

SLORETA NEUROFEEDBACK— FIRST CLINICAL RESULTS

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This review shows the first results of sLoreta-based neurofeedback (LNFB) in the clinical application in a neurofeedback practice in Switzerland. Patients who trained with 1-, 2- or 4-channel NFB using BioExplorer Software (Cyberrevolution, USA) also trained with LNFB at the anterior cingulate, intraparietal sulcus (Brodmann Area 40; P4) and on Brodmann Area 6 (fronto-central).

We analyzed the efficacy of LNFB while training on the anterior cingulate (BA 32) as a region that receives inputs from several sensory areas and which therefore plays a critical role in information processing, modulation of attention, executive functions, emotional control and monitoring (error detection). In addition to BA 32 the patient with sensory integration deficit was trained at intraparietal sulcus (Brodmann Area 40) and the patient with depression at Brodmann Area 6 (fronto-central).

METHOD

A 19-channel EEG was recorded during LNFB with Mitsar (St Petersburg, Russia) and Braintuner Software (Mitsar, St. Petersburg, Russia). Patients were watching a DVD that began jamming when feedback-criteria were not matched.

All subjects have been investigated by a QEEG at the beginning of their treatment. We compared QEEG data from the LNFB training sessions with the data from

the QEEG at the beginning of the training.

SUBJECTS

1. 14-year-old boy with increased frontal midline theta
2. 14-year-old boy with alpha excess in central (mu rhythms) and parietal regions
3. 57-year-old male with depression, alpha excess over whole cortex and alpha asymmetry

RESULTS

Subject #1

14-year-old boy with increased frontal midline theta

The complained symptoms were hyperactivity, ADHD, problems with sustained attention and impulse control. The patient showed significant amount of frontal midline theta in the QEEG. He received the following trainings:

36 sessions (1/2 hour) with conventional Neurofeedback:

- ACC training on Fz
- Hemoencephalography (BioExplorer (Cyberrevolution), Neuroamp and pIRx3 Sensor from EEGInfo, Switzerland) on Fp1/Fpz/Fp2



8 sessions with sLORETA Neurofeedback

- ACC left on -5/29/31

He was the only one of the subjects where we recorded another QEEG after the treatment.

Figure 4 (page 28) results show a significant decrease of theta activity in frontal regions. The patient reported much decreased hyperactivity, improved concentration and impulse control and no more need for treatments at the psychiatrist.

The shift is also visible in the ERP component for impulse control (figure 5):

The indicator for the improved impulse control is the P3 supF component, which shows much more activity after treatment than before.

Subject #2

14-year-old boy with alpha-excess in central (mu rhythms) and parietal regions

The QEEG at the beginning of the treatment showed excessive alpha activity over central and parietal regions. The complaints of the boy were sensory integration deficit (proprioception), problems with sustained attention, hyperactivity and math problems mostly in geometry. He was medicated with 8 mg Dexamin (dexamphetamine) per day. His trainings were adapted to his alpha

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TRAINING PROTOCOLS

ACC protocol Brodmann Area 32 left (BA 32) -5/29/31

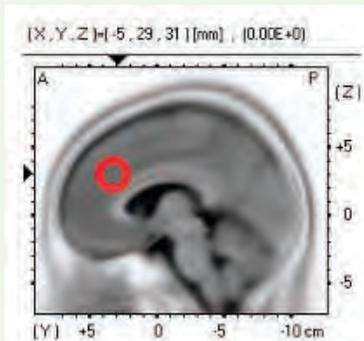


Figure 1—Subject 1
Anterior cingulate -5/29/31

Enhanced were 12-20 Hz and 36-40 Hz, inhibited were 4-8 Hz. The duration of a session was 2 x 5 minutes training with 1 min relaxation between the trainings.

Protocol for intraparietal sulcus right on 39/-53/47 and 45/-52/48 (BA 40)

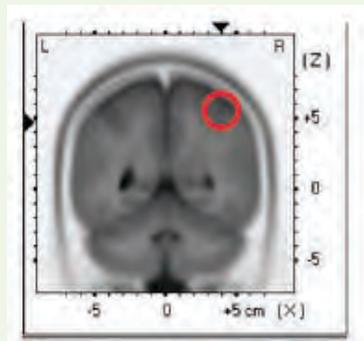


Figure 2—Subject 2
Intraparietal sulcus right on 39/-53/47 and 45/-52/48 (BA 40)

Enhanced were 12-17 Hz and 35-40 Hz, inhibited were 8-13 Hz. The duration of a session was 2 x 5 minutes training with 1 min relaxation between the trainings.

Training protocol for depression -35/-15/45 (BA 6 left)

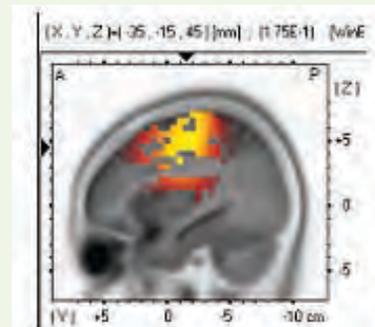


Figure 3—Subject 3
BA 6 left -35/-15/45

Enhanced were 14-20 Hz and 36-40 Hz, inhibited were 8-12 Hz. The duration of a session was 2 x 5 minutes training with 1 min relaxation between the trainings.

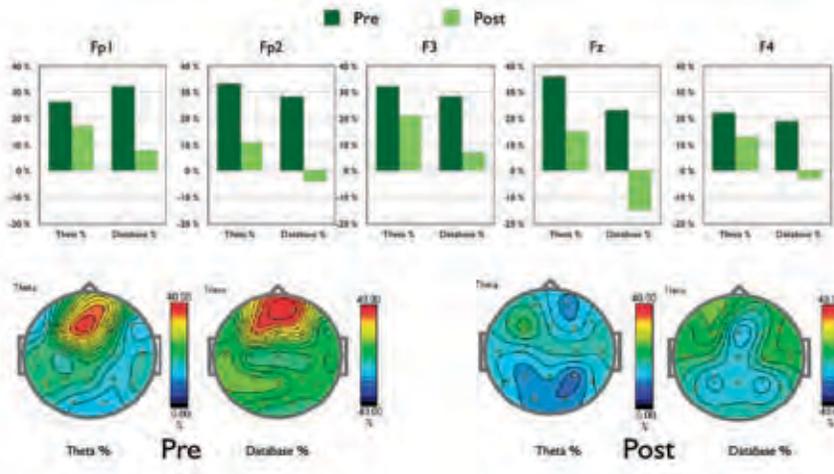


Figure 4
Relative power Theta (4 – 8 Hz) and comparison with the database before (dark green bars) and after (light green bars) treatment.

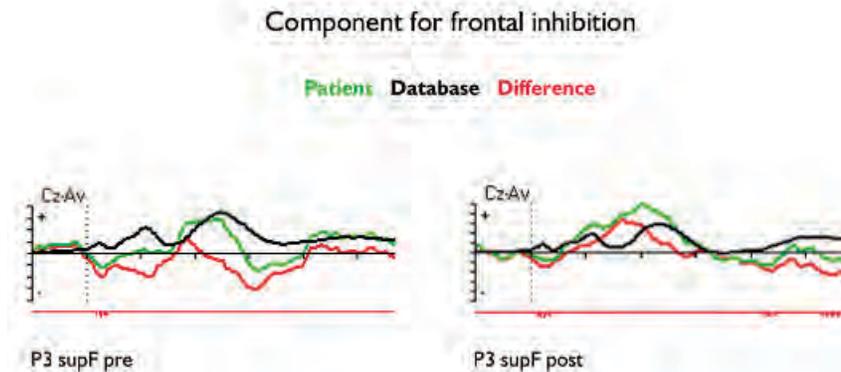


Figure 5
Event Related Potential component P3 supF (suppression frontal) on Cz

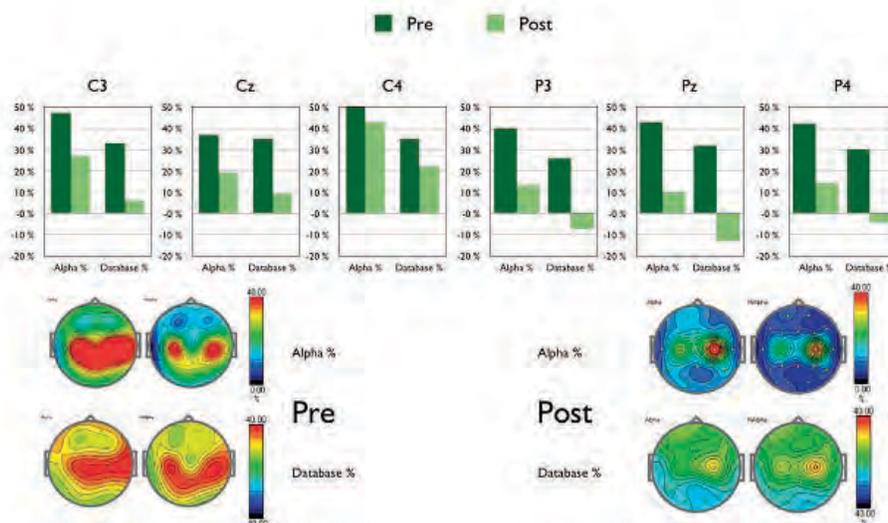


Figure 6
Relative power Alpha (8 -12 Hz) and comparison with the database before (dark green bars) and after (light green bars) treatment.

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excess by stopping 8-12 Hz instead of 4-8 Hz in ACC protocol.

He got the following 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 LORETA Neurofeedback

- ACC left on -5/29/31 with alpha stop
- Intraparietal sulcus on 39/-53/47 with alpha stop

The comparison of the QEEG file with a file recorded during a sLORETA neurofeedback session shows a significant decrease in the alpha activity in central and parietal regions. The boy reported improved proprioception and improvements in geometry. He also reported improved concentration and planning and also decreased hyperactivity. His Dexamin dose could be reduced to 2mg/day.

Subject #3

57-year-old male with depression, alpha excess over whole cortex and alpha asymmetry

The QEEG at the beginning of the therapy showed a dominance of alpha rhythms over the frontal, central and parietal regions. The patient complained of depression since 1986 with symptoms such as poor self-image, negative and unhappy, low energy level, problems with socializing, hopelessness about the future and not seeing any positives in life. His ACC training protocol in sLoreta neurofeedback was adapted to his alpha excess by stopping 8-12 Hz instead of 4-8 Hz. We also developed an individual protocol for a region in BA 6 in reference to his QEEG data that showed a significant source of his alpha activity in this region.

He got the following trainings:

36 sessions (1 hour) with conventional Neurofeedback

- ACC training on Fz
- Alpha-asymmetry training on F3/F4
- Hemoencephalography on Fp1/Fpz/Fp2

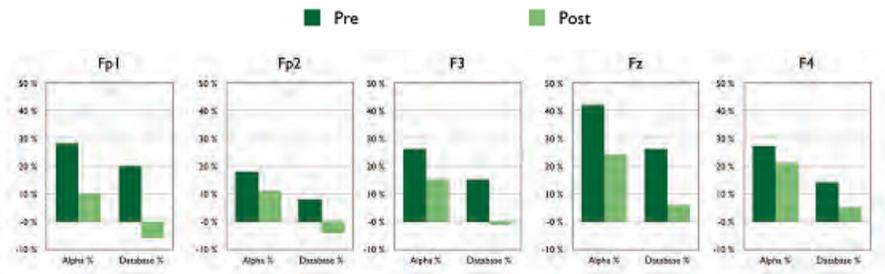
8 sessions with sLORETA Neurofeedback

- ACC left on -5/29/31 with alpha stop
- BA 6 left on -35/-15/45 with alpha stop

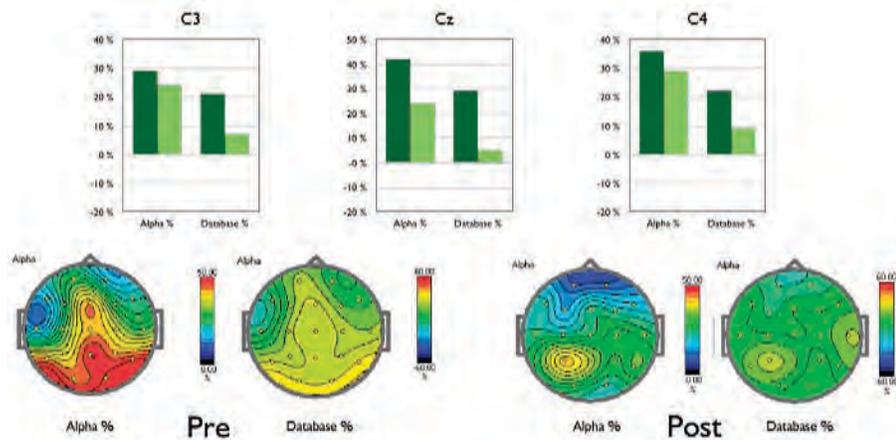
Figure 8: Relative power Alpha (8 -12 Hz) and comparison with the database before (dark green bars) and after (light green bars) treatment

The comparison of the QEEG file with a file recorded during a sLORETA neurofeedback session shows a significant reduction in

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**Figure 7**

Relative power Alpha (8 -12 Hz) and comparison with the database before (dark green bars) and after (light green bars) treatment.

**Figure 8**

Relative power Alpha (8 -12 Hz) and comparison with the database before (dark green bars) and after (light green bars) treatment

LORETA neurofeedback will work best for areas that are relatively large, for example the cingulate gyrus. We have done and published studies showing that it is possible to learn to change current density in the cingulate and that this is helpful for a variety of problems including ADHD, possibly depression, and may even be helpful in treating chronic pain. One of the areas in which people are very interested is the amygdala. The problem is that the amygdala is a relatively small region and consists of two main divisions one of which receives olfactory input and the other, the basolateral division is involved in a variety of functions. This latter division has at least eight sub nuclei, such as the central, lateral, basal and others. Back in the 1960s Birger & Kaada and later Birger & Kaada and Holger & Ursin published many studies and monographs showing that with stimulation of the amygdala in a variety of species an enormous number of autonomic, emotional, sexual, and repetitive responses could be elicited. These were shown to be precise to specific sub nuclei of the amygdaloid complex. At present LORETA only has a 7 mm resolution confined to 2,394 voxels. Even MRI and fMRI utilizing five and seven Tesla coils cannot get very far below 1 mm resolution, still not sufficient to target in detail the individual sub nuclei of the amygdaloid complex. Another problem is that the Talairach Atlas is based on an average of 305 MRIs and therefore mapping an individual onto that atlas can lead to errors as large as 5 mm which might actually target outside of the amygdaloid complex completely. So the question for me is what happens when you try to train activity using LORETA neurofeedback in the region of the amygdala which has so many different functions. This could be quite dangerous and should be approached with great caution.

I also have some concerns about training in the insular cortex. Dirk De Ritter pointed out that the left insular cortex is involved with parasympathetic functions and the right insular cortex with sympathetic functions. All of our internal organs are mapped within the insular cortex so it is not unreasonable that we could impact psychophysiological disorders of internal organ functions such as irritable bowel syndrome as one example. Again the resolution of LORETA is so low that it cannot target the individual regions within the insular cortex representing different organ systems with any degree of precision. Furthermore, for both the amygdaloid complex and the insular region we don't know which frequency bands or even which individual frequencies are best to train for specific disorders. The point of all this is that we must be very cautious and training these internal structures whether we use LORETA neurofeedback or fMRI neurofeedback. My best advice would be before training these areas and patients try it on your self and note carefully what kind of experiences take place.

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his overall alpha activity, though it is still too much in comparison with the database in central regions. The patient reported much less depressive feeling, less problems with socializing, he is much more energetic and enthusiastic - he began with a theatre course and with traveling. He also feels much more positive about the future and finds pleasure and enjoyment in life.

CONCLUSION

LNFB seems to be a very effective way for neurofeedback training. The training is stronger than in conventional neurofeedback, so that the training time with twice 5 minutes is long enough. The EEG patterns all showed significant changes and patients all reported improvements. Although the improvements certainly can't be attributed only to the LNFB, patients reported much stronger improvements when we began to train them with LNFB. The additional time needed for the montage of the full cap is counterbalanced by the shorter training time. This makes LNFB practicable for clinical application.

BIOGRAPHY

Susanne Schmid-Grether, MTh, is a neurofeedback therapist and director of the Neurofeedback Center of Excellence "SCHORESCH" in Wetzikon, Switzerland that provides an own high level neurofeedback education. Susanne is also a lecturer at the "Neurofeedback-Akademie Schweiz."