Feedback on a radio aid study

Stuart Whyte, University of Southampton Auditory Implant Service, summarises his radio aid study

The aim of the study was to test the validity of electroacoustic verification of radio aid systems coupled with cochlear implant (CI) sound processors and to examine the rationale of proposed protocols for Phonak Roger design-integrated receivers for CI.

The University of Southampton Auditory Implant Service radio aid study (Whyte, 2019) considered the validation of proposed electroacoustic verification protocols for design-integrated radio aid receivers coupled to cochlear implant sound processors. The United Kingdom (UK) Children's Radio Aid Working Group (formerly the FM Working Group) in collaboration with the UK National Deaf Children's Society have published standards and guidance on amplification systems used with hearing aids and auditory implant sound processors (UKCRAWG, 2017). In the United States (US) adaptations of the American Academy of Audiology guidelines for hearing aids have been proposed for implant sound processors in peer-reviewed research (Nair, Sousa, & Wannagot, 2017; Schafer, Musgrave, Momin, Sandrock, & Romine, 2013).

It is important that when hearing aids or auditory implants are coupled with radio aids, an appropriately qualified individual ensures that the whole system provides the desired benefit. However, the approaches by the UK and the US to achieve the balance or 'transparency' of the combined systems differ. The traditional approach of the UK, built on work associated with the NHS Modernising Children's Hearing Aid Service programme, was first produced as guidance in 2006 and published in 2008. The original US work was published in 2013 and followed up by an article in 2017. It only uses test signals of 65dB and allows transparency within 3dB.

The study looked at the two approaches to determine which is most effective. The balance or electroacoustic transparency is demonstrated when the hearing instrument analyser outputs of the sound processor on its own and then coupled with the radio aid are equal to within 2dB in the range 750Hz, 1kHz and 2kHz.

Measures of output at the implant electrode level and electroacoustic responses of contemporary CI sound processors were conducted with their design-integrated receivers at different gains.

The current UK and US electroacoustic test protocols for radio aid receivers coupled to CI sound processors were used. Measurements were conducted in the laboratory with the CIs and their design-integrated receivers to determine transparency, where suitable inputs to the CI and to the CI and radio aid, give equivalent outputs.

Results

Changes in the gain of the radio aid receiver resulted in corresponding changes in implant output at the electrode level. This was found to be similar in the electroacoustic output of the processor shown by the test box response curves. To avoid compression effects in the SONNET, CP1000 (N7) and CP910 (N6) processors 55dB signal levels were used as a maximum and a maximum of 65dB for Naida CI.

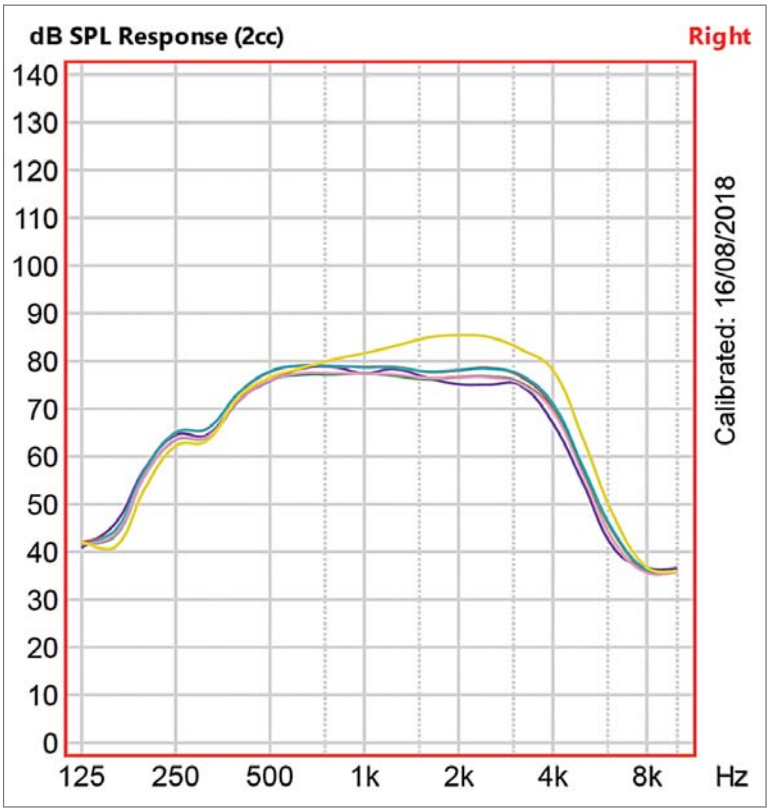

Figure 1

Naida CI Q90 and Roger 17 example

Figure 1, left, and Table 1, on next page, show the curves and data for the Naida CI Q90 and Roger 17 set at EasyGain 0 and -2.

Curves 1 and 2: 65/65 EasyGain 0 are within 2dB but the radio aid is just louder:

Offset calculation = – 1.7dB [average of values at 750Hz, 1kHz, 2kHz]. Note RMS of -1.

Curves 3 and 4: 65/65 EasyGain -2 are also within 2dB but the radio aid is just quieter:

Offset calculation = +1.7dB [average of values 750Hz, 1kHz, 2kHz]. Note RMS of +1.

As with the hearing aid procedure, you can run a "Reality Check". For example, speech usually reaches the child's ear at 65dB at a metre. However, the transmitter is worn at 15-20cm below the talker's mouth and the sound is greater at that distance, so the input to the radio aid is approximately 80dB.

Curves 5 and 6: 65/80 at EasyGain -2 show a frequency offset of -5.3dB (RMS -5). However, to show the reality of wearing a transmitter in use with an 80dB input we use the F2B values (feature to benefit). Here the Gain offset [750Hz, 1kHz, 2kHz] is -11.7dB (louder). But it is not really about crunching numbers – it is important to use common sense and look at the shape of the curves! Above all, it is essential that speech in noise tests are used to validate the fitting.

Test signal values

Table 2 shows the recommended values for Phonak Roger design-integrated receivers for cochlear implants.

Conclusions

Although the test box curves only indicate the microphone output, this has been shown to correspond at the implant electrode level. Initial results show that suitable signals of equal intensity presented to the sound processor and the radio aid transmitter are appropriate for design-integrated receivers coupled to CI sound processors, a modification of the US approach.

The protocols need further validating with speech in noise testing to provide more evidence that the desired benefit has been achieved and that the user is satisfied with the quality.

Similar investigation needs to be undertaken with other ear level receivers and with receivers coupled by electromagnetic induction to the telecoil of the processor.

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Right	250	500	750	1K	1.5K	2K	3K	4K
Curve1	65	76	79	77	77	75	75	67
Curve2	65	78	79	79	78	78	77	71
F2B 1	0	-2	-1	-1	-1	-3	-2	-3
Curve3	65	78	79	79	78	78	77	71
Curve4	64	76	77	77	76	77	76	70
F2B 2	2	2	2	1	1	2	1	1
Curve5	64	76	77	77	77	77	76	70
Curve6	62	77	80	82	84	85	83	78
F2B 3	6	8	13	12	12	10	10	9

Table 1

Device combination	SPL to processor	SPL to radio aid	Connevans test lead *
MED-EL SONNET & Roger 21	55dB	55dB	DCTEST 4 & MTD adapter
Cochlear Nucleus 7 & Roger 20	55dB	55dB	DCTEST 4 & mono adapter
Cochlear Nucleus 6 & Roger 14	55dB	55dB	DCTEST 3
Cochlear Nucleus 5 & Roger 14	65dB	65dB	DCTEST 3
Advanced Bionic Naida CI & Roger 17	65dB	65dB	DCTEST 4

Table 2
*www.connevans.co.uk/productSearch.do?query=dctest&Search+Button=

References

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