Effectiveness of frequency-lowering hearing aids and electric acoustic stimulation (EAS) cochlear implant for treating people with a severe-to-profound high-frequency hearing loss.

Mathieu Hotton M.O.A. Ph.D. candidate & François Bergeron Ph.D.
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Patients with a HFHL have now access to new hearing technologies
- EAS implant
- Frequency-Lowering (FL) hearing aids, frequency-compression or frequency-transposition h/a

The effectiveness of those hearing technologies is not clearly demonstrated yet for persons with HFHL
Systematic literature review
Hotton M & Bergeron F (in prep)

• Gain with frequency-lowering: 5 to 40 % vs conventional h/a
• Gain with EAS: 4 to 19 % vs electric implant, up to + 88 % vs conventional amplification
• Great variability in individual results: from 0 to 100 %, with possibility of deleterious effects
• No study compared these technologies directly with each other for patients with HFHL
Research objective

• To compare the effectiveness of frequency-compression and frequency-transposition HA, and of EAS cochlear implant on speech perception for people with a severe-to-profound sensorineural HFHL.
Methods

• Ten adults with sensorineural HFHL (52-74 y/o)
  – < 50% aided speech recognition
  – Well experimented hearing aid users

• ABAC single-subject design
  – 4 weeks baselines were completed with own HA (phases A)
  – 8 weeks trials with each FL device (phases B and C)
  – 1 participant also received an EAS implant after FL trials
  – Follow-up time ranged from 16 to 32 weeks
Methods

• Repeated measures for each technology (each week)
  – HINT in quiet and noise (+10, +5, 0 dB SNR)
  – Monosyllable lists in quiet
  – GHABP and APHAB questionnaires

• Semi-structured interviews at the end of the protocol

• Complementary data on EAS implant effectiveness extracted from our database of EAS users (N=10)
HINT bruit RSB +5 dB mots

Reconnaissance de la parole (%)

Habituelle
Prothèse A
Prothèse B

FL-ON
FL-OFF
FL-ON
FL-OFF
FL-OFF

Own HA  F.-transposition  Own HA  F.-compression

1 out of 4, null probability 0.05
X-squared = 27.842, df = 1
p-value = 1.316e-07

3 out of 4, null probability 0.05
X-squared = 0.016316
df = 1
p-value = 0.8711
Monosyllabes - sujets EAS (N=10)

Pré

Début RFI

Fin RFI

0 % 100 %

- Scores groupe HFHL
- M groupe HFHL
- IC 95% groupe HFHL
- Sujet 3
- Sujet 3 baseline 1
Results / Discussion  

**EAS implant (N=1)**

- Positive effect for speech recognition ($p<0.05$)
  - Up to +43%, in comparison with conventional or FL h/a
- Better performance in general with EAS implant than FL h/a
- Questionnaires and interview showed reduced hearing disability
- Performances comparable to EAS group data
Results / Discussion

FL h/a (N=10)

• Positive effect for some individuals (p<0.05)
  – Up to +10% for speech recognition vs conventional h/a
  – Specifically attributed to FL: up to +3%

• Clinical significance supported by results to questionnaires and interviews
  – Benefit for speech understanding and listening comfort in noise

• No advantage for frequency-compression vs -transposition

• No significant advantage specific to FL at a group level
Results / Discussion

FL h/a (N=10)

• Detrimental effect of FL for some individuals
  – Max -9% for frequency-compression h/a
  – Max -15% for frequency-transposition h/a
  – More common with transposition
  – Apparently linked to HFHL importance and FL fitting

• Potential risk to affect hearing abilities negatively with FL in the clinic
Conclusion

• EAS implant appears as the first indication for treating people with a severe-to-profound sensorineural HFHL
• Frequency-lowering hearing aids can provide a significant benefit for individuals with a HFHL
• Trials with frequency-lowering should be considered on an individual basis prior to cochlear implantation
Thank you for your attention!

mathieu.hotton.1@ulaval.ca