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FORMATION OF AFFERENT PROJECTIONS IN ORGANOTYPIC SLICE CULTURES FROM RAT VISUAL CORTEX.

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Thalamic afferents form very specific connections with their cortical target cells. In order to learn about mechanisms involved in the development of these connections we used a thalamocortical in vitro system. We prepared slice cultures from the visual cortex of young rats (P0 - P8) and cocultured them with slices from the lateral thalamus (E16 - P5). Thalamocortical connections were traced with DiI in cocultures after 4-14 days in vitro. As reported previously, cortical slices survive for several weeks in vitro and the different cell types continue their morphological and neurochemical maturation (Caeser et al., Exp. Brain Res.77,234,1989; Götz and Bolz, Neurosci. Lett. 107,6,1989).To examine the laminar organization of the cortical cultures, cells of different layers were labeled at their birthdates by injecting timed pregnant rats with BrdU. After 1-3 weeks in culture the laminar distribution of labeled cells matched the in vivo situation at the corresponding age. This was also true for the earliest generated neurons situated in the so called "subplate". It has been proposed that subplate cells serve as transient targets for thalamic afferents before they disappear. We found that many subplate cells survive both in vivo and in slice cultures where no afferents are present. In cocultures fibers from thalamic slices obtained from animals up to P2 grew into the cortical explant and terminated in layers 4 and 3, but not in the subplate zone. This specific ingrowth was established whether the thalamic slice was placed at the white matter or at the pial side of the cortex slice. Electrophysiological and optical recording experiments showed that the thalamocortical connections are functional. Thus thalamic afferents form specific connections with their cortical targets in vitro without a "waiting period" in the subplate zone.