



● SPECIAL ISSUE

## Neural regeneration after peripheral nerve injury repair is a system remodelling process of interaction between nerves and terminal effector

In China, there are approximately 20 million people suffering from peripheral nerve injury and this number is increasing at a rate of 2 million per year. These patients cannot live or work independently and are a heavy responsibility on both family and society because of extreme disability and dysfunction caused by peripheral nerve injury (PNI). Thus, repair of PNI has become a major public health issue in China.

Repair of PNI involves two processes, (i) the central nervous system remodels and innervates the target organs in an antero-grade manner *via* the repaired peripheral nerve, and (ii) distal target organs induce retrograde remodelling of the central nervous system *via* the repaired peripheral nerve. Our team (the 973 program team) was the first to propose that “neural regeneration after PNI repair is a system remodelling process of interaction between nerves and terminal effector” (Jiang et al., 2007, 2014). It is based on regeneration, regulatory and remodelling mechanisms. The following six topics are the major concerns for discussion.

### Mechanisms underlying tissue inducing PNI

The Institute of Orthopedics of the General Hospital of Chinese PLA assumed responsibility to investigate the mechanism by which tissue induces peripheral nerve regeneration using histological and electrophysiological methods in a PNI model repaired with slit-sleeve technique.

### Regulatory mechanisms underlying neuronal axon growth and myelination

The Jiangsu Provincial Key Laboratory of Nerve Regeneration, Nantong University, China assumed responsibility to investigate axon degeneration, myelination and neuronal function change in the proximal injured peripheral nerve at molecular and cellular levels using biochip technique, and to reveal the regulatory mechanism underlying neuronal axon growth and myelination during the process of peripheral nerve regeneration.

### Regulatory mechanisms underlying denervated muscular atrophy after PNI

The Department of Hand Surgery, Huashan Hospital of Fudan University, China assumed responsibility of using proteomic techniques to investigate the regulatory mechanism underlying denervated muscular atrophy, determining the interventional strategy for effectively preventing denervated muscular atrophy and determining mechanisms underlying further nerve bud regeneration and established appropriate surgical methods.

### Mechanisms underlying pain and paraesthesia after PNI and interventional strategies

The Institute of Neuroscience, Beijing University, China assumed responsibility of investigating the neuronal ion channel change and its effect on pain sensitivity using patch clamp techniques, clarifying the central mechanism underlying the interaction between pain perception and emotional states, and determining effective interventional measures.

### Central structure remodelling and function repair after PNI

The Jinan University in China assumed responsibility of investigating central structure and nerve circuit loop functional remodelling in the brain and spinal cord after PNI using a tracer technique, imaging, and gene knockout models.

### Terminal effector-induced system function remodelling during innovative repair of injured peripheral nerve

The Peking University People's Hospital assumed responsibility to investigate terminal effector-induced system function remodelling and the possible underlying mechanisms of multiple innovative repair modes of PNI.

The 973 program team has assembled many Chinese teams whose research focuses on the peripheral nerve, with members coming from eight institutions including: Peking University, Fudan University, The General Hospital of Chinese PLA, Sun Yat-sen University, Fourth Military Medical University of Chinese PLA, Nantong University, Jinan University, and Southern Medical University in China. Among these scholars, two are academicians of the Chinese Academy of Engineering, four have been awarded National Outstanding Youth Foundation, and three are new century excellent talents awarded by the Ministry of Education of China. The 973 program team enables to provide labs for neuroscience. These teams already have long-term collaborations and abundant case sources of their own. This program will, on the whole, elucidate the major mechanisms underlying regeneration after PNI and more importantly provide new solutions for the treatment of PNI.

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## References

- Jiang BG, Yin XF, Zhang DY, Fu ZG, Zhang HB (2007) Maximum number of collaterals developed by one axon during peripheral nerve regeneration and the influence of that number on reinnervation effects. *Eur Neurol* 58:12-20.
- Jiang BG, Feng Yin X, Xun Zhang P, Han N, Kou YH (2014) Hypothesis of peripheral nerve regeneration induced by terminal effectors. *Artif Cells Nanomed Biotechnol* 42:92-94.