Baha Attract: Our Experience

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Abstract In this study, we have highlighted our experience with a new transcutaneous bone conduction hearing device, the Baha Attract System along with finer details on its surgical technique, some challenges faced intraoperatively and the surgical outcome. This study was carried out in our tertiary care hospital over the last 1 year. Our study included the first 4 patients, all of which were males; with a mean age of 13.25 years in whom the new Baha Attract System was used. The mean air–bone gap was 48 dB. Bone smoothening around the implant was needed in 2 patients. We did the switch-on after 6–12 weeks for all the patients where the programmed processor was applied with the help of a magnet at the implanted site. Our study results suggest that the Baha Attract System is promising for the patients with microtia–anotia having conductive or mixed hearing loss. These patients cannot be offered conventional air conduction hearing aids. Their hearing outcomes were comparable to percutaneous Baha systems.

Keywords Bone conduction · Osseointegration · Transcutaneous · Single sided deafness · Hearing

Introduction

Baha or bone anchored hearing aid is a well-established hearing rehabilitation solution for patients with conductive, mixed or unilateral hearing loss [1]. The Baha attract

system, introduced in 2013, is a magnetic transcutaneous bone conduction implant system with intact skin interposed between two magnets. It has an osseointegrated implant attached to an implant magnet which is implanted underneath the skin and coupled to an external magnet to which the sound processor is attached. Very few studies are available related to this system at present as it is relatively in its early stage of experience.

This system, unlike the previous Baha systems, avoids the need of soft tissue reduction at the implant site and thus prevents its drawbacks like skin irritation, inflammation, skin overgrowth and pain [2]. Moreover, being a non-skin penetrating implant, it adds to the cosmetic appeal, increases patient compliance in young population and also avoids the need for daily cleaning of the implant site. In this new system, there needs to be an adequate skin thickness between the two magnets to avoid any minor chances of skin reactions or swelling due to the magnetic strength as well as to obtain the best audiological outcome.

In this article, we are discussing our experience with the Baha Attract System, its surgical technique, challenges and outcome.

Materials and Methods

This is a prospective study undertaken at our tertiary care Hospital in the Department of Otorhinolaryngology, over the last 1 year. In total, 4 patients (4 males; mean age 13.25 years; range 8–19 years) were enrolled in this study. In this article, we present the first 4 patients implanted with Baha Attract System. Our surgical and clinical experience with this system is described here.

Patients over 5 years of age were included in the study. All of them had either microtia or anotia with conductive

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or mixed hearing loss. Those with sensorineural hearing loss were excluded from this study. All the patients were counselled about the available treatment options, the risks and benefits of this procedure. Informed consent was taken. All data on sex, clinical presentation, audiological data and other syndromic associations were recorded. A pure tone audiogram (pre-operative) or bone conduction brainstem evoked response audiometry (BERA) was performed for all the patients and all were given a trial with Baha using either a soft band or metallic band before surgery. A pre-operative high resolution computed tomography (CT) scan of the temporal bone was undertaken to measure the bone thickness behind the temporoparietal suture line. Other congenital anomalies and syndromic associations were identified and a detailed paediatric evaluation and clearance was done for all the patients prior to the surgery.

Surgical Technique

The site of the implant was marked in the postaural region using Baha attract indicator. All of our patients had microtia or anotia, hence the marking was done preferably behind the expected site of the neo-pinna. We preferred the implant site 6.5 cm away from ear canal and at an angle dissecting the orbitomeatal line. A semicircular incision was marked about 1.5 cm anterior to the anterior edge of the magnet (Fig. 1). Soft tissue thickness was measured at implant site and at the anterior and posterior edges of the magnet (x mark) using a needle with artery forceps and a

measuring scale. In all our cases, soft tissue thickness was less than 6 mm, so soft tissue reduction was not needed. Local anaesthetic infiltraton was done only at the incision site. The incision was taken keeping a thin intact periosteum below and ensuring that the elevated flap accommodated the implant magnet template. The implant site was then marked deep on the periosteum using a methylene blue dye to enable a good orientation for implant placement later. A cruciate incision was taken on the deeper periosteum at the marked implant site and it was elevated with a raspatorium.

The site of the implant was drilled using a 3 mm conical guide drill with spacer at 2000 rotations per minute (rpm) with continuous irrigation to prevent thermal damage to the osteocytes. While drilling, the burr should always be moved perpendicular to the bone surface which can be ascertained by using a drill indicator. The movement of the drill burr was up and down to ensure drilling under vision and to allow the water to reach the tip. The bottom of the hole was then checked for the presence of bone.

We have designed a set of serial depth gauges with markings of 2.5, 2.75, and 3 mm for this purpose. These are usually helpful in younger patients with microtia when the bone is not very well-developed. In these patients, if dura is felt at the bottom of the hole due to inadequate bone thickness, then the site of implant was changed and the decision for staging the surgery may be required. If the bone thickness was adequate, the drilling was further continued to 4 mm depth by removing the spacer.

A widening drill was then used in a perpendicular alignment at 2000 rpm to widen the hole and to create a counter sink of around 0.5 mm all around (Fig. 2). Implant was then inserted in the bone using an implant inserter (using a low speed torque of 20 rpm). No irrigation was used until the first thread was inserted. Then the torque was gradually increased to around 50 rpm depending on the

Fig. 1 Semicircular incision marked 1.5 cm anterior to the anterior edge of the magnet

Fig. 2 0.5 mm countersink created

bone quality and insertion was continued using irrigation till a beep sound was heard (Fig. 3). The drill stopped automatically once the preset torque was reached. The implant inserter was released carefully and a bone bed indicator was then placed on the implant and rotated clockwise to ensure that there were no bony irregularities (Fig. 4). The periosteum was repositioned back and sutured keeping the implant exposed. Magnet was then placed over implant keeping 'UP' mark directing superiorly, taking care that it didn't touch the bone and the screw was then tightened with a hand screwdriver followed by a machine screwdriver (Fig. 5). The flap thickness was evaluated with a soft tissue gauge. It was reduced to 6 mm or less if it didn't loosely fit in the gauge. The flap was then repositioned over the magnet and sutured. The surgical site was covered with a light pressure dressing for 24–48 h.

Results

In our series of 4 patients, all were males ranging from 8 to 19 years, with a mean age of 13.25 years. The mean air-bone gap was 48 dB. Intraoperatively, we used the 4 mm implant for two of our patients with an adequate bone thickness. One patient required 3 attempts before the site with an adequate bone thickness could be found. A 3 mm implant was put in this patient. Similarly, 2 attempts were required to insert a 3 mm implant in the last patient. Smoothing of bone was needed in two cases. None of the patients required staging of surgery. We did the switch-on after 6–12 weeks for all the patients where the programmed processor was applied with the help of a magnet at the implanted site (Fig. 6), after which a repeat audiogram was done (Fig. 7).

Fig. 3 Inserting the implant using an implant inserter and irrigation

Fig. 4 Bone bed indicator used to check any bony irregularities

Discussion

The concept of osseointegration was first introduced for dental and craniofacial reconstruction surgeries by Brånemark in 1965 [3]. Later Tjellström introduced skin penetrating titanium implant for direct bone conduction. Baha bypasses the external and middle ear mechanism of hearing and transmits the sound directly to cochlea through the skull bone. Thus it is ideal for patients with external ear deformities viz. microtia and anotia. Patients with chronic suppurative otitis media, adhesive otitis media, otitis externa and those with a discharging mastoid cavity who can't use conventional hearing aids also benefit with the

Fig. 5 Screwing the magnet over the implant keeping 'UP' mark directing superiorly

Fig. 6 Switch on done after 6–12 weeks

Fig. 7 Post-operative audiogram

use of Baha. It is indicated in patients with conductive hearing loss, mixed hearing loss or those with a single-sided deafness. The use of Baha improves the audibility and quality of sound which leads to an improved quality of life in these patients [4]. But the main drawback of the previous Baha systems was the skin penetration. It also required soft tissue reduction which led to skin inflammation, irritation, skin overgrowth and pain and the need for maintenance.

Being a tertiary care center, most of our patients belong to a low socio-economic group; thus adequate cleaning of the implant site and maintaining a good daily hygiene is quite troublesome to them, especially in our city with its humid climate. Excess sweating at the implant site adds to the problem. It also gives a cosmetically poor outcome as the abutment is seen outside the skin [5]. All these factors have reduced the acceptance of the conventional Baha

systems among the young population. To overcome these drawbacks, the Baha Attract system was introduced in 2013.

Baha Attract is a non-skin penetrating alternative, which has an implant and an implant magnet under the skin and a sound processor externally, coupled to it with a magnetic force. Sound processor is attached to a magnet plate on the skin via a SoftWear pad to equalize the pressure distribution over the attachment surface. It also gives a satisfactory audiological outcome as compared to conventional Baha [5].

All the patients that we operated on (both children and adults) had microtia with a conductive hearing loss. So while making the site of implant, care was taken to leave behind enough space for possible pinna reconstruction in the future. We prefer a distance of approximately 6.5 cm from the external auditory canal. In patients with a normal pinna, it can be marked at 5–7 cm. Care is taken that the superior edge of the sound processor is in line with the expected site of neo-pinna and the sound processor is away from the pinna to prevent any acoustic feedback.

The thickness of the flap is a very important factor for the success of surgery using the Baha Attract system. Recommended flap thickness is around 3–6 mm. If soft tissue thickness is more than 6 mm, it may increase attenuation of sound and soft tissue reduction may be needed. If it is less than 3 mm, there is risk of flap necrosis due to pressure [6]. To get an accurate flap thickness, measurements are taken before infiltration. Infiltration is done preferably on the incision site. In one of our cases, the infiltration was done on implant site which caused unwanted thickening of the flap.

While using the guide drill, it should always be placed perpendicular to the bone surface. Drilling is done with lots of irrigation to prevent any thermal damage to the osteocytes which would prevent osseointegration. The osteocytes die after a minute at 42 °C. The widening drill is designed with a hard stop to prevent over counter-sinking. This assures a good implant stability and facilitates osseointegration.

Once the implant is inserted and if the bone bed indicator touches some bone, the irregularities are drilled out

and levelled and if it touches some soft tissue, it is reduced. This will ensure the correct mounting of magnet over implant.

Before closure of flap, thorough hemostasis is to be ensured to prevent any post-operative hematoma.

Conclusion

The Baha Attract System is an excellent transcutaneous bone conduction hearing solution leading to an improved hearing performance. It can be used effectively in all the patients with conductive hearing loss, mixed hearing loss or single sided deafness. It has an added advantage of no skin penetration with increased patient comfort and reliable retention over other Baha systems, thus avoiding the challenges of soft tissue reduction and its consequences.

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Compliance with Ethical Standards

Conflict of interest There is no conflict of interest.

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