Axogenesis in the embryonic brain of the grasshopper Schistocerca gregaria : an identified cell analysis of early brain development

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Author(s) Boyan, G; Therianos, S; Williams, J L; Reichert, H
Author(s) at UniBasel Reichert, Heinrich ;
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Axogenesis in the embryonic brain was studied at the single cell level in the grasshopper Schistocerca gregaria. A small set of individually identifiable pioneer neurons establishes a primary axon scaffold during early embryogenesis. At the beginning of scaffold formation, pioneering axons navigate along and between glial borders that surround clusters of proliferating neuroblasts. In each brain hemisphere, an axonal outgrowth cascade involving a series of pioneer neurons establishes a pathway from the optic ganglia to the brain midline. At the midline the primary preoral commissural interconnection in the embryonic brain is pioneered by a pair of midline-derived pioneer neurons. A second preoral commissural connection is pioneered by two pairs of pars intercerebralis pioneer neurons. Descending tracts are pioneered by the progeny of identified neuroblasts in the pars intercerebralis, deutocerebrum and tritocerebrum; the postoral tritocerebral commissure is pioneered by a pair of tritocerebral neurons. All of the pioneering brain neurons express the cell adhesion molecule fasciclin I during initial axon outgrowth and fasciculation. Once established, the primary axon scaffold of the brain is used for fasciculation by subsequently differentiating neurons and, by the 40% stage of embryogenesis, axonal projections that characterize the mature brain become evident. The single cell analysis of grasshopper brain development presented here sets the stage for manipulative cell biological experiments and provides the basis for comparative molecular genetic studies of embryonic brain development in Drosophila.

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