High Frequency Oscillation Collisions Depend on the Direction of Paired Whisker Stimulation

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Abstract

The somatosensory evoked response (SEP) to somatosensory stimulation is a well defined electrical signal recorded on the somatosensory cortex. SEP's show a dominant frequency of ~40 Hz, but there are also high frequency oscillations (HFO, 200 - 400 Hz), and very high frequency oscillations (VHFO, 400 - 600 Hz) superimposed on the low frequency SEP. HFO's might be involved in the timing of sensory information and also in the spatial integration of multivibrissal stimulation, through the interaction of adjacent neuronal networks in the somatosensory cortex. This integration is due to the spread of fast oscillations within the cortical barrels that are phase locked. We studied the integration of HFO's and VHFO's within the cortex after paired whisker stimulation in the rostral to caudal and caudal to rostral directions. We acutely instrumented rats with a 64 electrode array over the somatosensory cortex to record somatosensory evoked responses (SEP) to contralateral whisker stimulation. Cortical barrel mapping was performed by 1 mm deflection whisker stimulation 2 ms pulse width in 1-2 s random inter-stimulus-intervals (ISI). Paired whiskers were stimulated with different delays ranging between 0 ms to 4.5 ms, first in rostral to caudal direction and then in reverse. Evoked responses were band-pass filtered in three frequency ranges (300 to 1000 Hz; 200 to 400 Hz; 400 to 600 Hz). We observed standing waves which spread across the cortical surface after whisker stimulation. When two vibrissa where stimulated asynchronously in the rostral whisker to caudal whisker direction, we found a significant collision in the oscillatory waves at 1.5 ms and 3.6 ms, as found by others. These changes were found across all oscillation frequency ranges. We also found significant collision in the oscillatory waveforms during asynchronous vibrissa stimulation in the caudal whisker to rostral whisker direction, at 2.7 ms delay. These changes contrary to the previous ones didn't occur consistently across all oscillation frequency ranges. Taken together, these results suggest that the spreading of the HFO's and VHFO's within the cortical barrel prefer to occur in the rostral whisker to caudal whisker direction but also can occur in the opposite direction, but shifting the time phase of synchronization.