

## Centers of Advanced Medicine

### Center for Neuroscience of Pain

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#### General Summary

The Jikei Center for Neuroscience of Pain (JCNP) was established in April 2014 as the first member of the Core Centers for Advanced Medicine of The Jikei University as a stronghold to advance the research, clinical and biomedical, in the Jikei University under the support of the Ministry of Education, Culture, Sports, Science and Technology-Supported Program for the Strategic Research Foundation at Private Universities (S1311009; FY2013-2017).

In FY2017, the JCNP has concluded 5-years project with a large amount of publications, presentations and scientific products, through which the JCNP has become well known domestically as well as internationally as a very unique and advanced center for the basic and clinical medical sciences to fight against the pain through neuroscience.

Pain is one of the most serious concerns in medicine. Besides being a beneficial physiological alarm for on-going harmful events, such as the injury and inflammation, pain is not only a simple sensation but it is inevitably suffering, being accompanied by strong negative emotions. This latter characteristic also helps patients remember the potentially harmful situations to change their future behaviors. However, such emotional aspect of pain also results in decreased quality of life. It prevents concentration and rest and leads the patients to various mental disorders including depression and anxiety. These changes often lead to various psychosomatic complications. Thus, identifying the cerebral mechanism underlying the emotional aspect of pain is an urgent issue to alleviate, control and mitigate the patient's suffering from a large variety of pain symptoms described in various parts of the body, such as the head, back, viscera and even absent limbs (e.g., "phantom limb pain" syndrome). Recent advances in pain science have identified the networks of the brain as the core mechanism responsible for such clinically "undesired" pain. In particular, chronic pain, which numerous patients claim (>15% of the population in major countries), is now thought to be established through changes in the widely distributed neural networks underlying the sensory, cognitive and affective dimensions of pain. The JCNP has been successful in integrating the activities of the diverse research teams in The Jikei University and other institutions to establish a basis for advances to be made in understanding, evaluating and mitigating unnecessary pain.

#### Research Activities

*The JCNP is composed of 3 research cores*

1. Core for the brain mechanism of pain (core leader, Fusao Kato)

This core studies the brain plasticity mechanism underlying the establishment of chronic pain using neurophysiological, neuroanatomical, and neuropharmacological approaches

with techniques from molecular biology, behavioral sciences, to optogenetics/pharmacogenetics. In addition, this core utilizes ultrahigh field magnetic resonance imaging for small animals at The Jikei University to visualize brain activity during the chronification process of pain (in which pain changes from episodic to chronic) and to evaluate the effects of various therapeutic interventions, such as the transcranial magnetic stimulation.

2. Core for the specific disease-associated pain (core leader, Toya Ohashi)

This core aims to identify mechanisms underlying aberrant specific pain accompanying specific types of diseases, such as Fabry disease, syringomyelia, poststroke pain, postherpes pain, fibromyalgia and painful diabetic neuropathy. Taking advantage of The Jikei University Hospital, which is visited by many patients with these diseases, this core will use various approaches, including animal models of disease, primary cultured cells and induced pluripotent stem cells derived from patients and attempt to translate the findings in the animals to clinical applications.

3. Core for the pain in human patients (core leader, Shoichi Uezono)

This core deals with the pain of multiple etiologies frequently observed in patients. Such pain includes postoperative pain, cancer pain and neuropathic pain, most of which are resistant to therapy and have unidentified mechanisms. Collaborations between divisions for biomedical sciences in other cores and clinical departments, such as anesthesiology (including the pain clinic), rehabilitation medicine, orthopedic surgery, neurology and neurosurgery, are promoted in this core. The detailed clinical analyses of the sensory, cognitive and affective dimensions of pain in relation to other clinical observations in each patient will be used to develop and examine novel strategies against therapy-resistant complications of chronic pain.

Close mutual interactions between these cores are promoted with the strong leadership of the core leaders. Advanced experimental systems for pain evaluation and brain activity measurement are installed in the Department of Neuroscience, the head quarter of the JCNP, which are frequently used by many researchers belonging to the JCNP.