Regionalisation of the callosal contribution to the barrel field activity in the mouse

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Abstract summary

Synchrony of neural activity indicates functional coupling between brain areas. Under deep anaesthesia, the slow wave of the two barrel fields (BFs) is highly synchronous thanks to the callosal glutamatergic reciprocal innervation. Here we ask how this synchrony is achieved: are there specific BF's sub-regions more sensitive to the contralateral ongoing activity?

Barrel fields' c-Fos patterns in the two hemispheres after free-exploration with perturbed whisker pads. a) Schematic of the arena, objects, illumination and camera used for animals tracking and two examples of free-exploration performance. b) Bilateral trimming of the whiskers resulted in a spreaded c-Fos signal in L4 of the BFs. c) Lidocaine injection of the right whisker pad resulted in a spreaded c-Fos signal in the right BF but in a laterally-restricted one in the left BF.

Electrophysiological recordings in deep anaesthesia. d) Two LFPs were positioned in the lateral (azure, BFI) and medial (orange, BFm) aspects of the right BF, while intracellular recordings were simultaneously obtained in the left BF in one of the two mirror positions (gray). On the right, a neuron stained by Streptavidin-biotin reaction. e) LFPs recorded at sites specified in d) with UP (gray) and DOWN (violet) oscillations of membrane potential (black) of a supragranular neuron recorded in BFI.

Characterisation of the slow-wave and its interhemispheric propagation. f) Frequency of oscillation was faster in BFI than in BFm due to shorter UP state events but not DOWN. g) Slow-wave of neurons recorded in BFI had greater coherence and coefficients of correlation with contralateral LFPs than neurons in BFm. Also, the probability that an UP state detected in contralateral LFPs is followed by an UP state in the neuron is higher in BFI than in BFm.

- Contralateral suppression of whiskers input during free-exploration results in a laterally-restricted activation of the deafferented BF, suggesting a callosal recruitment of this sub-region brought about by the active BF.
- The faster rhythm of the slow-wave in the same sub-region may indicate the presence of additional input compared with the rest of the BF territory.
- In the same direction, interhemispheric slow-wave coupling is higher in the BFI than BFm. Thus, we put forward this region as the main recipient of contralateral BF activity.