Volume 46(1-2):51, 2002
Acta Biologica Szegediensis
http://www.sci.u-szeged.hu/ABS

DISSERTATION SUMMARY

Plasticity of the somatosensory cortex in adult rodents

Katalin Kóródi

Department of Comparative Physiology, University of Szeged, Szeged, Hungary

Life is a long history of sensory experience, in the course of which the nervous system proves capable of adapting to the ever-changing environment as well as to behavioural challenges and pathological alterations. This ability is termed plasticity. A fundamental issue in neurobiology is the understanding of the morphological and physiological correlates of these adaptive changes in the nervous system. Controlled alterations of sensory input permit studies of the consequent structural and functional changes, *i.e.* studies of experience-dependent neural plasticity.

In our experiments we have been studying alterations of functional parameters with electrophysiological methods on the so-called barrel field of rodents. This region of the cerebral cortex contains discrete groups of neurons in layer IV, called barrels, which are related one-to-one to the large mystacial vibrissae on the contralateral face. Anteromedially we can find the forepaw representation area adjacent to the barrel field, which is also topographically organized. Despite the strict cortical representation of the body surface on the primary somatosensory cortex (SI), a significant capacity to undergo functional changes in response to alterations in sensory input remains even in the adult cortex.

First, we investigated the consequences of infraorbital nerve injury on the organization of cortical representational maps in adult rats. The infraorbital nerve is a sensory branch of the trigeminal nerve that innervates the whisker follicles of the face, so its injury eliminates the input of the contralateral barrel cortex. Recording somatosensory evoked potentials and extracellular unit activity over the barrel field as well as on the adjacent forepaw representation area we present evidence indicating that changes in the somatotopic map of the SI appear early after nerve crush. We closely studied the borderline between the physiological representation of the sinus whiskers and the digits. Following the injury, the physiological representation of the digits of the contralateral forepaw extended posterolaterally, occupying a part of the whisker region. The extended physiological representation of the digits, though somewhat shrunken, remained after the reappearance of whisker-evoked responses, forming an overlapping area between the obligate digit and whisker representations. Thus, we demonstrate that entire reorganization in cortical topography does not take place after nerve regeneration in adult animals.

Our purpose was then to identify physiological correlates of cortical plasticity, however subtle, that arise as a result of milder, nearly natural alterations of sensory experience, leaving the nervous system intact. So we examined the changes of somatosensory evoked potentials after increased and a subsequent decreased use of the vibrissae in adult mice. Thus, the animals were first subjected to a behavioural challenge, the radial arm maze, which requires active use of the vibrissal system and also motor skills. Their whiskers were then trimmed to create a state of sensory deprivation. Furthermore, to follow activity-dependent changes, their time course or reversibility, it was desirable to apply a technique that allows repeated measurements on the same group of animals. Therefore, we applied the minimally invasive epicranial evoked potential recording method, which proved to be sufficient for repeated use. The consequences of each alteration were measured above the primary somatosensory and motor cortices of the contralateral hemisphere. The latencies of the evoked potentials were found to shorten, while their amplitudes decreased, after the behavioural challenge involving the vibrissal apparatus. Sensory deprivation achieved by whisker trimming resulted in a partial reversal of the changes observed after increased activity. Some derived parameters imply that cortical information processing speeds up as a result of experience, while decreased activity has the opposite effect.

Our results demonstrate that the nervous system is capable of adaptive changes, such as reorganization of cortical maps or change of the dynamics of the evoked potentials at adult age, and these functional alterations are detectable and traceable even by minimally invasive physiological methods through repeated measurements on the same group of animals.

Supervisor: József Toldi
E-mail: kkorodi@bio.u-szeged.hu