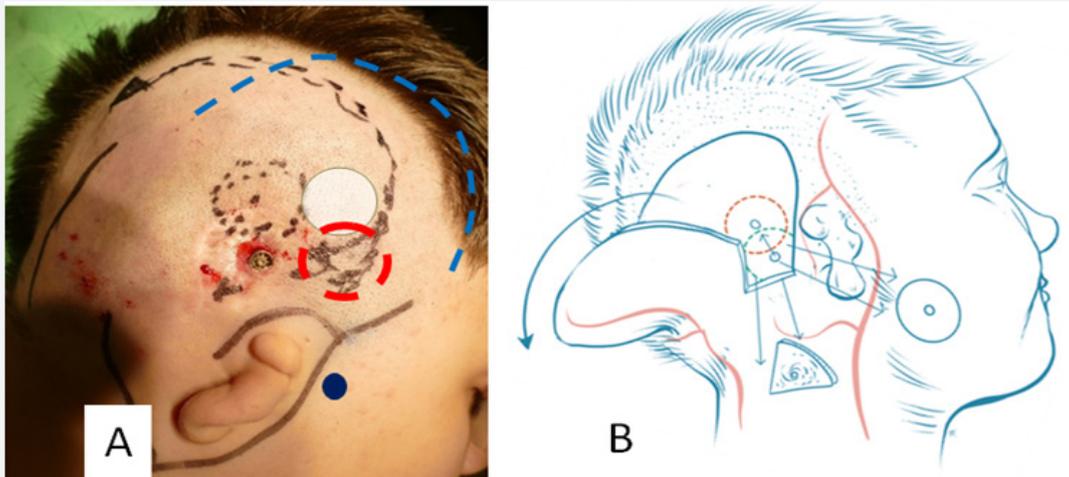


Figure 3:

A. Preoperative planning: Continuous Black Line Shows the Main Artery Branches. Area Surrounded with Red Dash Line Represents Scar Tissue. Blue Dash Line is the Plan of the Skin Flap and White Transparent Area Is the New Position of the Magnet. Dark Blue Dot Represents the Expected Location of the Ear Canal for setting the New Position of the Implant.
B. Main steps: Removing of Scar Tissue, Flap Formation and Replacement of the Abutment, and Expected Position of the Magnet.



Figure 4.

The arterial map of the operative field is shown on (Figure 3). After the resection of the peri-implant soft tissue, the former abutment was removed. The reconstructive flap was prepared and placed in position as demonstrated on (Figure 4). Since skin incision lines so as sutures and scar tissue above the Attract magnet should be avoided, the implant had to be placed in a more

supero-posterior position (Figure 5). We have also considered not to exceed the officially recommended distance from the ear canal entrance. The Attract system was implanted into the bone in this new optimal position, wound was closed, suction drain was applied. Perioperative parenteral antibiotic treatment was administered, wound healing was undisturbed (Figure 6). Surgical sutures were removed in the 14th postoperative day. Sound processor fitting and audiological tests were performed after 5 weeks; the child was aided with BAHA® 5 Processor. The result of pure tone audiometry correlated with the result of the Softband test (Figure 7). There was no significant difference between thresholds on the different frequencies.

Discussion

The main advantage of the BAHA® Attract System is that its thick soft tissue coverage protects the implanted magnet from any mechanical trauma or injury. Since there is no direct connection between the skin surface and the underlying tissues through the abutment, the chance for any descending infection is neglectable. The aesthetic benefits of the transcutaneous system are indisputable [16]. The recurrent soft tissue complications of the Connect System may prohibit the proper use of the hearing aid, this may tend to result in impairment of hearing and

communication development in childhood and social separation in the elderly [14,15]. In such cases, instead of long-lasting, often ineffective conservative treatments (e.g. topical application of

combined antibiotic and peeling treatment, special dressing for chronic wounds, etc.) surgical conversion to Attract System is highly suggested.

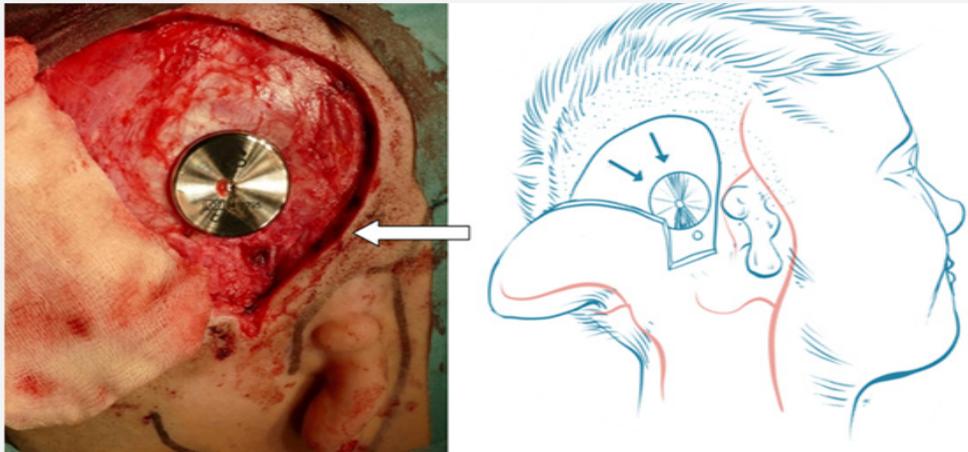


Figure 5.



Figure 6.

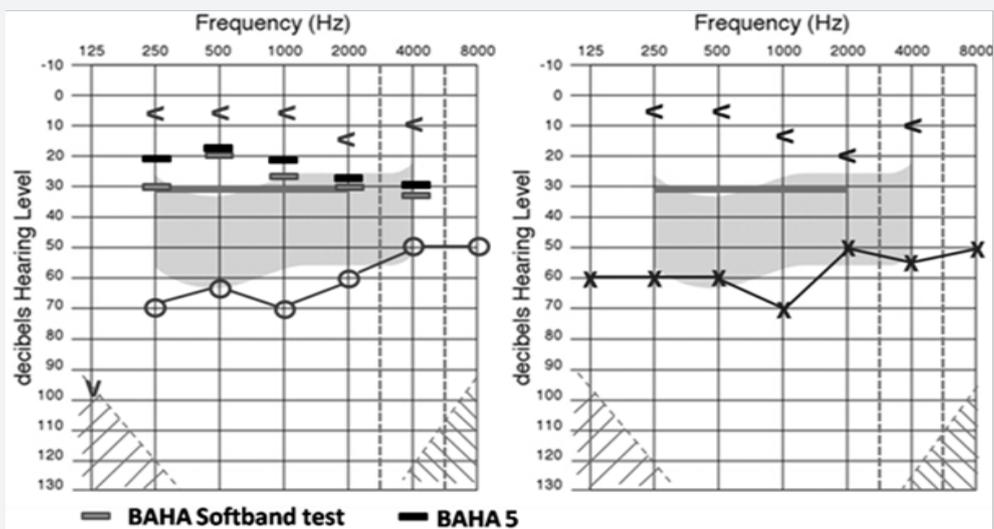


Figure 7.

One key point in the preoperative assessment of these conversion surgeries in our opinion is the prudent mapping of the vascular anatomy of the wide peri-implant area, which helps the surgeon to plan the adequate skin flap with a stable vascular pedicle. In order to securely cover the magnet, a relatively thick, well-vascularized tissue layer should be applied in cases, where the resection of the damaged peri-implant soft tissue must be excessive either due to the former soft tissue reduction technique with consequent scar formation, or infected/necrotic skin granulation. The other very important key point is the replacement of the implant into a more posterior localization to avoid any scar close to the rim of the magnet, nevertheless the new position of the implant should consider the recommended distance from the external ear canal.

One report of such conversion surgery has already been published in the literature recently [21], however the novelties in our method compared to theirs are the following:

- a. We always consider the vascular anatomy of the region, and instead of a simple excising-undermining-suturing technique we apply a pedicled flap with a stable supplying artery for the most optimal nutrition of tissues covering the implant.
- b. Scars of previous surgeries should always be removed, on one hand for the increased risk of pressure skin necrosis due to the sparse vascularisation of scars, on the other hand for a better aesthetic outcome.
- c. After excessive scar removal large tissue defects can be replaced with a properly designed, well vascularised flap.
- d. With our method scars over the magnet and its rim could be completely avoided, which provides perfect docking of the sound processor and prevents secondary complications of the suture scar line caused by pressure or tension.
- e. Regarding the standard surgical technique of the Connect System (i.e. the position of the abutment compared to the external ear canal) the occipitally based rotation flap could always be an adequate solution because of its standard anatomy and vascularisation [22].

Summary

Our BAHA® Attract surgical conversion method provides a safe, technically feasible solution for those patients, who are not able to use their BAHA® Connect System due to the recurrent peri-abutment soft tissue complications. In one set, all the disadvantages of the percutaneous implantation could be terminated, and with the more advantageous, aesthetically more favourable transcutaneous system could be applied with fine linear scars covered completely by the hair and most importantly with satisfactory audiology results.

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DOI: [10.19080/GJO.2018.14.555892](https://doi.org/10.19080/GJO.2018.14.555892)

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