

Optimal Stimulation Parameters for Spike-Ripple Disruption in Patients Undergoing Invasive Monitoring

NCT06141668

Protocol Date 3/8/24

Protocol and Statistical Analysis Plan

Patient Selection and Data Collection

Patients undergoing intracranial EEG monitoring with implanted electrodes for clinical evaluation of drug-resistant epilepsy were enrolled in the study. Eligibility requires the presence of intracranial electrodes in the epileptogenic zone (EZ), a spike ripple (SR) rate exceeding 0.5/min on at least one intracranial channel during baseline recording, and clinical approval for the stimulation protocol to proceed.

Stimulation Protocol

Neurostimulation was performed between post-operative days 2-10 using the CereStim device (BlackRock Microsystems). The channel with the highest SR rate during baseline recording was selected as the stimulation target. The protocol consisted of 180 minutes of open-loop stimulation and tested five frequencies (1, 20, 40, 140, and 200 Hz) in randomized order. Each stimulation consisted of 100ms bursts with 0.5-1mA current and 100 μ s pulse width, delivered every 5 seconds. Each frequency was tested through multiple trials with a 900ms post-stimulation observation window, followed by a 5-second pause between trials.

Data Analysis

SR and spike detection used a validated automated detectors. For each subject, we calculated relative spike and SR rates in the 900-s post-stimulation ignoring time periods impacted by stimulation artifact. Baseline rates were computed from the final second of all 5-second pause periods throughout the experiment. A linear mixed-effects model assessed the relationship between event rates and stimulation frequencies, with subject as a random effect. Statistical significance was evaluated for each frequency compared to baseline.

A mixed-effects model assessed relationships between event rates and stimulation frequencies:

$$Event\ Rate \sim Stimulation\ frequency + (1|Subject)$$