Beyond Motor Function: What is the Role of Quantitative Electroencephalography in the Assessment of Amyotrophic Lateral Sclerosis? – A Case Report

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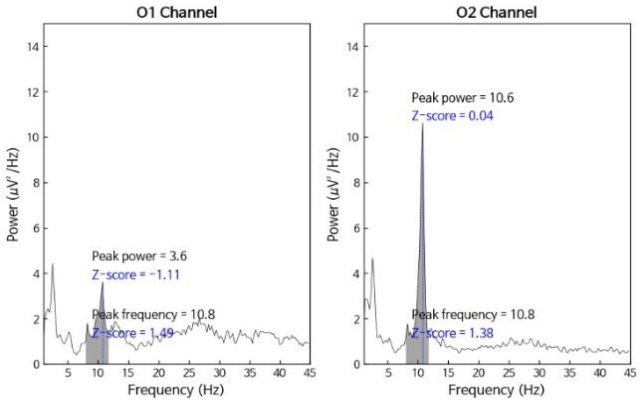
Abstract

Introduction: Amyotrophic lateral sclerosis (ALS) primarily affects motor neurons, but evidence shows that its progression may also compromise non-motor networks, potentially leading to cognitive dysfunction. In this context, quantitative electroencephalography (qEEG) emerges as a valuable, non-invasive, and cost-effective method for analyzing brain oscillatory activity. By detecting subtle changes in cortical rhythms, qEEG aids in the early identification of neurophysiological alterations, supports monitoring of disease progression, and may guide therapeutic strategies.
Clinical description: G.S.V.R.J., a 56-year-old male diagnosed with ALS in October 2024, exhibits early-stage motor difficulties with minimal impact on speech and mobility. In the following month, under neurological follow-up without pharmacological treatment, he participated in a pilot study at a university hospital, where qEEG was performed to assess brain activity and detect pathological changes. Recordings during resting state (eyes closed and open) revealed a global reduction in alpha band activity, with decreased spectral power (z-score < -2.3), hypoconnectivity (z-score < -1.96), and asymmetry in occipital alpha peak amplitude (z-score -1.11 left vs. 0.04 right), compared to normative values for sex and age. These findings may reflect cortical hyperexcitability due to an imbalance between inhibitory and excitatory circuits, as well as thalamo-cortical dysfunction. In addition, altered posterior dominant rhythm — relevant for cognitive assessment — and elevated frontal power ratios (theta/beta, theta/alpha, delta/alpha) were observed and associated with reduced attention and cognitive performance.
Discussion: Although G.S.V.R.J. is currently asymptomatic regarding these issues, compensatory neural reorganization may keep the condition subclinical. Nonetheless, qEEG indicators should be considered in prognosis, especially given the risk of frontotemporal dementia. Non-invasive interventions such as neurofeedback and photobiomodulation, guided by qEEG, may help modulate affected frequencies and preserve quality of life.
Conclusions: This case highlights qEEG's potential to detect early neurophysiological changes in ALS. Identifying deviations in alpha activity and frontal power ratios can support broader clinical assessment, enable timely intervention, and ultimately contribute to improving personalized patient care.



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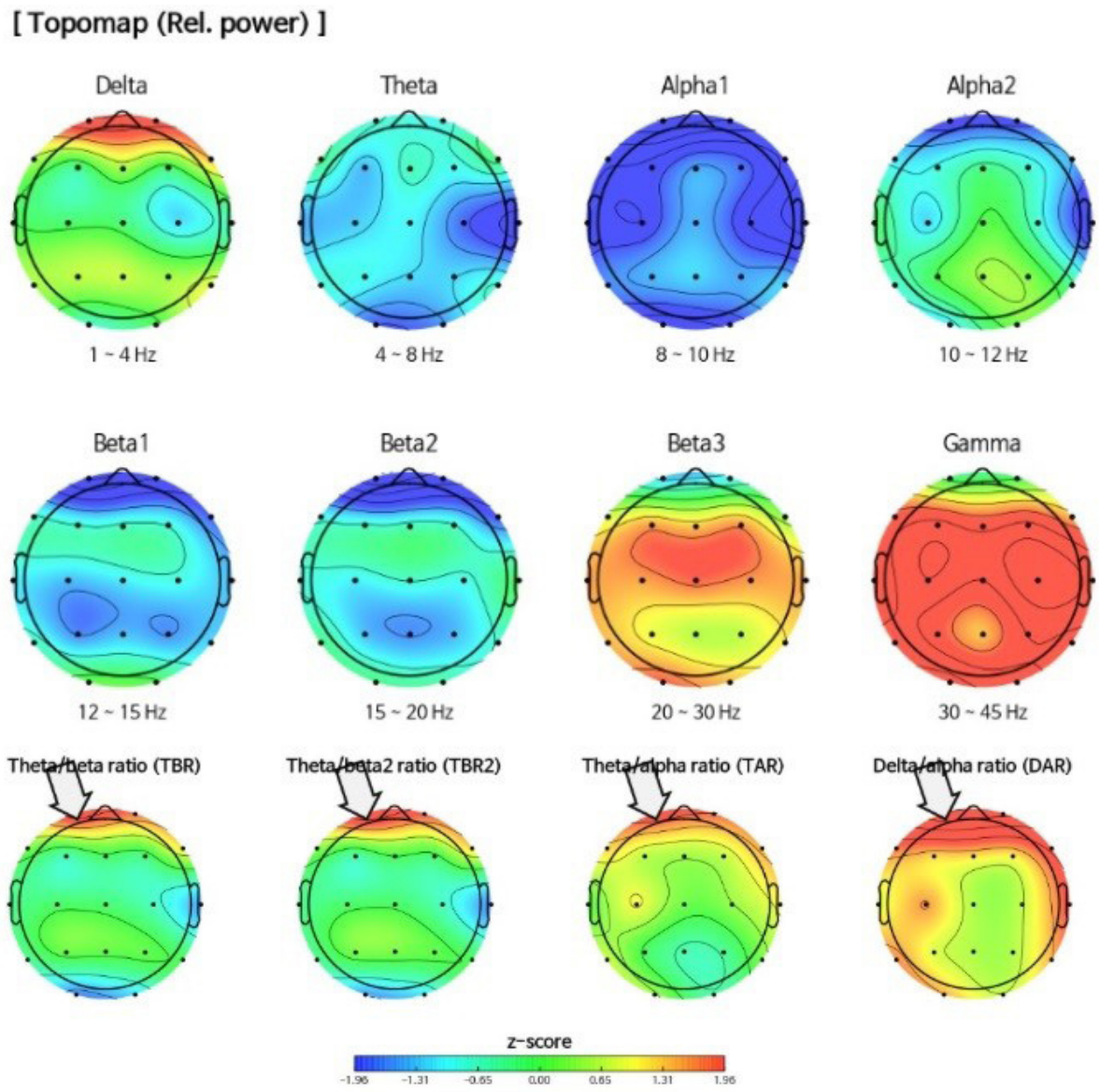
[Topomap (Rel. power)]
Delta
1 ~ 4 Hz
Theta
4 ~ 8 Hz
Alpha1
8 ~ 10 Hz
Alpha2
10 ~ 12 Hz
Beta1
12 ~ 15 Hz
Beta2
15 ~ 20 Hz
Beta3
20 ~ 30 Hz
Gamma
30 ~ 45 Hz
Theta/beta ratio (TBR)
Theta/beta2 ratio (TBR2)
Theta/alpha ratio (TAR)
Delta/alpha ratio (DAR)
z-score
-1.96
-1.31
-0.65
0.00
0.65
1.31
1.96