

Japan-US Brain Research Cooperation Program
Group Joint Study Report [field: Neural mechanism of motor control]

1. The Representative of Group Joint Study:

Institute/ Title/ Name

National Institute for Physiological Sciences/Research Associate/ Futoshi Mori

2. Project Title:

Primate locomotion and higher nervous activity

3. Japanese Investigator's Name, Title, Affiliation and Phone Number:

Chief: Futoshi Mori, Research Associate, NIPS

Collaborator: Akichika Mikami, Professor, Kyoto University

Yoshio Sakurai, Professor, Kyoto University

Masahiko Inase, Professor, Kinki University

Katsumi Nakajima, Assistant professor, Kinki University

Shigemi Mori, Emeritus Professor, NIPS

Chijiko Takasu, Technical staff, NIPS

Atsumichi Tachibana, Postdoctoral fellow, NIPS

4. U.S. Investigator's Name, Title, and Affiliation:

Chief: Douglas G. Stuart, Emeritus Professor, University of Arizona

Collaborator: Fraser A. W. Wilson, Professor, University of Arizona

Bernrad Cohen, Professor, Mount Sinai Medical School

Carol A. Boliek, Assistant Professor, University of Arizona

James R. Bloedel, Professor, Barrow Neurological Institute

Vlastislav Bracha, Associate Professor, Barrow Neurological Institute

Jiping He, Professor, Arizona State University

5. The Term of Research: From Y. M. D. To Y. M. D. (Years)

1999. 4. 1. – 2001. 3.31 (3 years)

6. Abstract, Result and Significance of Research (300 Words):

This research collaboration project was aimed at elucidating the higher nervous control

mechanisms of bipedal (Bp) locomotion in Bp walking Japanese monkey (*M. fuscata*), which was recently developed by our Japanese research group. Collaboration projects include; 1) acquisition process of obstacle clearance task in Bp walking monkey, 2) identification of brain areas related to the execution and control of Bp and quadrupedal (Qp) locomotion by PET, 3) understanding of the functional role played by each of the PET identified brain areas, and 4) establishment of a new method which allows multi-unit recordings from the brain areas during Bp and Qp locomotion.

Project-1: Dr. Boliek had visited NIPS from September to December 1999, and participated in this. We found that the young Japanese monkeys acquired novel capability to clear the obstacle with a recruitment of knee-hip flexion strategy and visuo-motor coordination. The strategy acquired by them has been observed during Bp locomotion in human.

Project-2; PET study showed significant activation at the cerebral cortices such as primary motor area (MI), supplementary motor area (SMA), visual cortex and the cerebellum with different activation patterns during execution of Bp and Qp locomotion.

Project-3: We inactivated the identified hindlimb areas of MI and SMA by focally microinjecting muscimol (GABA_A agonist). After inactivation of the MI, the monkey showed a localized impairment of hindlimb movement such as the knee and/or ankle flexion disability, whereas that into the SMA resulted in generalized impairment of upright posture accompanying Bp locomotion.

Project-4: We also tried to record multiple cortical unit activities from Bp and/or Qp walking monkeys, but we have not yet succeeded because of several technical problems.

Our results obtained during the past 3 years suggest that the higher nervous system such as the MI and the SMA are involved in the control of Bp locomotion by activating multiple subcortical neural mechanisms in parallel. We had several opportunities to visit counterpart institutes in the USA for the discussion and the exchange of ideas, and also talk at the major domestic and international scientific symposiums. Dr. Hideo Tsukada, Hamamatsu Photonics, K. K, and Prof. Atsushi Nambu (NIPS) also actively participated in the projects 2) and 3).

7. The Others (Practical Issues, Special Mention Matters):

Prof. Stuart, a principal USA investigator, well understood the importance of JAPAN-USA collaboration Project. He generously introduced this project to many prominent and active USA scientists. Thanks to him, both Japanese and US researchers were able to work together in their home Institutes. We owe very greatly the success of this project to him.