Medical Audiology Services

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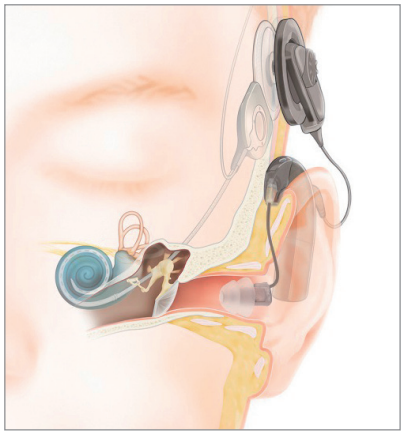
Evolution of the **Modern Cochlear Implant**

By Dr Dayse Tavora Viera & Dr Vesna Maric

The first commercially available cochlear implant (CI), a single-channel device, was implanted in over 1000 adults between 1972 and mid-1980s. From 1980, candidacy included children over 2 years of age. Meanwhile, multi-electrode cochlear implants were being developed simultaneously by three different groups worldwide; Graham Clark's group at Melbourne University, the UCSF group in the USA and the Holchmairs in Austria. These later became commercialised as Cochlear Corporation's Nucleus device, the Advanced Bionics' Clarion and the Med-El system, respectively. The first multi-electrode system was implanted by the Melbourne University group in 1984. The frequency-specific information it provided marked a significant step towards improved speech understanding. Additional advances in early diagnosis, refinement of surgical techniques and speech processing strategies led to cochlear implants becoming the therapeutic choice for bilateral profound hearing loss.



Picture 1. Combined acoustic and electrical stimulation. Image courtesy of Cochlear Limited

The early success in post-lingually deafened adults and congenitally deaf children drove broadening of selection criteria. Soon, those with residual hearing were implanted successfully, and candidacy extended to include patients with moderate to severe bilateral hearing loss. With this, the potential benefits of hearing aid use in the contralateral ear became the focus, and evidence mounted towards superior results of such 'bimodal' hearing relative to CI alone. Importantly, the findings revealed that compatibility between acoustic hearing and electric hearing is possible*.

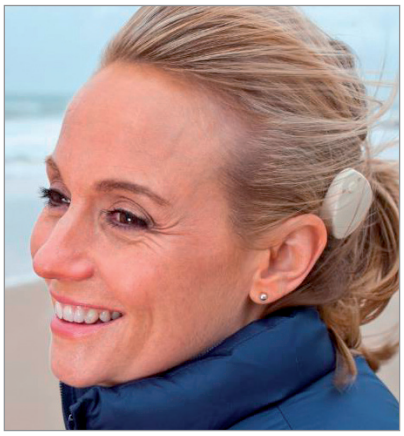
Pushing the candidacy criteria even further, patients with good low frequency hearing and a profound high frequency hearing loss in the same ear became the research focus.

Combined electrical and acoustic systems were developed incorporating cochlear implant technology (for high frequency information) and hearing aid technology (for low frequency information) in one instrument, as shown in Picture 1. During early 2000s, multiple studies reported benefits of the combined input over CI use alone or hearing aid use alone*.

Most recently, attention has expanded to cochlear implantation for single-sided deafness. While selection criteria for these patients are still under investigation, several studies have shown that electrical stimulation can be integrated with normal hearing in the contralateral ear and that there is benefit for tinnitus relief and speech understanding*. In Australia, CIs were approved as a treatment for unilateral deafness in late 2013.

The current processors are small, lightweight and water resistant. The latest design is a single unit which many users prefer for comfort and aesthetics (see Picture 2). Processors boast high speed, background noise management and connectivity, while modern electrode arrays and surgical techniques allow increasing preservation of residual hearing. Novel internal magnet designs have improved MRI compatibility.

**References available on request*



Picture 2. Rondo – single unit processor. Image courtesy of Med-El