Fully Implantable Hearing Devices

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Devices that can augment hearing in the hearing impaired have evolved over the years. But one thing has not changed. All devices ranging from the funnel shaped object held against the ear by my great-grandfather to today's sophisticated cochlear implant systems are characterised by external, visible components. These visible components often contribute towards the stigma surrounding people with hearing loss. While reading glasses are socially acceptable, (except perhaps the coke bottle variety) a parallel is often drawn between hearing impairment and mental capability. The speech problems that often manifest in the hearing impaired tend to aggravate the whole situation.

Fully implantable hearing devices – a logical evolution of hearing aid technology – are now available. Their functioning is not dependant on external components, which makes the devices invisible from the outside. Kind of like those used by aliens when abducting humans. These devices offer added value to patients with active lifestyles, for example sport participants, swimmers and divers. Unfortunately, contact sport remains a problem. They also benefit those who work in dusty, dirty or wet environments. Some people unable to wear hearing aids due to constraints or safety equipment, for example members of the armed forces and building workers, may also benefit.

Additional benefits of not having components in the external ear canal include avoiding feedback and the occlusion effect. Feedback is the high pitch noise that a conventional hearing aid sometimes produces if the fit in the patient's ear canal is not tight enough. The occlusion effects are best described as the fullness experienced in the ear of a patient who has a cold.

There are currently two devices available: the Carina Device from Otologics and the Esteem Device from Envoy Medical. Although the Food and Drug Administration (FDA) in the USA has not yet granted pre market approval, over 300 of the Carina Devices have been implanted worldwide over the past seven years as have more than 180 of the Esteem Devices.

Both the devices are indicated for moderate to severe hearing loss; neither for profound hearing loss. In patients with profound hearing loss, cochlear implantation may still be the only option.

A surgical procedure of about 3-4 hours is necessary to implant the new devices.

With the Carina Device, the microphone is fitted to the mastoid bone, under the skin behind the ear. The sound is then transmitted to the digital signal processor where the sound is amplified and then transmitted to the middle ear transducer. The middle ear transducer is positioned on a mounting system that allows gentle contact to the ossicular chain (incus), round window or oval window in order to stimulate the middle ear anatomy. The system is powered by a rechargeable battery that needs to be charged for approximately one hour per day, by a charger worn on a headband.

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Residual hearing is maintained in cases of device failure or dead battery. Replacing the battery, which is an integral part of the electronics capsule as is the magnet, is a problem as general surgery is required.

The Esteem Device works differently. It has no microphone but uses the patient's eardrum to act as the microphone. Vibrations picked up by the sensor are then relayed through a processing and amplifying process to the driver on the stapes bone. The stapes is directly stimulated and its vibration enhanced. During the surgical procedure, the incus and stapes bones are dislocated which means that in a case of device failure or dead battery the patient will be deaf, without being able to rely on residual hearing. On the other hand, the battery, like that of a pace maker, does not need charging and can last up to five years. Replacing a battery can be performed under local anaesthesia.

Other drawbacks of the current systems include cost (approximately $US 14 500 for the Carina Device alone, not counting the surgery) and reliability, mainly due to hermetic issues. Hermetic/Hermetism refers to the airtight seal created for electronic parts to prevent entry of micro-organisms and body fluids. Body fluids and electronics do not like each other. Neither of the systems is MRI compatible and should the patient need an urgent MRI, surgical removal of the device or explanation of magnets may be necessary.

The development of fully implantable hearing devices is very exciting

It is my opinion that, although the new technology and the development of fully implantable hearing devices is very exciting, an assessment of their long-term impact and efficacy is still required. It would probably be better to wait for a few more years before encouraging a patient to mortgage their house in order to afford the implant. As with the cochlear implant industry, problems and issues often accompany the launch of new products. At present, these problems outweigh the benefits. However, the current negatives are likely to be addressed in the next few years.

To view the devices and for more information follow the links below.

References and links

1. MacPherson B. Bob MacPherson on Implantable Hearing Aids. Hearing Loss Web. Cited 2009 October 10. Available from: http://www.hearinglossweb.com/tech/ha/impl/bob.htm
2. Envoy Medical: http://www.envoymedical.com
3. Otologics LLCUS: http://www.otologics.com/worldwide.htm

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