Tinnitus and sLORETA-Neurofeedback: A pilot study.

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Background & Goals

Tinnitus
Several studies1,2,3,4,5 show differences in spontaneous resting-state EEG-activity in the auditory cortex (A1) of patients with chronic tinnitus compared to healthy controls:
- Enhanced activity in the delta/theta and high-beta/gamma range
- Reduced activity in the alpha band

Neurofeedback
This promising form of therapeutic approach enables patients to voluntarily modulate certain features of their brain activity on the basis of operant conditioning (reward for desired activity changes, punishment for unwanted ones). It has lately been improved by the combination with sLORETA source estimation technology5,6 which makes a more specific training of certain areas in the brain possible.

Goal:
With the use of sLORETA-neurofeedback, patients learn to normalize the abnormal EEG patterns related to tinnitus (i.e., enhance alpha, reduce delta/theta and high-beta/gamma).

Hypotheses:
- a) Reduction of alpha, increase of delta/theta and high-beta/gamma activity between pre- and post measures of resting-state EEG.
- b) Amelioration of tinnitus related symptoms between pre- and post measures.

Methods

Participants:
6 patients with chronic tinnitus (4 male, 2 female)
- Groups: 1 after 3 sessions (excluded from analysis), 1 after 12 trainings (included in analysis)

Design:
- Oct/Nov 13: University Hospital Zurich
- Posting of EEG
- Tinnitus Questionnaires
- Psychological Questionnaires
- Audiometry
- Oct 13 – Apr 14:
  - Schener Kompetenzzentrum für Neurofeedback
  - 15 Training Sessions (30 min)
  - sLORETA in first and last session

Post-Test:
- Nov/Dec 2014:
- University Hospital Zurich
- Resting-state EEG
- Tinnitus Questionnaires
- Psychological Questionnaires

Tinnitus-Measures:
- Tinnitus Handicap Inventory (THI)5
- Tinnitus-Behinderung-Fragebogen (TBF-12)4
- Tinnitus Fragebogen (TF)4
- PRISM (Pictorial Representation of Illness and Self Measure)4

Results

a) EEG Data:
- Trained Theta/Delta (1 – 6 Hz) in A1:
  - Pre
  - Post
- Trained High-Beta/Gamma (20 – 35 Hz) in A1:
  - Pre
  - Post

Tinnitus Data:
- Tinnitus-Handicap Inventory sum score (0 – 100):
  - Pre
  - Post
- PRISM Distance (in cm):
  - Pre
  - Post
- Tinnitus Loudness (0 – 10):
  - Pre
  - Post

Conclusion

- Significant reduction in trained high-beta/gamma in right A1
  - > surprising effect if small sample size is considered (Cohen’s d = 1.3 => strong effect)
- Tendencies in other frequency bands in the right direction (except of alpha)
  - > not significant due to high interindividual variance and small sample size
- Promising results in tinnitus related measures
  - > not significant due to high interindividual variance and small sample size
- Neurofeedback has specific effects on brain activity and tinnitus related symptoms.

Over the course of this pilot project various indispensable experiences in the use of sLORETA-neurofeedback as a possible treatment for chronic tinnitus were gained, which will be of major importance for more substantial and better controlled clinical studies, starting subsequent to this project.

References