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CELLULAR AND MOLECULAR NEUROBIOLOGY

Morphological alterations of a central auditory synapse in a mouse model with enhanced medial olivocochlear efferent activity

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The auditory system in many mammals is immature at birth but fine-tuned in adults. Spontaneous neural activity in the inner ear was proven to play a critical role in guiding this process. This is shaped by an efferent pathway that descends from the brainstem (the medial olivocochlear system, MOC) which transiently contacts the inner hair cells. In the knock-in mouse model with enhanced MOC activity (L9'T), altered functionality of auditory brainstem responses (Boero et al., 2019) and synaptic dysfunction of calyx of Held (CH) in the medial nucleus of the trapezoid body (MNTB) (Di Guilmi et al., 2019) have been observed at different developmental stages. Furthermore, our unpublished results of intracellular dye injection experiment revealed a delayed innervation refinement in L9'T MNTB principal cells during development. In this work, we set out a comprehensive structural investigation of the CH-type synapses from different tonotopic regions at P22-25 by means of large-scale 3D electron microscopy. We observed the presence of MNTB cells co-innervated by multiple CHs in both WT and L9'T mice with a slightly higher percentage of this phenotype in the L9'T (5/19 cells, 26%) than in the WT (4/22 cells, 18%). This was found mainly in the lateral MNTB region in the L9'T mice (Lat: 30%, 6/20 cells vs. Med: 26%, 5/19 cells). These results suggest a long-lasting impact of enhanced MOC innervation on the structural refinement of central auditory synapses persisting beyond hearing onset.