sLORETA Neurofeedback
- first clinical results
Overview

• Review of sLoreta based neurofeedback (LNFB) in the clinical application

• Patients were trained with 1-, 2- and 4-channel NFB using BioExplorer

• They received additional LNFB trainings on the anterior cingulate BA 32, intraparietal sulcus BA 40, Brodmann Area 6 or BA 41

• All subjects have been investigated with a QEEG before treatment

• We compared the QEEG data with sessions data from a LNFB session
Method

• 19 channel EEG with SuSaCap at 10/20 Positions

• Sintered mushroom electrodes with a felt moistured with saturated saline solution
• impedances below 5 kOhm
• Montage of the full cap takes about 10 minutes

• Mitsar Equipment with
• Braintuner software for sLoreta Neurofeedback
Subjects

- 12-year-old boy with increased theta in frontal-central cortex
- 14-year-old boy with increased frontal midline theta
- 14-year-old boy with alpha-excess in central (mu rhythms) and parietal regions
- 57-year-old male with depression, alpha-excess over whole cortex and alpha-asymmetry
- 42-year-old female with tinnitus
sLORETA Training Protocol on anterior cingulate

ACC left  -5/29/31
BA 32

denhanced
d12-20 Hz and 36-40 Hz

inhibited
d4-8 Hz

Duration
d2 x 5 minutes training with 1 min
relaxation between the trainings

\((X,Y,Z)=(-5,29,31)\text{[mm]} ; (0.00E+0)\)
Feedback

Patients were watching a DVD that began jamming when feedback-criteria were not matched.
12-year-old boy with increased theta in frontal cortex

Complained symptoms
- Slow information processing
- Aggression
- Impulse control

Neurofeedback trainings
- **20 sessions** (1/2 hour) with conventional Neurofeedback:
  - ACC training on Fz
  - Hemoencephalography on Fp1/Fpz/Fp2
  - Bipolar training on T3/T4
- **18 sessions** with sLORETA Neurofeedback:
  - ACC left on -5/29/31

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Improvements

- More focused
- Less tantrums - can overcome tantrums in less time
- More perseverance in homework-situations
14-year old boy with increased frontal midline theta

Complained symptoms

- ADHD
- Sustained attention
- Hyperactivity
- Impulse control

Neurofeedback trainings

- **36 sessions** (1/2 hour) with conventional Neurofeedback:
  - ACC training on Fz
  - Hemoencephalography on Fp1/Fpz/Fp2

- **8 sessions** with sLORETA Neurofeedback
  - ACC left on 5/29/31
Improvements

• Much decreased hyperactivity
• Improved concentration
• Improved impulse control
• No more need for treatments at the psychiatrist
Event related potentials

Component for frontal inhibition

Patient  Database  Difference

P3 supF pre  P3 supF post
14-year-old boy with alpha-excess in central and parietal regions

Complained symptoms

- Sensory integration deficit
- Sustained attention
- Hyperactivity
- Math problems

Neurofeedback trainings

- **18 sessions** (1/2 hour) with conventional Neurofeedback:
  - 4 channel training on C3/C4 and P3/P4 alpha stop and gamma go
  - Hemoencephalography on Fp1/Fpz/Fp2

- **14 sessions** with sLORETA Neurofeedback
  - ACC left on -5/29/31 with alpha stop
  - Intraparietal sulcus on 39/-53/47 with alpha stop
sLORETA Training Protocol for intraparietal sulcus

IPS right 39/-53/47
BA 40 45/-52/48

enhanced
12-17 Hz and 35-40 Hz

inhibited
8-13 Hz

Duration
2 x 5 minutes training with 1 min relaxation between the trainings
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Improvements

• Improved proprioception
• Improved concentration and planning
• Decreased hyperactivity
• Improvements in geometry
57-year-old male with depression, alpha excess over whole cortex and alpha-asymmetry

Complained symptoms

- Depression since 1986
- Poor self image
- Negative and unhappy
- Low energy level
- Problems with socializing
- Hopeless about the future
- Can’t see positives in life

Neurofeedback trainings

- **36 sessions** (1 hour) with conventional Neurofeedback:
  - ACC training on Fz
  - Alpha-asymmetry on F3/F4 (Rosenfeld)
  - Hemoencephalography on Fp1/Fpz/Fp2
- **8 sessions** with sLORETA Neurofeedback
  - ACC left on -5/29/31 with alpha stop
  - BA 6 left on -35/-15/45 with alpha stop

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sLORETA-Training Protocol Brodmann area 6

**BA 6 left on -35/-15/45**

**enhanced**
14-20 Hz and 36-40 Hz

**inhibited**
8-12 Hz

**Duration**
2 x 5 minutes training with 1 min relaxation between the trainings
Improvements

- Much less depressive
- Feels better about self
- Less problems with socializing
- Energetic and enthusiastic - began with a theatre course and traveling
- Much more positive about the future
- Finds pleasure and enjoyment in life
42-year old female with tinnitus

Complained symptoms

- Tinnitus right side
- Sometimes also tinnitus left side

Neurofeedback trainings

- 7 sessions (1 hour) with conventional Neurofeedback:
  - T3/T4 Tinnitus protocol
  - T3/T4 bipolar
  - Alpha-Theta on P3/P4

- 17 sessions with sLORETA Neurofeedback
  - Tinnitus protocol
sLORETA-Tinnitus Protocol on primary auditory cortex

**Tinnitus right on 55/-25/10**
BA 41

**enhanced**
8-12 Hz

**inhibited**
1-4 Hz and 23-40 Hz

**Duration**
2 x 5 minutes training with 1 min relaxation between the trainings
Improvements

• Tinnitus on right side faded away completely
• Much decreased tinnitus on left side
No positive changes in EEG patterns
Conclusions

- sLORETA Neurofeedback seems to be a very effective way for neurofeedback training
- EEG patterns show significant changes
- Training time is much shorter than in conventional neurofeedback
- The additional time needed for the montage is counterbalanced by shorter training time
- LNFB seems to be practicable for clinical application
Thank you for your attention