Vibrant Soundbridge: A New Implantable Alternative to Conventional Hearing Aids in Children

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SUMMARY

The Vibrant Soundbridge is a new middle ear implantable hearing device. It was first introduced for adult patients with moderate to severe sensorineural hearing loss. With the innovation of the surgical techniques, its usage had been broadened for children and those patients with conductive and mixed hearing loss. We report first two cases of monoaural Vibrant Soundbridge implantation in Malaysia. They were children with bilateral conductive hearing loss who had failed to benefit from previous hearing aids. Floating mass transducers were attached in oval window and long process of incus respectively. Remarkable hearing yield was observed without surgical complication.

KEY WORDS:
Vibrant Soundbridge, conductive hearing loss, meatal atresia, middle ear

INTRODUCTION

The Vibrant Soundbridge (VSB) is a middle ear implant, a new alternative hearing device to conventional hearing aids. It consists of two main subsystems, i.e. the implantable vibrating ossicular prosthesis which contains the floating mass transducer (FMT) and the external audio processor. The FMT is placed on a vibratory structure in middle ear, such as the long process of incus, remnant of stapes, oval window or round window. It vibrates in a controlled manner in response to electrical activity from the processor. In turn, the mechanical energy is transmitted via the middle ear structure to cochlear hair cells for sound perception. VSB is useful in patients with sensorineural, mixed or conductive hearing loss. VSB implantation had been recognized as a new rehabilitation alternative for children and adolescents in a recent international consensus [1].

We report the first two paediatric cases of monoaural Vibrant Soundbridge® (MED-EL Corporation, Innsbruck, Austria) implantation in Malaysia who had failed to benefit from previous bone conduction hearing devices.

CASE REPORT

Two boys presented to our clinic with bilateral conductive hearing loss due to bilateral microtia and osseous meatal atresia.

LH was nine-year-old. He had softband hearing aid since two-year-old. His speech development was normal. However, he complained of head discomfort caused by softband pressure. He refused to wear it after start attending to school. Computed tomography showed bilateral osseous meatal atresia with normal middle ear and inner ear structures. VSB was implanted in the left ear via post-auricular approach and posterior tympanotomy.. The FMT was positioned to be coupling to the long process of incus (Figure 1). He was prescribed with non-steroidal anti-inflammatory drug as post-operative analgesics. He was discharged from ward on second post-operative day. The audiogram before the surgery (Figure 2) and three months after the surgery (Figure 3) showed mean hearing gain of 22 dB. He was satisfied with the VSB and complied to it remarkably.

MN came to us late at five-year-old with speech delay. The computed tomography showed bilateral osseous meatal atresia with stapes abnormality. The inner ear structures appeared normal. Bone-anchored hearing aid (BAHA) was implanted. Unfortunately, the BAHA extruded two weeks after surgery. VSB was implanted in the right ear by the same surgical approach. The FMT was placed in contact with the oval window. He developed vomiting after surgery, but was well after observation and adequate intravenous hydration. He was discharged two days after surgery with oral analgesics. The post-auricular wound healed well with no complication observed in follow-up. The audiogram before surgery and three months after surgery showed a mean hearing gain of 15dB without significant unaided threshold shift. His speech developed after surgery.

DISCUSSION

It is crucial to augment children's hearing early to avoid compromising the development of language, speech and social skills. Bone conduction hearing aids e.g. bone-anchored hearing aid (BAHA) and softband are the common options for children with bilateral congenital external or middle ear malformations. BAHA is a surgical implant that transmits sound by direct bone conduction to the inner ear, bypassing the external and middle ear. In response to acoustic stimulus, BAHA vibrates the skull and inner ear which in turn stimulates the auditory nerve fibres for sound perception. There is minimal attenuation and little sound distortion in BAHA. However, its application is hindered by a few disadvantages. There is risk of poor osseo-integration, adverse skin reaction and appositional growth of temporal bone in children.

Head softband is an easily applied hearing device. However, the drawbacks of softband include pressure-induced discomfort on the skull by the transducer, impaired sound

This article was accepted: 19 July 2012
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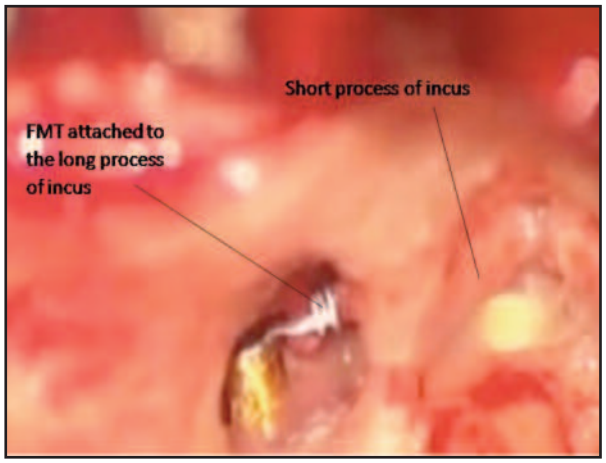

Fig. 1: The FMT was positioned coupling to the long process of incus via posterior tympanotomy.
FMT : Floating mass transducer

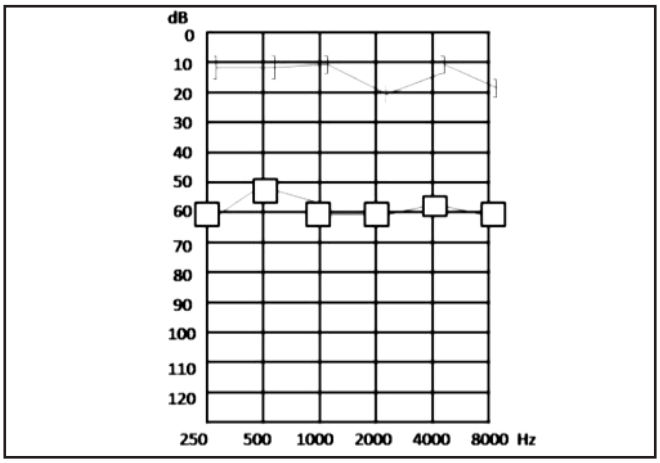

Fig. 2: Pre-operative audiogram showed conductive hearing loss with air-bone gap of 45 dB.

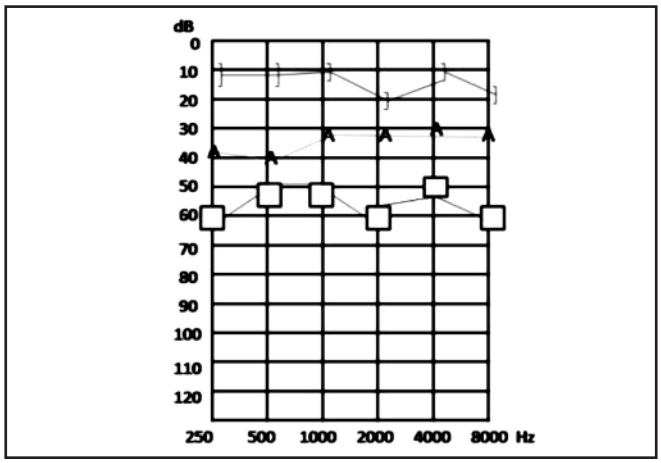

Fig. 3: Three-month-post-operative audiogram showed mean hearing threshold gain of 22dB without significant unaided hearing threshold shift.

quality due to skin attenuation and movement of the transducer and aesthetic concern.

Other surgical options for meatal atresia in children include canalplasty. However, atresia repair is a complicated otologic procedure. There is varying surgical outcome with high rate of revision surgery. It is usually postponed till the age of five to six years. Therefore, it is not practical as a mean of hearing restoration at the early age of life. Even after a successful surgery, the majority of patients remain with a 20-30dB air-bone gap that requires hearing aid for optimal hearing.

VSB implantation in paediatric group had been discussed controversially. Although middle ear structures are fully developed at birth, tympanic cleft enlarges to certain extent up to the age of five years. The gradual expansion in middle ear cleft may lead to increase in distance between middle ear structures with age. There is a hypothesized concern of FMT position shift during the growth that would alter the desired vibrating function. In the International Consensus on VSB Implantation year 2010, no age limitation were proposed for the surgery; the space adequacy in middle ear for the accommodation of FMT and the availability of surgical expertise are the utmost important factors for successful surgical outcome[1].

In comparison to BAHA, the cost of device is comparable between VSB and BAHA. BAHA could be applied in cases with chronic middle ear infection. Furthermore, impact to the residual hearing threshold during surgery is lower in BAHA compared to VSB. However, in the condition of device failure and device-associated complications of BAHA, VSB is still an alternative if surgical expertise is available.

The superiority of VSB to conventional hearing aids in terms of audiometric gain has been shown in several longitudinal studies[2,3]. However, the implantation of VSB carries the risk of threshold modification due to change of middle ear impedance by the physical weight of FMT. Other potential long term complications include implant failure, infection and cochlear overstimulation that should not be overlooked.

CONCLUSIONS

The advantages and disadvantages of all possible hearing rehabilitation options should be weighed against each other in the light of each individual case to provide the best treatment. In our cases which the air conduction hearing aid is not feasible, VSB had been proven to be a favourable option after the failure of the conventional bone conduction hearing aid and BAHA.

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