NC STATE UNIVERSITY

JOINT DEPARTMENT OF BIOMEDICAL ENGINEERING

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

Coulter Seminar Series Presents

"New horizons in peripheral nerve surgery "

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Hitoshi Hirata MD, PhD. professor of Innovative Research Center for Preventive Medical Engineering and professor of Department of Hand Surgery, Faculty and Graduate School of Medicine at Nagoya University. He graduated from Mie University in 1982 and competed his resident program at Shizuoka municipal hospital. He obtained his orthopaedic surgery training from Mie University and his hand surgery training at Mie Univerity, Hiroshima University, and Mayo clinic. He became the professor of Hand Surgery at Nagoya University in 2005 and the professor of Innovative Research Center for Preventive Medical Engineering in 2016.

Dr. Hirata's research interest lies in functional reconstruction of the extremities, peripheral nerve surgery, design and control of robotic prosthetics and exoskeletons, development of new materials for fracture treatment, computer simulation and virtual reality technology in upper extremity surgery, etc.

ABSTRACT

The nervous system is one of the most primitive functional units in the body. Its origin could date back 600 million years, a sign that this basic system has been indispensable for survival amidst a harsh environment. The musculoskeletal system of humans and other vertebrates operates in a control mode integrated with the central nervous system (CNS). The CNS, comprised of the brain and spinal cord, is responsible for such information processing as integration, deduction, learning and modulation. It serves the periphery by forming and sending out appropriate motion instructions. In this fundamental nervous system action, known as sensory motor integration, the primary role of the peripheral nervous system (PNS) is to transmit signals directly, without modulation, between sensors embedded throughout the body and the CNS.

The brain and PNS respond to injury in distinctly different ways. The PNS shows amazing regenerative capacity, while that of the brain is very limited. On the other hand, the brain retains functionality through neuroplasticity, while the PNS cannot modify connections in response to changing demands.

The primary aim of peripheral nerve surgery is to restore disrupted sensory motor integration by repairing ruptured axons, thereby regaining functionality. To obtain optimal treatment results, surgeons need to consider not only how to enhance axonal growth at the injury site but also how to enhance brain plasticity to cope with faulty wiring, referred to as misdirection, which is an inevitable consequence of nerve repair.

In this lecture, I will give an overview of the relevant anatomy, physiology, injury classification, and regeneration mechanism of the PNS and then introduce medical devices and techniques we developed to enhance axonal regeneration. Finally, we will explore compelling new strategies to overcome the physiological limitations of the PNS regenerative capacity as well as to enhance brain plasticity.

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