



Transcranial Magnetic Stimulation as an Adjunctive Intervention in an Adolescent with Substance Use Disorder and Co-occurring Behavioral Disorders: A Case Report

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Adolescent Vulnerability

The immature development of the adolescent brain contributes to a heightened vulnerability to substance use disorders.



Figure 1. Phases of the Developing Brain (Gogtay et al., 2004)

Background

TMS Potential

Transcranial Magnetic Stimulation (TMS) has been widely utilized in the treatment of various psychiatric conditions in adolescents, including ADHD, autism spectrum disorder, and depression.

Research Gap

There is a paucity of literatures specifically addressing its application in the context of SUD accompanied by behavioral disorder.

Case Presentation

A 15-year-old male was admitted for methamphetamine use disorder and multiple co-occurring issues, including gambling, theft, and school dropout. His quantitative electroencephalogram (qEEG) showed impaired inter-regional brain communication, which correlated with deficits in concentration, decision-making, emotional regulation, and impulse control.

Intervention/Management

Four-Month Rehabilitation Program

First 3-Month

SUD Treatment

- Individual and group counseling
- Family sessions
- Motivational interviewing
- Psychoeducation
- Cognitive Behavioral Therapy

Psychopharmacological

- Olanzapine
- Depakote
- Escitalopram

No significant improvements seen in his behavioral issues.

Fourth Month

TMS as an adjunctive therapy

- Ten days daily session
- Continuous Theta Burst Stimulation (cTBS) → F4 area
- Intermittent Theta Burst Stimulation (iTBS) → F3 area.

Result

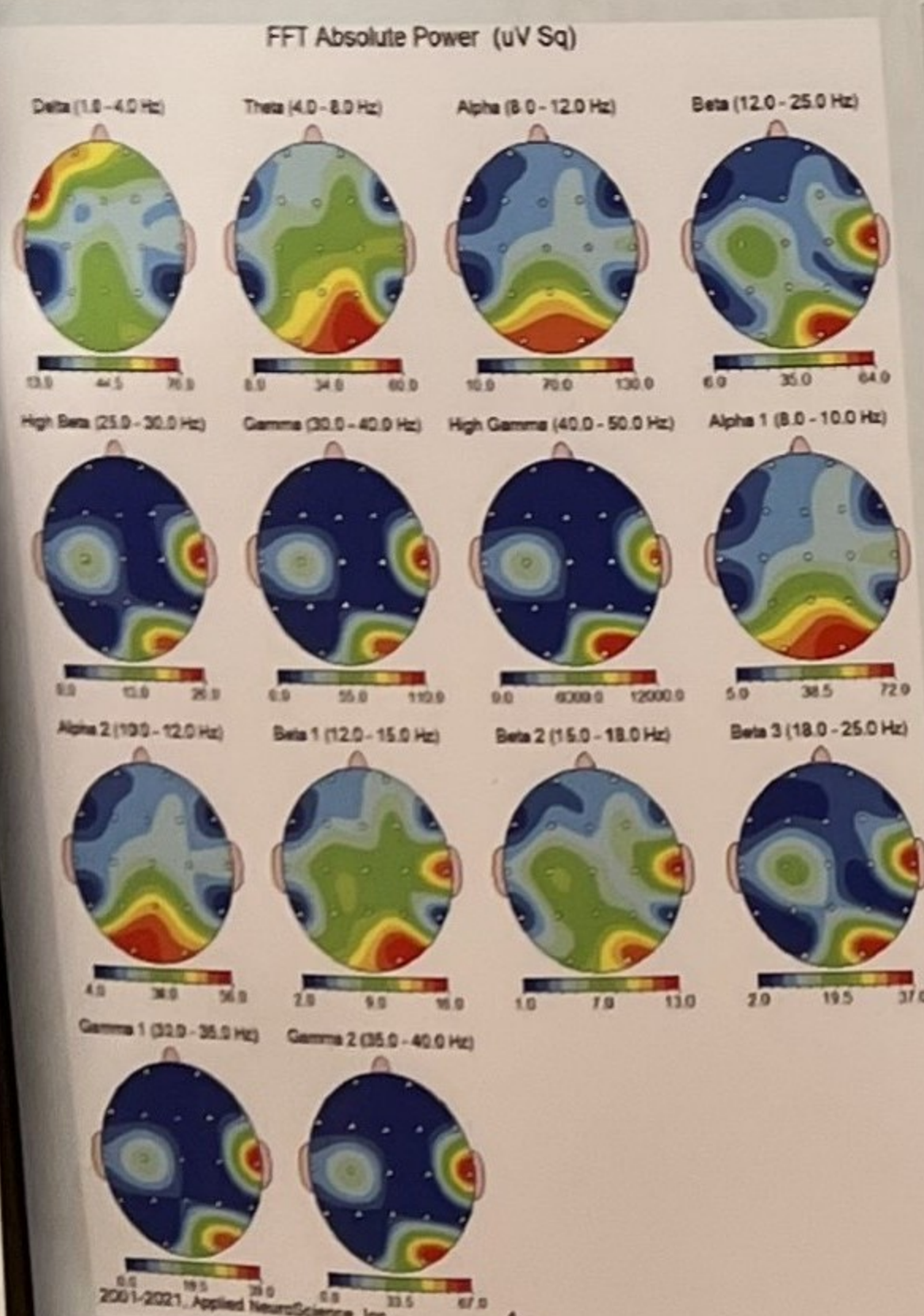


Figure 3. Brain Map Before TMS



Figure 4 Brain Map After TMS

Table 1. qEEG Assessment Comparison : Before and After TMS

Aspect	Before TMS	After TMS	Improvements Observed
Delta (1-4 Hz)	High in frontal and temporal areas → slow overload	Decreased, more evenly distributed	Reduced slow overload → indicates more conscious brain activity
Theta (4-8 Hz)	Dominant in fronto-central areas → slow focus	Significantly reduced in frontal, more stable	Improved focus and attention
Alpha (8-12 Hz)	Weak throughout, especially parietal	Increased in parietal and occipital areas	Alpha recovery → enhanced relaxation and memory processing
Beta (12-25 Hz)	High in frontal → overthinking, stress	More evenly distributed, decreased intensity	Reduced mental stress & overarousal
High Beta (25-30 Hz)	Dominant in fronto-central → impulsive, aggressive	Drastically reduced	Significant reduction in impulsivity and motor tension
Gamma (30-40 Hz)	Too high in frontal, less synchronized	Stable, more harmonious in parietal-temporal areas	Improved integrative function & complex information processing
High Gamma (40-50 Hz)	Very active in midline → overstimulation	Decreased, forming a harmonious pattern	Reduced cognitive and emotional overload
Alpha 1 (8-10 Hz)	Weak → lack of calmness	Increased, especially in occipital	Improved sleep transition and relaxation



Figure 2. Performing TMS to patient

After 10 days Performing TMS

qEEG Improvement

- Better cognitive function
- Improved emotional regulation
- Reduced impulsive and compulsive behaviors

Clinically Improvement

- Better sleep quality
- Fewer racing thoughts
- Improve information processing

Conclusion

TMS can be a promising adjunctive intervention for managing both substance use and behavioral disorders.

Reference

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