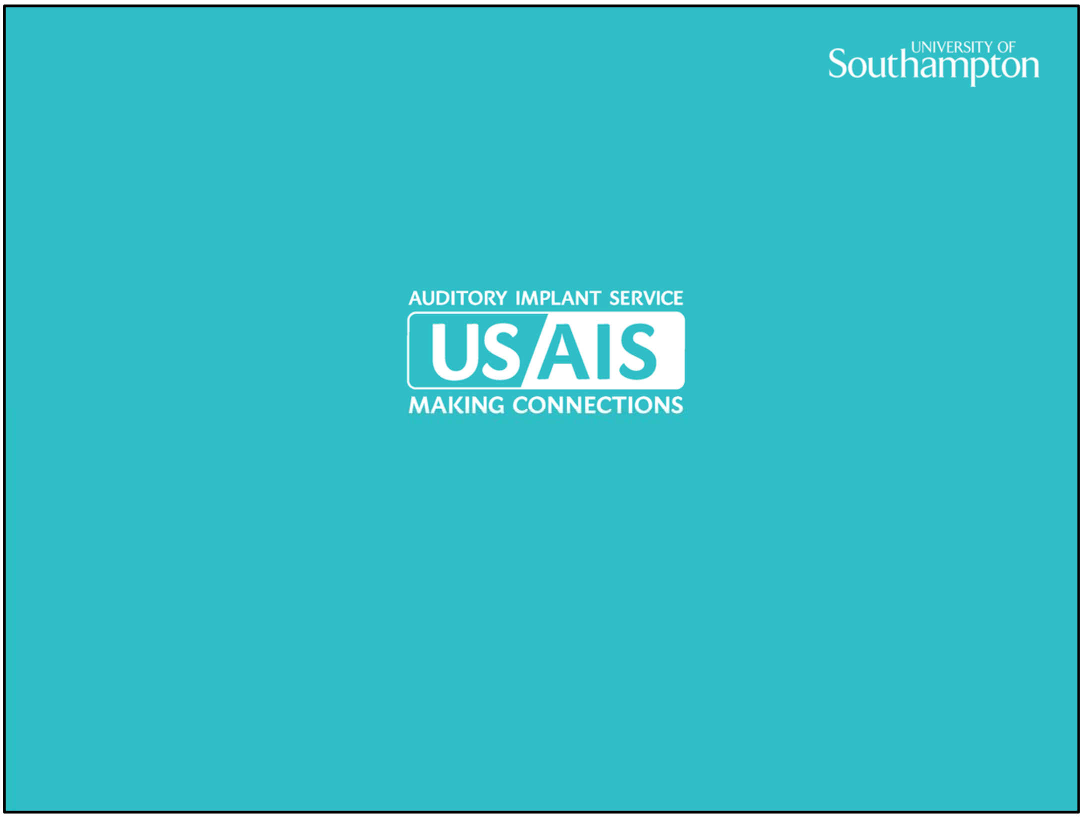
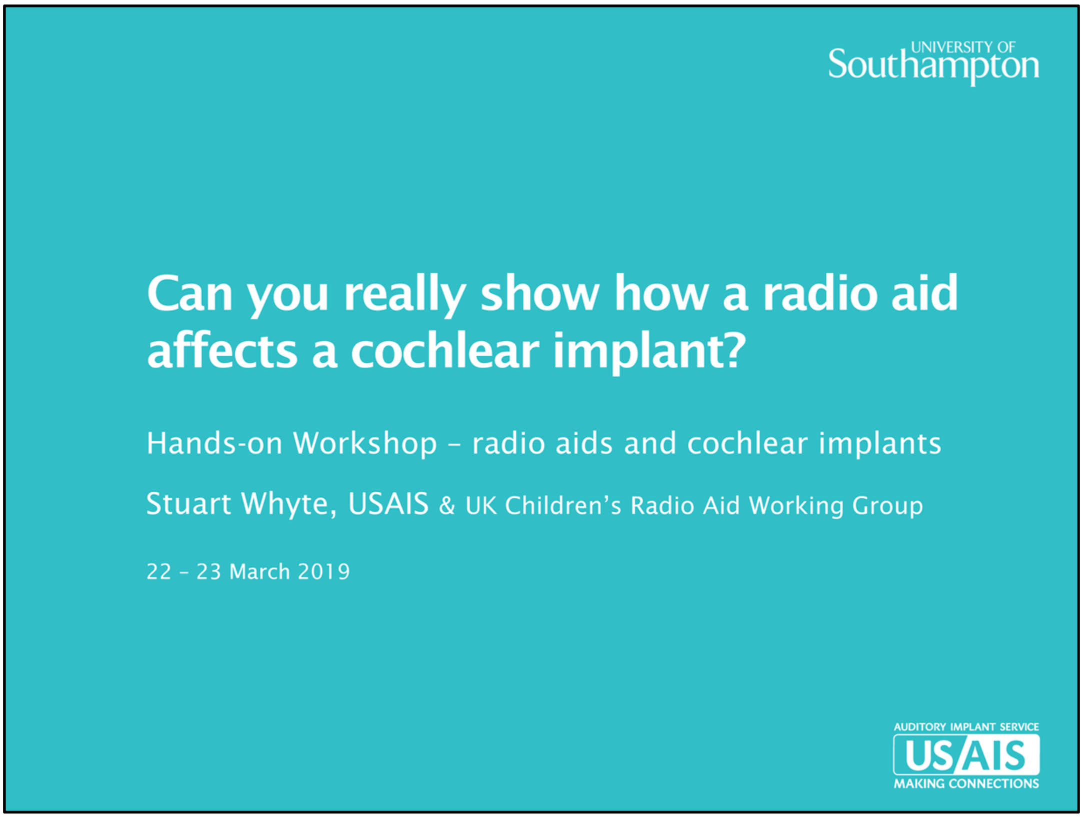


a front logo slide for use in all presentations - this will be used as a holding slide while your guests arrive



a title slide, which introduces the presentation and speaker

Background

- National Quality Standards for radio aids were first published in 2008 and updated in 2017.
- Practical guidance is also available for each QS section:

https://www.fmworkinggroup.org.uk/Home/quality-standards

- The UK has a protocol for setting up radio aid systems for use with hearing aids:

https://www.connevans.info/image/connevans/fmadvantage.pdf

- The US approach is incorporated into the Phonak Offset Protocol (POP) https://bit.ly/2STbSTV

3

Literature shows that individuals with hearing loss often struggle to understand speech against competing background noise or in reverberant noisy environments and that remote microphone systems coupled with hearing devices are an effective intervention. As well as the benefits to school-aged children, the value of radio aids and toddlers has been shown by a report from the Ear Foundation in collaboration with the National Deaf Children's Society (Allen et al., 2017).

The UK Children's Radio Aid Working Group in collaboration with Britain's National Deaf Children's Society have published standards and guidance on amplification systems used with hearing aids and auditory implant sound processors (UKRAWG, 2017). Previously published peer-reviewed research (Nair et al., 2017; Schafer et al., 2013) has used an adaptation of guidelines with hearing aids from the American Academy of Audiology.

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Background

- The approach for cochlear implants considers the UK and US approaches
- We often ‘balance’ by eye, i.e. the curves should overlap each other
- All the protocols consider the average SPL recorded at 750 Hz, 1 kHz, and 2 kHz
- The hearing device and the radio aid response should be within 2dB of each other

4

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It is important that when hearing aids or auditory implants are coupled with radio aids that the clinician or 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 implant processor and radio aid system differ from each other. The traditional approach of the UK built on work associated with the NHS Modernising Children’s Hearing Aid Service program and 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.

This workshop will discuss and demonstrate the two approaches to determine which is most effective in achieving the balance of the coupled systems through verification by electroacoustic transparency (balance). This is demonstrated by the hearing instrument analyser test box outputs of the sound processor on its own and coupled with the radio aid being equal to within 2dB.

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Justifying the use of the test box

- Aside from balancing, it is very helpful to establish baseline curves in the test box; e.g.
  - compare curves over time to consider any changes
  - consider responses at different sound levels
  - check any changes in responses of the device microphones
- Hearing aids and bone conduction devices: 65dBSPL
- Cochlear implants: 50 - 65dBSPL (processor dependent)
  - see QS8 Good Practice Guidance UKRAWG (2018)

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For hearing aids and BCHD suitable signals of equal intensity (65dB) can be presented to both the hearing device and the radio aid coupled with the device and the outputs can be balanced in a test box. However, consideration needs to be given to the signal intensities that are present to CI (UKRAWG, 2018). It is also important to consider the type of radio aid receiver; e.g. design-integrated, attached directly or with an adapter or coupled by electro-magnetic induction (telecoil/loop systems).

Phonak proprietary Roger technology utilizes intelligent adaptive algorithms
- wireless transmission and automatically adjusts to the noise level surrounding
- Roger Pen and Touchscreen transmitter sense orientation and adapts microphone mode

Roger Table Mic - omnidirectional microphone user can participate and contribute in small and large meetings (join units in a multi-talker network).
Roger Focus, a discreet behind-the-ear receiver, minimizes distracting background noise for children with normal hearing but attention-related issues; UHL, APD, ASD.

HiBAN (Hearing instrument Body Area Network) is a digital inductive 10.6 MHz technology, which wirelessly transfers stereo audio and control information to enabled hearing instruments from Phonak/AB or even audio and control signals between the hearing instruments.

The new Naída bimodal hearing solution from AB and Phonak provides the first hearing aid specifically designed to work with a cochlear implant system. It features the Naída CI sound processor* and Naída™ Link or CORS hearing aids.

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Signal levels

The UK Children's Radio Aid Working Group,
until further research evidence is available , continues to advise:

Devices and ear-level receivers Phonak Roger, Comfort Audio DT20	1st SPL level to processor	2nd SPL level to processor	SPL level to radio aid	Test Lead	Response curve to aim for balance/transparency ±2dB
All Advanced Bionics processors	60dB	65dB	65dB	DCTEST4	65dB
MED-EL OPUS2 FM battery Cover with DT20 or Roger X (02)CI setting 2	60dB	65dB	65dB	DCTEST4 ◄	65dB
MED-EL RONDO and mini battery pack with DT20 or Roger X (02) CI setting 2	60dB	65dB	65dB	DCTEST4 ◄	65dB
Cochlear Nucleus 5 Roger 14 or Euro accessories adaptor with DT20 or Roger X (02) CI setting 9	60dB	65dB	65dB	DCTEST3	65dB
MED-El SONNET Roger 21 or FM Battery Cover with DT20 or Roger X (02) CI setting 3	50dB	55dB	55dB	DCTEST4 ►	55dB
Cochlear Nucleus 6 Roger 14 or Euro accessories adaptor with DT20 or Roger X (02) CI setting 9	50dB	55dB	55dB	DCTEST3	55dB
Cochlear Nucleus 7 Roger 20	50dB	55dB	55dB	DCTEST4 + mono adapter	55dB

1st and 2nd Curves to the processor are with the processor on the everyday/standard program.
When the radio aid is attached a dedicated program may need to be selected. Check with your Auditory Implant Service.
◄ Requires Microphone Test Device Kit, mini battery pack and connecting-cable
► Requires SONNET Microphone Test Device Kit

Telecoil/Loops systems may be between the lower and upper curves.

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AUDITORY IMPLANT SERVICE USAIS MAKING CONNECTIONS

A study by the author to test the validity of electroacoustic verification of radio aid systems and design-integrated receivers for CI will be presented at the April conference of the British Cochlear Implant Group (Whyte, 2019). Measures of output at the implant electrode level and electroacoustic responses of contemporary CI sound processors were conducted with their design-integrated receivers. Using the current UK and US proposed clinical electroacoustic test protocols for radio aid receivers coupled to CI sound processors, measurements were conducted in the laboratory with the CI and design-integrated receivers to determine transparency. Suitable equivalent inputs to the CI and the radio aid result in equivalent outputs.

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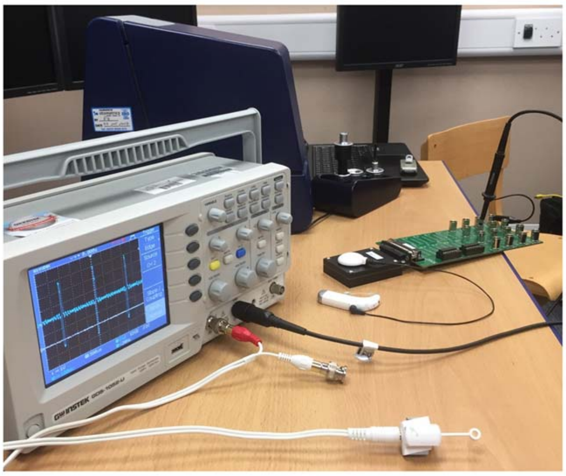
Demonstration

- Advanced Bionics Naida and Roger 17



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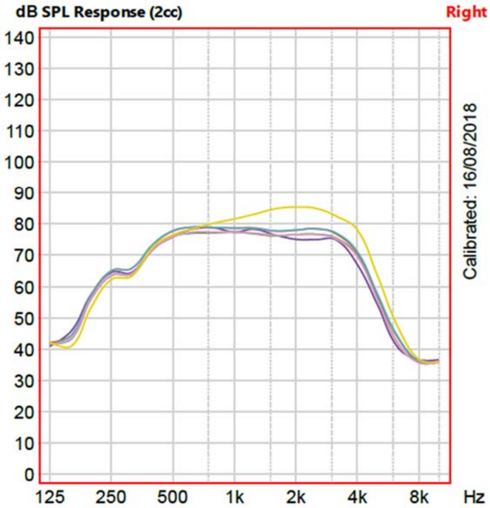
Advanced Bionics Naida



FreeStyle Table Right (2cc)

Right	250	500	750	1K	1.5K	2K	3K	4K	6K	RMS
Curve1	65	76	79	77	77	75	75	67	44	87
Curve2	65	78	79	79	78	78	77	71	47	88
F2B 1	0	-2	-1	-1	-1	-3	-2	-3	-3	
Curve3	65	78	79	79	78	78	77	71	47	88
Curve4	64	76	77	77	76	77	76	70	45	87
F2B 2	2	2	2	1	1	2	1	1	2	
Curve5	64	76	77	77	77	77	76	70	45	87
Curve6	62	77	80	82	84	85	83	78	51	93
F2B 3	6	8	13	12	12	10	10	9	7	

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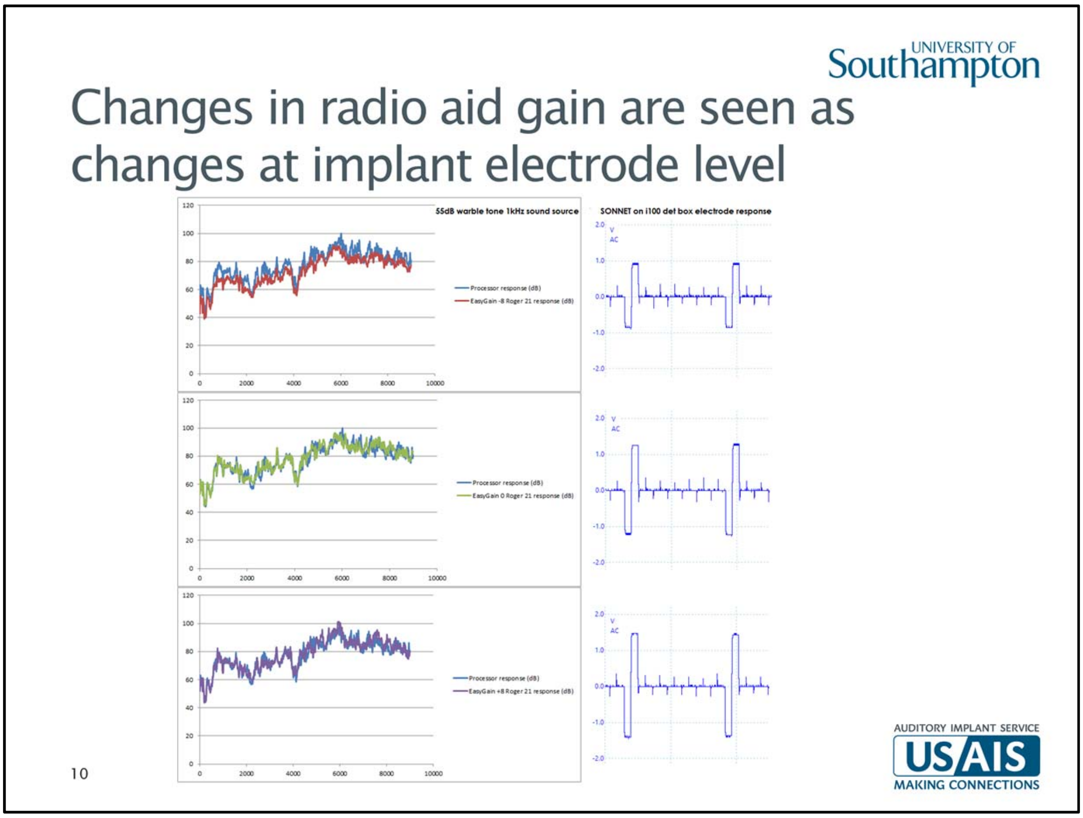
Curves 1 and 2: 65/65 EasyGain 0 within 2dB but radio louder, offset = - 1.7dB [750Hz, 1kHz, 2kHz], (RMS -1)
Curves 3 and 4: 65/65 EasyGain -2 within 2dB but radio quieter, offset = +1.7dB [750Hz, 1kHz, 2kHz], (RMS +1)

REALITY CHECK
Curves 5 and 6: 65/80 EasyGain -2 frequency offset = -5.3dB (RMS -5). Shows the reality of wearing transmitter in use 80dB input.
F2B (feature to benefit) Gain offset [750Hz, 1kHz, 2kHz], -11.7dB (louder) Important to look at the shape of the curve and not just crunch numbers!



The University of Southampton study (Whyte, 2019) showed that changes in 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 sound processor suitable signal levels (UKRAWG, 2018) were chosen and outputs of the sound processor on its own and then the processor coupled with the radio aid where shown to be equal to within 2dB.

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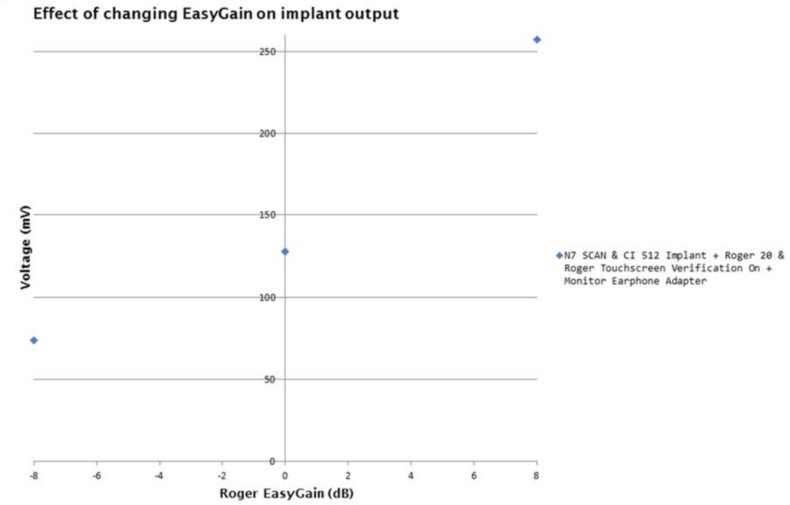
Changes in radio aid gain are seen as changes at implant electrode level



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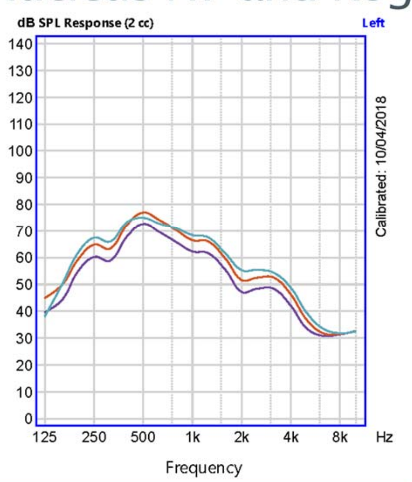
Cochlear Nucleus N7 and Roger 20 EasyGain 0



FreeStyle Table Left (2cc)

Left	250	500	750	1K	1.5K	2K	3K	4K	6K	RMS
Curve1	60	73	67	62	57	47	48	42	31	76
Curve2	65	77	71	67	61	52	53	46	33	81
Curve3	67	75	71	68	63	55	55	49	35	80

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50dB input Curve 1 67 +62 +47 = 176, 176/3 = 58.7dB
55dB input Curve 2 71 +67 +52 = 193, 190/3 = 63.3dB
55dB input Curve 3 71 +68 +55 = 193, 194/3 = 64.7dB (1.3dB difference)

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Conclusions

- Test box curves only indicate the microphone output of the processor or processor coupled with the radio aid receiver
- USAIS studies show correspondence at 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
- The proposed protocols need further validating with speech in noise testing
- Similar investigations need to be undertaken with other radio aid systems

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AUDITORY IMPLANT SERVICE USAIS MAKING CONNECTIONS

Although test box curves only indicate the microphone output of the processor or processor coupled with the radio aid receiver, this has been shown to correspond at 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. However, the proposed protocols need further validating with speech in noise testing to provide more evidence that the desired benefit has been achieved and that the individual using the system is satisfied with the benefit. Similar investigation needs to be undertaken with other direct input ear level receivers and with receivers coupled by electromagnetic induction to the telecoil of the processor.

References

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UKRAWG. (2018). Good Practice Guide for Radio Aids - checks with auditory implants [The UK Children's Radio Aid Working Group. Updated guidance v.1.4]. Retrieved Date Accessed, 2019 from https://www.fmworkinggroup.org.uk/Home/quality-standards.

Whyte, S. D. (2019). *Validation of proposed electroacoustic verification protocols for design-integrated radio aid receivers coupled to cochlear implant sound processors.* Presented at BCIG, April 2019, Southampton.

YOUR QUESTIONS

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Thank you for particpating

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a title slide, which introduces the presentation and speaker