

Hemodynamic and Cognitive Changes in Cerebellar Cognitive-Affective Syndrome: A Case Study

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Introduction

- The cerebellum is known for its role in motor coordination.
- Increasing evidence suggests it also plays a crucial part in cognitive and emotional processing.
- In Cerebellar Cognitive-Affective Syndrome (CCAS), disruption of the cerebro-cerebellar loop results in functional impairment of the frontal cortex, particularly affecting executive process.
- Accordingly, assessment of frontal cortex activity provides insight into the neural basis of cognitive deficits.
- We report a case with bilateral cerebellar infarction presenting features CCAS and longitudinal changes in cortical activation and functional connectivity.

Case Report

Participant

- A 40-year-old man with an unremarkable medical history was diagnosed with bilateral cerebellar infarction complicated by hydrocephalus and brain edema.
- The patient underwent right suboccipital craniotomy and external ventricular drainage.
- He was admitted to the department of rehabilitation, 26 days after initial onset.

Statistical Methods

- Functional near-infrared spectroscopy (fNIRS) was conducted along with a Stroop task at 5 (T0) and 8 weeks (T1) after onset.
- A 20-channel fNIRS was set up for the frontal lobe,
- Cortical activation was analyzed using nirsLAB® with statistical parametric mapping. OptoNet II®, a MATLAB-based toolbox was used to assess functional connectivity.
- Neuropsychological assessments were conducted at 4 and 8 weeks after initial onset.

Figure 1. Initial Imaging of the patient

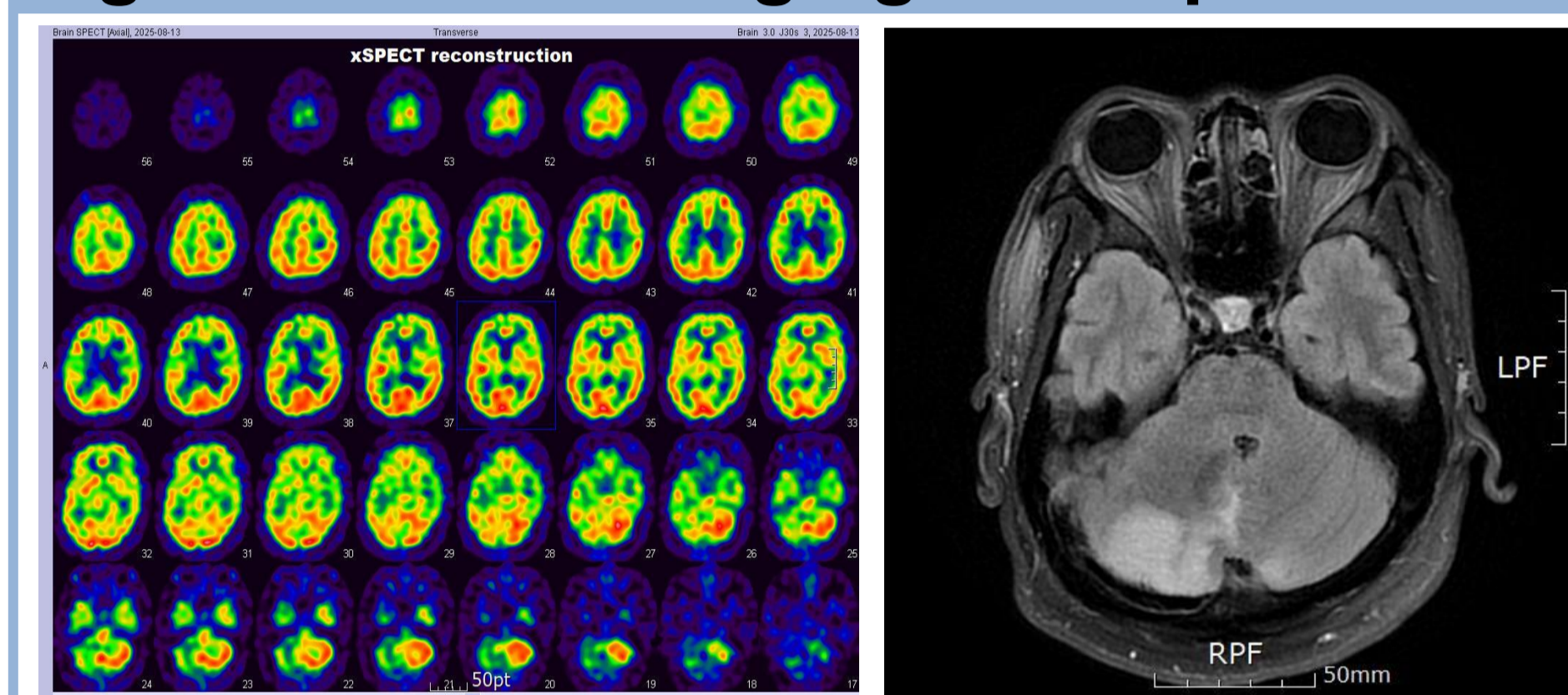
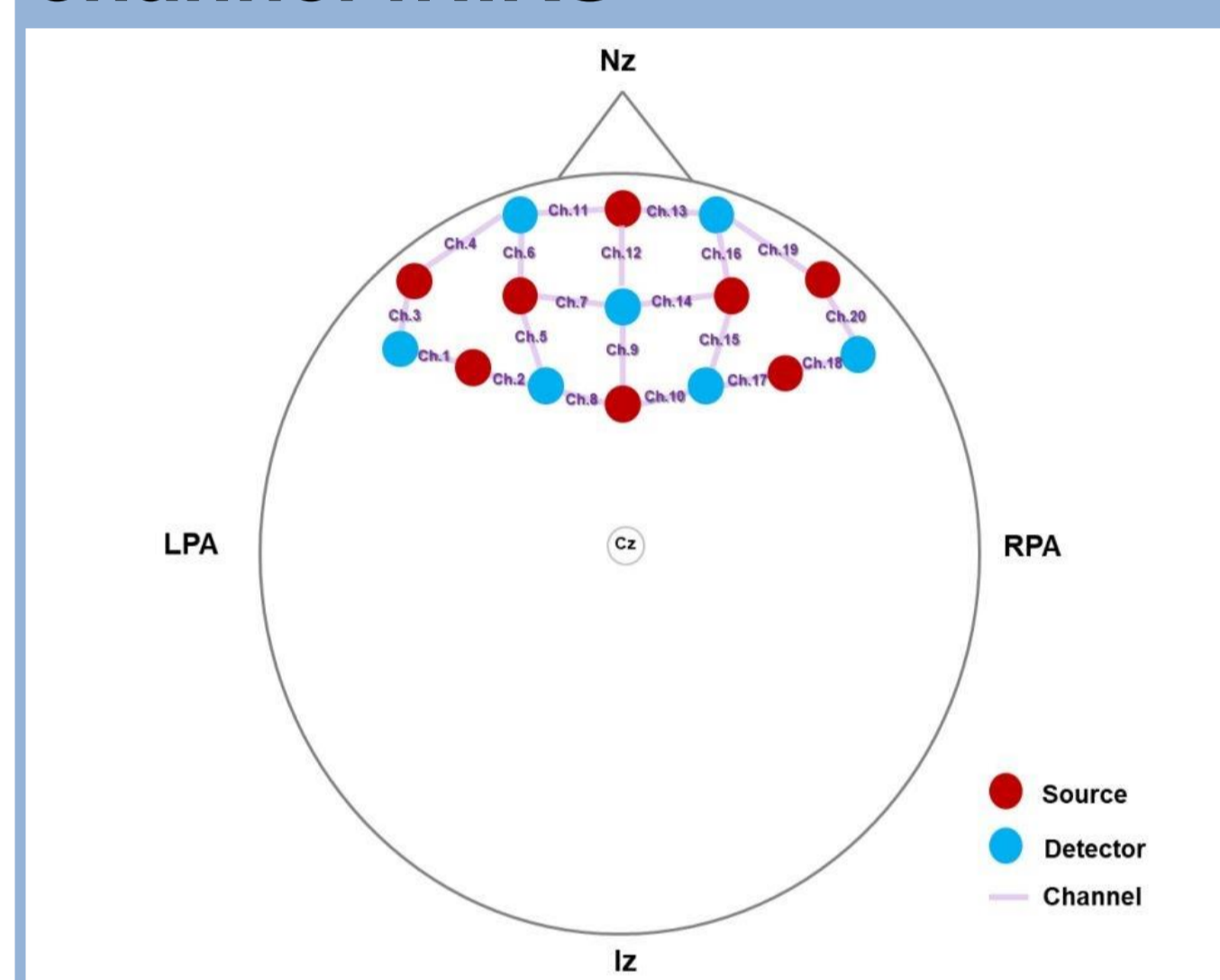
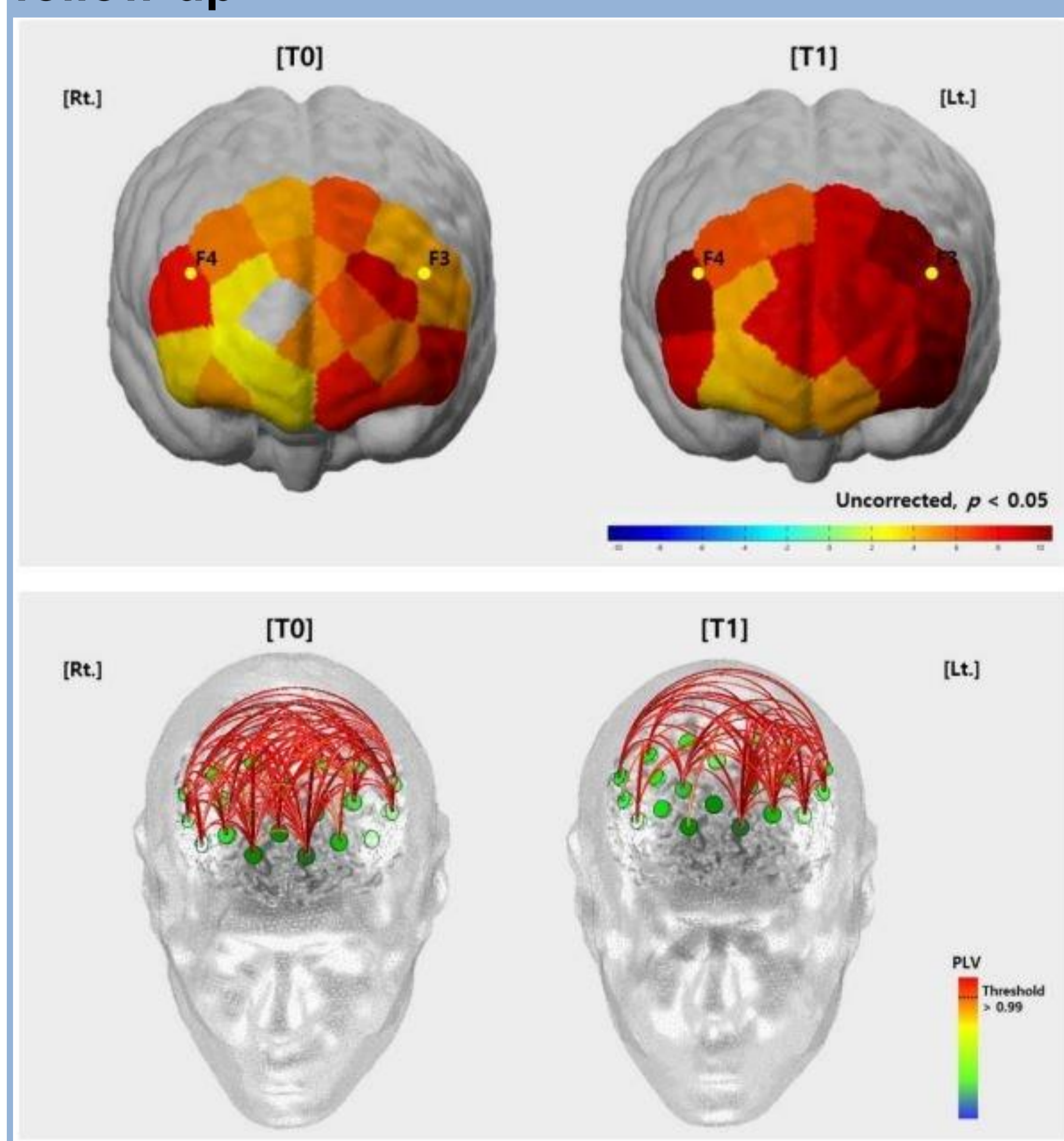


Figure 2. Topomap of 20-channel fNIRS



Result

Figure 3. Results of statistical parametric mapping by fNIRS during stroop test at initial and follow-up



* Initial assessment was done 31 days after stroke onset.

* Follow-up assessment was performed 4 weeks after initial assessment

Table 1. Seoul Neuropsychological Screening Battery (SNSB)

Cognitive Domain	Initial Raw score	Follow-up Raw score	Initial Percentile (%)	Follow-up Percentile (%)
Attention	0.65	0.65	26.90	26.90 -
Language	0.48	0.55	67.93	82.90 ▲
Visuospatial	0.11	0.43	4.39	50.96 ▲
Memory	0.23	1.14	6.35	63.75 ▲
Frontal/Executive function	-0.35	0.84	0.01	23.12 ▲

- Comprehensive neuropsychological testing revealed subsequent improvement in visuospatial processing, memory, and executive function.
- Stroop task accuracy remained high at both time points (98.7% at T0 and 100% at T1)
- Cortical activation increased in the F3 channel at T1, corresponding anatomically to the left dorsolateral prefrontal cortex (DLPFC).
- Overall frontal functional connectivity decreased at T1.
- Inter-hemispheric frontal connectivity showed no clear increase, suggesting localized strengthening of network interactions rather than global network reorganization.
- Intra-hemispheric connectivity centered on the left DLPFC increased compared to T0.

Conclusion

- This case suggests that subtle cognitive deficits following cerebellar infarction may not be detected by brief screening tools.
- Serial fNIRS showed changes in cortical activation and connectivity despite stable behavioral performance.
- Detailed cognitive assessment combined with targeted rehabilitation may support neural reorganization even in patients with normal MMSE scores.

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