AB003. Pulvinar mediates the transmission of gamma and alpha oscillatory bandsbetween areas 17 and 21a

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Background: Cortical activity across the visual hierarchy has different oscillatory ranges. While 25–90 Hz gamma band influences the feedforward processing, 6–13 Hz alpha band travels in the feedback direction. Furthermore, gamma band acts in supragranular layers, whereas alpha range is localized in infragranular cortical layers. Is the pulvinar, the largest visual thalamic nucleus, mediating this oscillatory cortical coupling? We investigated this question by inactivating pharmacologically the pulvinar in cats and analyzing its impact on the oscillatory flow of neural activity in the visual cortex.

Methods: Extracellular responses to full-field 100% contrast gratings were recorded in cortical areas 17 and 21a, from anesthetized cats using linear silicon probes before, during and after the pulvinar inactivation (injection of GABA solution). Visual stimuli were presented in one selected direction. Local field potentials (LFPs) were obtained from low-pass filtering of raw recordings. Wavelet and Granger causality analyses were performed on LFPs to determine the oscillatory coupling between cortical layers.

Results: We found that cortical oscillatory activity was enhanced during LPl inactivation. These increases were observed for alpha and gamma bands in areas 17 and 21a. In area 17, alpha and gamma bands significantly increased in layers IV, V, and IV. In area 21a, this increase was observed in all layers except layer I, with a substantial increase of gamma activity in layer IV. Granger causality analysis showed that the pulvinar inactivation caused enhanced of feedforward gamma band signals from area 17 (layer III) to area 21a (layer IV). For the feedback coupling, the alpha band rose from area 21a (layer V) to area 17 (layers III, V, and VI).

Conclusions: Our findings suggest that the pulvinar mediates the cortical oscillatory transmission between areas 17 and 21a. In particular, during the visual stimulation, the pulvinar mediates, to some extent, the bottom-up regulation from layer III of area 17 to layer IV in area 21a. Furthermore, the LPl regulates the feedback directionality of the alpha band from layer V in area 21a to layers II, V, and VI in area 17. These results contribute to our understanding of the mechanism underlying the oscillatory coupling of the feedforward and feedback processing throughout the visual cortical hierarchy.

Keywords: Transthalamic pathways; visual processing; visual hierarchy; neuronal oscillations; Granger causality

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