Streamlined Programming vs. Traditional Measured MAPs for Nucleus Cochlear Implant Recipients

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Introduction

- Cochlear implant (CI) candidacy criteria continues to expand with the number of CI recipients growing at an unprecedented rate.
- Provision of outstanding CI services by expertly trained audiologists is time intensive.
- The CI community would benefit from the development of techniques that reduce programming time while achieving optimal patient outcomes.
- Cochlear Corporation advocates streamlined programming for MAP creation.
- While this technique may reduce programming time, limited research has been conducted evaluating outcomes with MAPs created using this procedure.
- Review of PubMed database found only one article evaluating streamlined programming and this article was published in 2005[1].
- The streamlined method recommends using 900 Hz stimulation rate. A global survey of experienced CI centers found that 94% of the audiologists created initial MAPs using 900 Hz and stimulation rate was rarely changed after initial activation.[2]
- It is unlikely that all CI recipients achieve optimal outcomes with a single set of parameters. Several studies have shown individual preferences for stimulation rate and optimization of parameters improved performance[3,4].
- **This project was completed to evaluate CI outcomes for MAPs created using traditional measured vs. streamlined programming techniques.**

Methods

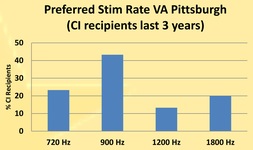
Subjects:

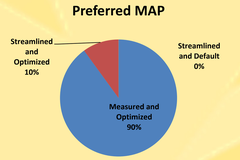
- Mean age: 73.1 years, Range: 65-88 years
- All subjects had stable MAPs with previously optimized parameters. Mean years post op: 4.95, Range: .5-15 years
- Our clinic optimizes MAP parameters soon after activation. Optimized stimulation rates for recipients included in this project were: 720 Hz: 20%
  900 Hz: 30%
  1200 Hz: 40%
  1800 Hz: 10%

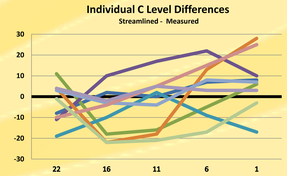
Protocol:

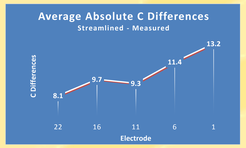
- Several MAPs were created for ten adult CI recipients during a single session.
  - MAP 1, Measured and Optimized: Measure T and Cs for 12-14 electrodes using patient's previously optimized parameters. Sweep Cs for equivalent loudness. Go live and modify MAP as needed to optimize sound quality.
  - 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.
- Patient perception for each MAP judged for sound quality and speech understanding using a Likert scale of 1 to 5 (1=poor, 5=excellent).
- Speech perception for CNC words and sentences in quiet assessed using the different MAPs.

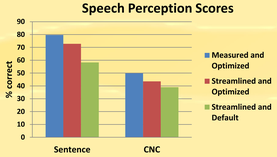
Results





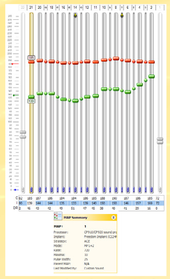


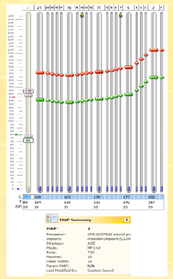


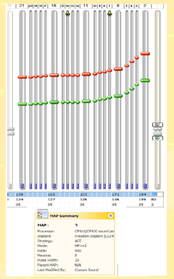


CASE STUDY

Data not included in results; patient unwilling to complete testing for MAPs 2 and 3 due to perceived poor sound quality


Measured and Optimized


Streamlined and Optimized


Streamlined and 900 Hz

- 90% of subjects preferred the measured MAP with optimized parameters F(1)=6.688, p=.029, effect size =.426.
- C level differences between measured and streamlined MAPs 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 C levels. Cs for apical electrodes for measured MAPs were lower than Cs obtained using streamlined programming F(1)=10.353, p=.011, effect size=.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

1. Plant K, Law MA, Whitford L, Knight M, Tari S, Leigh J, Pedley K, Nel E. (2005) Evaluation of streamlined programming procedures for the Nucleus cochlear implant with the contour electrode array. Ear & Hearing. 26(6): 651-668.
2. Vaerenberg B, Smits C, DeCeulaer, et al. (2014) Cochlear implant programming: A global survey on the state of the art. The Scientific World Journal. ID 501738.
3. Skinner MW, Arndt PL, Staller SJ. (2002) Nucleus 24 advanced encoder conversion study: performance versus preference. Ear & Hearing. 23(1S):2S-17S.
4. Patrick JF, Busby PA, Gibson PJ. (2006) The development of the Nucleus Freedom cochlear implant system. Trends in Amplification. 10(4):175-200.