Abstract: Neuronal migration is the critical cellular process which initiates histogenesis of cerebral cortex. Migration involves a series of complex cell interactions and transformation. After completing their final mitosis, neurons migrate from the ventricular zone into the cortical plate, and then establish neuronal lamina and settle onto the outermost layer, forming an “inside-out” gradient of maturation. This process is guided by radial glial fibers, requires proper receptors, ligands, other unknown extracellular factors, and local signaling to stop neuronal migration. This process is also highly sensitive to various physical, chemical and biological agents as well as to genetic mutations. Any disturbance of the normal process may result in neuronal migration disorder. Such neuronal migration disorder is believed as major cause of both gross brain malformation and more special cerebral structural and functional abnormalities in experimental animals and in humans.

An increasing number of instructive studies on experimental models and several genetic model systems of neuronal migration disorder have established the foundation of cortex formation and provided deeper insights into the genetic and molecular mechanisms underlying normal and abnormal neuronal migration. J. Med. Invest. 49 : 97-110, 2002

Keywords: cerebrum, ectopia, migration disorder, radial glia

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(1) Mode of neuronal migration

The mode of migration of cortical neurons is crucial for the development of the brain. During embryonic development, neurons migrate from the ventricular zone to the mantle zone. This process is highly regulated and involves specific molecular pathways. Disruption of these pathways can lead to neuronal migration disorders, which can result in neurological disorders. Understanding the mechanisms of neuronal migration is essential for developing therapies for these disorders.

(2) Determining correct position of migrating neurons within the cerebral layers

Accurate placement of neurons within the cerebral layers is necessary for proper brain function. Migratory streams guide the neurons to their final destinations. Misdirection of these streams can lead to disorders such as schizencephaly, where the inward migration of neurons is disrupted. Techniques such as magnetic resonance imaging (MRI) can be used to assess the integrity of these migratory streams and identify potential areas of dysfunction. Further research is needed to develop targeted interventions for these disorders.
(1) Teratogenic, physical and biological influences

The development of the neural tube requires the coordinated migration of cortical neurons. This migration can be disrupted by various factors, including teratogens, physical influences, and biological processes. Teratogens are substances that can interfere with normal embryonic development, either by arresting it completely or by causing deformations and/or functional impairments. Physical influences, such as mechanical stress or environmental changes, can also alter the migration of neurons. Biological processes, including those related to cell signaling and adhesion molecules, play a crucial role in guiding the migration of neurons. Understanding these influences is essential for developing strategies to prevent or mitigate the effects of such disruptions on neural development.
(2) Abnormal neuronal migration in mutant mice

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The image shows a comparison between two samples, A and B, with arrows indicating areas of interest. The text describes abnormal neuronal migration in mutant mice and includes a reference to β-DIBJO.
(3) Abnormal neuronal migration in the human brain

During the development of the human brain, cortical neurons undergo a complex process of migration from the ventricular zone to the cortical plate. This process is crucial for the proper formation of the brain's cortical layers. Abnormalities in this migration can lead to various neurological disorders, including autism spectrum disorder. X. Z. Sun et al. have studied the migration of cortical neurons and have identified abnormalities in this process. Their findings suggest that abnormal neuronal migration might be a contributing factor to the development of autism spectrum disorder. Further research is needed to understand the mechanisms underlying this process and to develop targeted therapeutic interventions.
X. Z. Sun et al.  migration of cortical neurons

migration of cortical neurons

migration of cortical neurons

in vitro