Assessing Automated Neural Response Telemetry Values During the First Year of Cochlear Implantation with Slim Modiolar Electrode Arrays: A Retrospective Data Analysis Study

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BACKGROUND & AIM

Since the introduction of Automated Neural Response Telemery (AutoNRT), there has been a keen interest on exploring its efficacy and usability in the clinical practice. There have been numerous studies gathering data from Cochlear implants with lateral wall electrode placement [2, 3, 6, 7]. However, since the introduction of perimodiolar electrode arrays, there have been a very few studies with data about the efficacy and longitudinal changes of AutoNRT with perimodiolar electrode array [1, 3, 5, 6], especially for the data with Slim Modiolar electrode array [4]. This study aims to discuss AutoNRT values gathered from 92 ears with Cochlear's Slim Modiolar cochlear implants (CI532 and CI632) at different timepoints during the first-year post-activation and the longitudinal changes identified.

METHOD

AutoNRT data were gathered from 56 CI recipients (n=92 ears, 36 bilateral CI recipients and 20 unilateral CI recipients), including children and adults (age of implantation ranging from 8 months to 89 years old, mean age of implantation = 17.3 ± 26.2 years). All the recipients were implanted with either CI532 or CI632 implants via cochleostomy approach, using Cochlear's implant with Slim Modiolar electrode array, having received the full insertion of the array. Data were gathered retrospectively at three different time points - at activation (switch-on), six months post-activation and one-year post-activation. Data were gathered from five electrodes including basal end (electrode 1 [e1] and e6), middle (e11) and apical end (e16 and e22) electrodes. Majority of the data recordings were from the actual electrodes e22, e16, e11, e6 and e1. However, when data was not recorded from the actual electrode, the recordable responses from the adjacent electrodes were accepted with a tolerance of [+1] electrode for e16, e11 and e6, [-2] for e22 and [+3] for e1. The data were discarded from the study for ears which did not meet this inclusion criteria.

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SUBJECTS & DATA

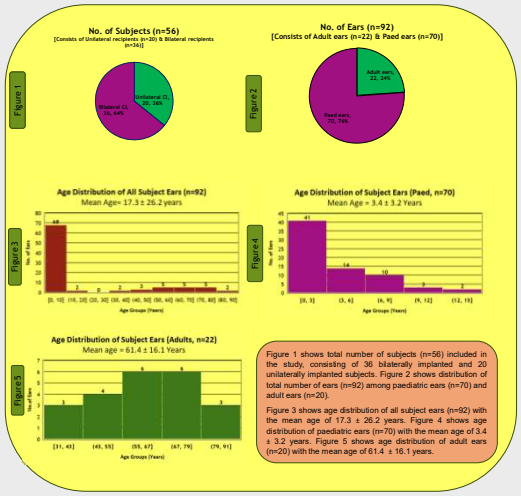

Figure 1 shows total number of subjects (n=56) included in the study, consisting of 36 bilaterally implanted and 20 unilaterally implanted subjects. Figure 2 shows distribution of total number of ears (n=92) among paediatric ears (n=70) and adult ears (n=20).

Figure 3 shows age distribution of all subject ears (n=92) with the mean age of 17.3 ± 26.2 years. Figure 4 shows age distribution of paediatric ears (n=70) with the mean age of 3.4 ± 3.2 years. Figure 5 shows age distribution of adult ears (n=20) with the mean age of 61.4 ± 16.1 years.

RESULTS (All EARS)

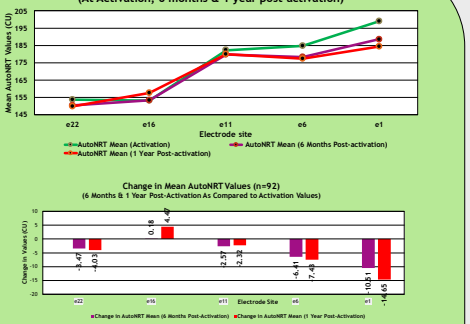

Table 1

Value in Current Unit (n=92)	e22	e16	e11	e6	e1
AutoNRT Mean (Activation)	153.72	153.08	182.29	184.74	199.01
AutoNRT Mean (6 Months Post-activation)	150.25	153.26	179.73	178.33	188.50
AutoNRT Mean (1 Year Post-activation)	149.68	157.54	179.98	177.30	184.36
p-value	0.23591	0.43353	0.61355	0.00182	0.00000

Figure 6 & Figure 7 show Mean AutoNRT values for e22, 16, 11, 6 and 1 and changes in the mean values respectively at different timepoints (Activation, 6 months and 1-year post-activation) for all ears (n=92). Lines show minimal changes in levels for e22, 16 and 11 (within 4 current unit [CU]), however the change (reduction) in mean AutoNRT levels was significant for e6 and e1 (from 6 to 14 CU) from activation to 6 months and 1-year post-activation.

Table 1 shows single factor ANOVA values showing the p-values of (<0.05) for change (reduction) in values on e6 and e1, indicating these reduction in AutoNRT mean values to be **statistically significant with all ears between different timepoints for e6 and e1**.

RESULTS (ONLY ADULT EARS)

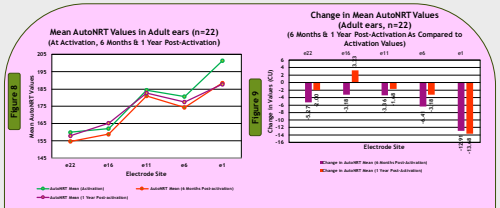

Table 2

Value in Current Unit (n=22)	e22	e16	e11	e6	e1
AutoNRT Mean (Activation)	159.91	162.05	184.32	180.68	201.41
AutoNRT Mean (6 Months Post-activation)	154.64	158.86	180.95	174.27	188.50
AutoNRT Mean (1 Year Post-activation)	157.91	165.27	182.64	177.50	187.73
p-value	0.55933	0.57112	0.64810	0.24579	0.04882

Figure 8 & Figure 9 show Mean AutoNRT values for e22, 16, 11, 6 and 1 and changes in the mean values respectively at different timepoints (Activation, 6 months and 1-year post-activation) in Adult ears (n=22). Lines show minimal changes in levels for e22, 16, 11 and 6 (within 4 to 6 current unit [CU]), however the change (reduction) in mean AutoNRT levels was significant for e1 (from ~13 to 14 CU) from activation to 6 months and 1-year post-activation.

Table 2 shows single factor ANOVA values showing the p-values of (<0.05) for reduction in mean values on e1, indicating these reduction in AutoNRT mean values to be **statistically significant in Adult ears between different timepoints for e1.**

RESULTS (ONLY PAED EARS)

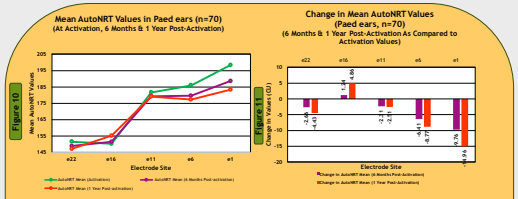

Table 3

Value in Current Unit (n=70)	e22	e16	e11	e6	e1
AutoNRT Mean (Activation)	151.53	150.26	181.66	186.01	198.26
AutoNRT Mean (6 Months Post-activation)	148.87	151.50	179.34	179.60	188.50
AutoNRT Mean (1 Year Post-activation)	147.10	155.11	179.14	177.24	183.30
p-value	0.31235	0.56523	0.73877	0.00387	0.00003

Figure 10 & Figure 11 show Mean AutoNRT values for e22, 16, 11, 6 and 1 and changes in the mean values respectively at different timepoints (Activation, 6 months and 1-year post-activation) in Paed ears (n=70). Lines show minimal changes in levels for e22, 16, and 11 (within 2 to 5 current unit [CU]), however the change (reduction) in mean AutoNRT levels was significant for e6 and e1 (from ~7 to 15 CU) from activation to 6 months and 1-year post-activation.

Table 3 shows single factor ANOVA values showing the p-values of (<0.05) for reduction in mean values on e6 and 1, indicating these reduction in AutoNRT mean values to be **statistically significant in Paed ears between different timepoints for e6 and 1.**

AutoNRT can be significantly variable over the time at basal end with Slim Modiolar electrode array.

DISCUSSION

- ✓ **Majority of AutoNRTs were higher at activation**
- ✓ Mean AutoNRT **values were higher in Adult ears as compared to Paediatric ears**
- ✓ Mean AutoNRT **values showed less variability at middle and apical end of electrodes as compared to basal end electrodes**
- ✓ **All Mean AutoNRT values (except electrode 16) showed reduction in values over the first year**
- ✓ Single factor ANOVA showed the variance in **reduction for Mean AutoNRT values to be statistically significant** over different timepoints for e6 and e1 **for all ears** (n=92) including Paediatric ears (n=70) and only for e1 in Adult ears (n=22)

Possible explanations for reduction in AutoNRT values:

- The trauma caused by **Cochleostomy approach at basal end & trajectory of the insertion of array** meaning closer hugging of array at the apical end – causing higher AutoNRTs initially at basal end, which settle and reduce over time.
- **AutoNRT algorithm altering the recording parameters**, when no NRTs obtained.
- **When values could not be obtained from the actual electrode, the value from the adjacent electrodes were accepted.**

CONCLUSION

AutoNRT values with Slim Modiolar electrode array show variability over time, so it is important to repeat these over time.

For mapping based on objective measures only, it is advisable to base the MAP on AutoNRT values from middle to apical end electrodes as compared to basal end electrodes, which showed more variability in values.

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