P009

COCHLEAR IMPLANT

Comparison of tonotopic and default frequency fitting for speech understanding in noise in new cochlear implantees: a prospective, randomized, double-blind, cross-over study

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Abstract

Objectives: While cochlear implants (CI) have provided benefits for speech recognition in quiet for subjects with severe-to-profound hearing loss, speech recognition in noise remains challenging. A body of evidence suggests that reducing frequency-to-place mismatch may positively affect speech perception. Thus, a fitting method based on a tonotopic map may improve speech perception results in quiet and noise. The aim of our study was to assess the impact of a tonotopic map on speech perception in noise and quiet in new CI users.

Design: A prospective, randomized, double-blind, two-period cross-over study in 26 new CI users was performed over a 6-month period. New CI users older than 18 years with bilateral severe-to-profound sensorineural hearing loss or complete hearing loss for less than 5 years were selected in the University Hospital Centre of Rennes in France. An anatomical tonotopic map was created using post-operative flat-panel computed tomography and a reconstruction software based on the Greenwood function. Each participant was randomized to receive a conventional map followed by a tonotopic map or vice versa. Each setting was maintained for 6 weeks, at the end of which participants performed speech perception tasks. The primary outcome measure was speech recognition in noise. Participants were allocated to sequences by block randomization of size two with a ratio 1:1(CONSORT Guidelines). Participants and those assessing the outcomes were blinded to the intervention.

Results: Thirteen participants were randomized to each sequence. Two of the 26 participants recruited (one in each sequence) had to be excluded due to the COVID-19 pandemic. Twenty-four participants were analyzed. Speech recognition in noise was significantly better with the tonotopic fitting at all signal-to-noise ratio (SNR) levels tested (SNR=+9 dB, p=0.002, mean effect (ME)=12.1% 95% Confidence interval (95%CI) = 4.9;19.2, standardized effect size(SES)=0.71; SNR=+6 dB, p=2.9x10-5, ME=16.3% 95%CI=9.8;22.7, SES=1.07; SNR=+3 dB, p=0.0004, ME=13.8% 95%CI=6.9;20.6, SES=0.84; SNR=0 dB, p=0.003, ME=10.8% 95%CI=4.1;17.6, SES=0.68). Neither period nor interaction effects were observed for any signal level,. Speech recognition in quiet (p=0.66) and tonal audiometry (p=0.203) did not significantly differ between the two settings. 92% of the participants kept the tonotopy-based map after the study period. No correlation was found between speech-in-noise perception and age, duration of hearing deprivation, angular insertion depth, or position or width of the frequency filters allocated to the electrodes.

Conclusion: For new CI users, tonotopic fitting appears to be more efficient than the default frequency fitting because it allows for better speech recognition in noise without compromising understanding in quiet.

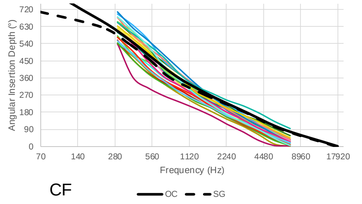
Objectifs

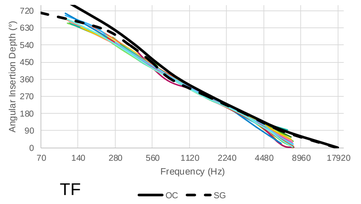
The aim of our study was to assess the impact of a tonotopic map on speech perception in noise and quiet in new CI users.

Méthodes et Matériels

A prospective, randomized, double-blind, two-period of 6 weeks cross-over study in 26 new CI users was performed.
Inclusion criteria : new CI users >18years with bilateral severe-to-profound hearing loss or complete hearing loss for < 5years.
An anatomical tonotopic map was created using post-operative flat-panel CT and a reconstruction software based on the Greenwood function.
After 6 weeks of each fitting, participants performed speech perception tasks: speech intelligibility in noise (signal-to-noise ratio (SNR)= +9/ +6/ +3/ 0dB) and tonal and speech audiometry in quiet.

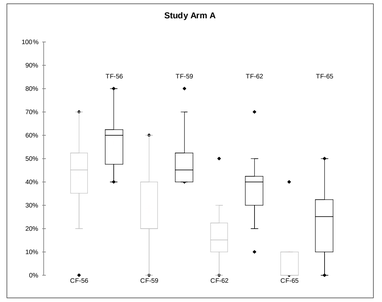
Résultats

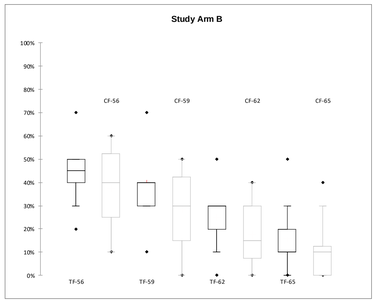




For each patient, angular insertion depth as a function of center frequencies of conventional fitting and of tonotopic fitting for CI users.

- *The frequency-to-place mismatch was reduced with TF comparing to CF for OC or SG tonotopy.*

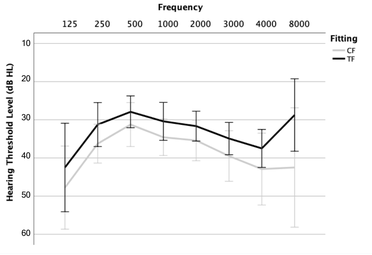


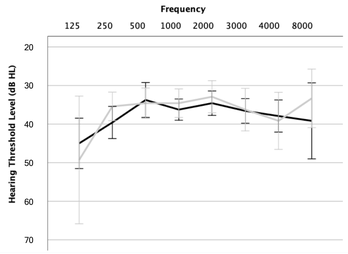


Combined data from each dB SNR for the study arm A and B

- *Speech recognition in noise was significantly better with the tonotopic fitting at all SNR:*
  - *SNR=+9 dB, p=0.002, mean effect(ME)= 12.1%, 95%CI = 4.9-19.2,*
  - *SNR=+6 dB, p<0.001, ME=16.3%, 95%CI = 9.8-22.7*
  - *SNR=+3 dB, p<0.001, ME = 13.8%, 95% CI = 6.9-20.6,*
  - *SNR=0 dB, p=0.003, ME = 10.8%, 95% CI = 4.1- 17.6,*
  - *Neither period nor interaction effects were observed for any signal level.*

TF: tonotopic fitting (black) / CF: conventional fitting (grey)





Hearing Threshold Level by frequency for study arm A and B

- *No significant difference was found at each frequency between the 2 settings (CF and TF) for study arm A and B.*

Conclusion

Tonotopic fitting appears to be more efficient than conventional fitting because it allows for better speech recognition in noise without compromising understanding in quiet.

Références

Canfarotta, M. W., Dillon, M. T., Buss, E., Pillsbury, H. C., Brown, K. D., & O'Connell, B. P. (2020). Frequency-to-Place Mismatch: Characterizing Variability and the Influence on Speech Perception Outcomes in Cochlear Implant Recipients. Ear and Hearing

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