computational networks can be a powerful tool to analyze the consequences of injury. Here, we use the Izhikevich spiking neuron model to create networks representative of cortical tissue. After an initial settling period with spike-timing-dependent plasticity (STDP), networks developed rhythmic oscillations similar to those seen in vivo. As neurons were sequentially removed from the network, population activity rate and oscillation dynamics were significantly reduced. In a successive period of network restructuring with STDP, network activity levels returned to baseline for some injury levels and oscillation dynamics significantly improved.

Gabrieli et al. explored the role that specific neurons have in the creation and termination of oscillation dynamics. They determined that oscillations initiate from activation of low firing rate neurons with limited structural inputs. To terminate oscillations, high activity excitatory neurons with strong input connectivity activate downstream inhibitory circuitry. Finally, they confirmed the excitatory neuron population role through targeted neurodegeneration. These results suggest targeted neurodegeneration can play a key role in the oscillation dynamics after injury [1].

[1]
Gabrieli D, Schumm SN, Vigilante NF, Parvesse B, Meaney DF. Neurodegeneration exposes firing rate dependent effects on oscillation dynamics in computational neural networks. PLoS One. 2020 Sep 23;15(9):e0234749. doi: 10.1371/journal.pone.0234749. PMID: 32966291.