Introduction

Cochlear implant (CI) candidacy criteria continues to expand with the number of CI recipients across the globe.\(^1\) Cochlear implant technology continues to evolve.\(^1\) Cochlear implant programming for MAP creation.

While this time may reduce programming time, strict programming may sacrifice optimal performance.\(^5\)

It is unlikely that all CI recipients achieve optimal outcomes with a single set of parameters.\(^2\)

Several studies have shown individual preferences for stimulation rate, 25 msec pulse width and 8 maxima.\(^1\)

This project was completed to evaluate CI outcomes for MAPs created using traditional and streamlined programming techniques.

Methods

Subjects:

Mean age: 73.1 years, Range: 65-88 years

All subjects had stable MAPs with previously optimized parameters. Mean years post-op: 4.95, Range: 5-15 years

Our clinic optimizes MAP parameters soon after activation. Optimized stimulation rates for recipients included in this project were:

- 720 Hz: 20%
- 900 Hz: 30%
- 1200 Hz: 40%
- 1800 Hz: 10%

Protocol:

Several MAPs were created for ten adult CI recipients during a single session.

- MAP 1, Measured and Optimized: Measure T and Cs for 12-14 electrodes using patient’s previously optimized parameters. Sweep Cs for equivalent loudness. Go live and modify MAP as needed to optimize sound quality.
- MAP 2, Streamlined and Optimized: Input Ts for electrodes 1-6-11-16-22 obtained from MAP 1 using patient’s previously optimized parameters. Go live and increase Cs to patient satisfaction.
- MAP 3, Streamlined: Measure Ts for Electrodes 1-6-11-16-22 using Cochlear default parameters including 900 Hz stimulation rate, 25 msec pulse width and 8 maxima. Go live and increase Cs to patient satisfaction. MAP 3 only created if patient's optimized stimulation rate not 900 Hz.

Cochlear Corporation’s streamlined programming guidance followed to create MAPs 2 and 3. MAPs modified to ensure equivalent volumes.

Patients likely biased towards measured and optimized MAPs, versus and measured.

Results

- 90% of subjects preferred the measured MAP with optimized parameters (F(1)=6.688, p=0.029, effect size = 0.428).
- C level differences between measured and streamlined MAPs were extremely variable for individual patients and electrodes.
- No significant difference found between the averaged C levels for the 3 different MAPs. There was a statistically significant difference in the pattern of Cs. Cs for apical electrodes for measured MAPs were lower than obtained using streamlined programming (F(1)=10.353, p=0.011, effect size = 0.535).
- When Ts are relatively flat across the array, performance and subjective rating less variable than when Ts show substantial differences across the array. With variable Ts streamlined programming resulted in poor sound quality and inadequate volume since the dynamic range was equal for all electrodes.
- Tendency found for increased performance with measured MAPs created from optimized parameters, but this did not reach a level of significant difference.
- Results must be viewed cautiously due to the limited number of subjects and short period of time the streamlined MAPs were used. Patients likely biased towards measured and optimized MAPs.

Conclusions

The CI field must develop an efficient method to optimize individual programming parameters and create faster programming methods while achieving optimal patient outcomes.

Streamlined programming techniques decrease programming time, but if strictly followed may sacrifice optimal performance.

Preliminary recommendations to improve programming:

- Optimize rate for each recipient.
- If streamlined programming is used, it is essential to sweep all Cs for equivalent loudness.
- Measure Cs if there is significant T level variability across the array.

Citations