DPS 2

A KEY ROLE OF THE MESENCEPHALIC TRIGEMINAL NEURON IN MODULATING MASTICATION

Youngnam Kang

Osaka University Graduate School of Dentistry, Osaka, Japan

The α-γ linkage is thought to be critical in the jaw-closing movement due to the structural specificities of the peripheral and central axon terminals of neurons in the mesencephalic trigeminal nucleus (MTN). The peripheral axon supplies the large number of annulospiral endings surrounding intrafusal fibers encapsulated in single muscle spindles while the central axon sends only a few number of synapses onto single motoneurons (MNs). Spike activity in a γ-motoneuron (γMN) would induce a large number of impulses in single peripheral axons by activating many intrafusal fibers simultaneously, subsequently causing an activation of α-motoneurons (αMNs) in spite of the small number of synapses. Thus, the activity of γMNs may be vital for modulation of jaw-closing movements. Independently of such a spindle activity modulated by γMNs, somatic depolarization in MTN neurons is known to trigger the oscillatory spike activity. Nevertheless, the trafficking of these spikes arising from the two distinct sources of MTN neurons is not well understood. In this FAOPS symposium, switching among multiple functional modes of MTN neurons is discussed. Subsequently, it will be discussed which mode can support the α-γ linkage. In our most recent study, simultaneous patch-clamp recordings from the soma and axon hillock revealed a spike-backpropagation from the spike-initiation site in the stem axon to the soma in response to a somatic current pulse. The persistent Na^+ current was found to be responsible for the spike-initiation in the stem axon, the activation threshold of which was lower than those of soma spikes. Somatic inputs or impulses arising from the sensory ending whichever trigger spikes in the stem axon first would be forwarded through the central axon to the target synapse. We also demonstrated in this study that at hyperpolarized membrane potentials, 4-AP-sensitive K^+ current ($IK_{4\text{-}AP}$) exerts two opposing effects on spikes depending on their origins; the suppression of spike initiation by increasing the apparent electrotonic distance between the soma and the spike-initiation site, and the facilitation of axonal spike invasion at higher frequencies by decreasing the spike duration and the refractory period. Through this mechanism, the spindle activity caused by γMNs would be safely forwarded to αMNs. Thus, soma spikes shaped differentially by this $IK_{4\text{-}AP}$ depending on their origins would reflect which one of the two inputs was forwarded to the target synapses.

Key Words: mastication, mesencephalic trigeminal nucleus, muscle spindle, gamma-motoneuron

DPS 3

MASTICATION, OCCLUSION AND MUSCLE SENSE

Toshifumi Morimoto

Matumoto Dental University, Matumoto, Japan