

BIMODAL HEARING

Issues in combining the use of a Hearing Aid with an Implant

Summary of a presentation by Dr Maire Doran, Audiological Scientist, North Wales Cochlear Implant Centre at the Winter Forum on 14 Nov, 2007

It is still the norm in the UK to do unilateral implantation and historically, implants (CI) were only given to people with little or no hearing and therefore they had no benefit with hearing aids (HA) at all. But implant centres are now seeing people with quite significant low-frequency residual hearing and who could benefit from HAs in the unimplanted ear. For suitable candidates there can be a wide range of benefits from having both an implant in one ear and a HA in the other (see Figure 1).

Possible Binaural Benefits for Unilateral CI + Contralateral HA

- Improved localisation of sound
- Improved perception of speech
- Improved perception of speech in background noise
- Maximum use of residual hearing
- Better sound quality
- Improved music perception
- Alleviation of tinnitus
- Continued stimulation of auditory pathways

Fig1

“In order to maximise the benefits we needed to know how best to fit the HA and whether it should be fitted to everybody or are there particular candidates who would benefit more than others. So we decided to conduct a study to find out. There is no clear protocol in the UK for fitting HAs but there was a study done in Australia by T Ching in which the HA was optimised and this showed that this could improve the overall hearing performance. There can be problems with setting up a procedure in the UK as there may be variation in the experience in fitting HAs by CI clinicians and some CI centres are physically isolated from the HA department.

The study was run in conjunction with the Southampton implant programme and was conducted on twenty subjects (18 adults and 2 children). All had post lingual hearing loss; they were all implanted with the same (Nucleus) implant

Procedures

- Hearing Aid Optimisation
- Speech performance testing
- Localisation testing
- Functional Performance Questionnaires

Fig2

and had had a stable map for nine months. Further none of them had worn a HA for at least a year before embarking on the study. There were 4 procedural steps (see figure 2).

The HA optimisation procedure had two parts. First, the frequency optimisation, setting up alternative responses of Bass Boost and Bass Cut (6db/octave) and secondly, loudness balancing in which the HA was adjusted to match the CI over a range of loudness levels. The speech perception was measured using an adaptive sentence test with BKB sentences, the speech being presented at 70 dBA and the signal to noise ratio was measured at which the candidate scored 50% correct. The localisation testing was done at the Southampton ISVR where the subjects sat in an anechoic chamber in a semi circle of loudspeakers. The last stage was the performance questionnaires which were completed first after implantation and then again after the HA had been fitted”



Dr Doran then presented a wide range of slides showing the analysis of all the results of the study. The first most significant conclusion was that for speech in noise, there

Conclusions of Study

- In the bimodal condition this study showed
 - no significant benefit to speech understanding in noise
 - significant benefit in ability to localise sound
- Using a hearing aid optimisation procedure showed
 - no additional benefit in localisation ability
 - no significant benefit to speech understanding in noise

Fig 3

was no significant benefit in speech discrimination with the addition of an HA over the CI. Localisation was significantly better but conversely there was no significant difference between candidates who had a standard fitting HA and those who had been put through the optimisation procedure.

The questionnaire results show that there was significant difference in the spatial and quality domains when a HA was used. Candidates were reporting improved localisation and quality of sound but they were not reporting improved

Conclusions of Study

- Patients report functional benefit in localisation and quality of sound when using a hearing aid with a cochlear implant
- Benefits were not correlated with residual hearing
- 60% continued wearing hearing aid with CI after the study

Fig 4

speech discrimination which matched the results of the tests at Southampton (see Figures 3 & 4). Interestingly 60% of the candidates continued wearing their HA after the study was finished.

“The optimisation showed no additional benefit and so we now had to face the question who is likely to benefit from having an HA fitted after implantation. Residual hearing does not seem to predict bimodal benefit so should implantees with some measure of residual hearing be encouraged to try a contralateral HA? We believe they should be. So we decided to check what else is happening in the UK and we sent questionnaires to 25 implant centres to which 17 responded. Most of the centres had the facilities to fit HAs however the majority did not exchange the HA after implantation and carried out no optimisation. Historically we actively discouraged the use of an HA when an implant is first fitted because we regard it important that the candidate learn to use the CI on its own. Binaural interference is not very common but some people cannot integrate the two signals and can be worse off with an HA and CI than with a CI alone.

So the recommendation is to have a flexible approach to HA introduction. We recommend the offer of a HA to everyone who has residual hearing and then again at the second point when the CI has stabilised and user adjusted to its performance. If the HA is accepted then it should be rechecked after a specified period of time in order to establish whether there is benefit or not.

The first significant conclusion was that for speech in noise, there was no significant benefit in speech discrimination with the addition of a hearing aid over the cochlear implant on its own.

Research on all the other bimodal studies show that they demonstrate improved localisation and this is of benefit to users. Some showed improved sound quality and improved music appreciation. A further question arose for those who have residual hearing. Should they go for bimodal fitting or for a bilateral implant? The key issue depends on the amount of residual hearing of the candidate. If there is no

residual hearing and it's an easy decision to consider a bilateral implant. As to the suitable level of residual hearing where a bimodal approach is the best, there is to date no clear evidence.” (See Figure 5).

Pros and Cons

- Bilateral
 - Improved speech discrimination in noise
 - Improved localisation
 - Continued stimulation of 2nd side (may preclude some future technologies)
 - No access to acoustic low freqs
 - Better access to high freqs in 2nd side
 -
- Bimodal
 - Improved speech discrimination in noise
 - Improved localisation
 - Continued stimulation of 2nd side
 - No access to high freq sounds
 - Better access to acoustic low freqs in 2nd side
 - Better sound quality and music appreciation

Fig 5

WINTER FORUM

This was held on 14 November at the Queen Elizabeth Hospital Birmingham. Opening the meeting Nigel Williams (Chairman) welcomed the audience and the three speakers of the day. Dr Maire Doran of the North Wales Cochlear Implant Centre whose presentation appears on pages 4 & 5. Presentations were also made by Dr Robert Morse from Aston University and Patrick Richmond-Ward of the Birmingham Cochlear Implant Centre. Those two presentations will appear in the Spring Edition.

Nigel welcomed and thanked the clinicians from the manufacturers and expressed, on behalf of the Association, our continued thanks for their support.

Yvonne James, of Advanced Bionics, reviewed their Harmony system with the HiRes 90K implant and the HiRes Fidelity 120 speech processing strategy. Harmony's rechargeable battery life is now upto 14 hours in the standard size and 24 hours in the larger size.

Fiona Kukiewicz, of MED-EL, reviewed their Opus 1 and Opus 2 processors, giving a choice of switched or switch free action. The implant now has a choice of housing; in ceramic, the Pulsar, or in titanium, the Sonata. Fiona also reviewed their Duet system, an electro-acoustic (EAS) combined implant with a hearing aid.

Mary Bell, of Cochlear UK, reviewed their Freedom system, which in early 2008 will be available as a backward compatible system for Nucleus 22 users, some of whom will have been users for 20 years. Mary also commented on their research work on EAS and multiple channels.