

Abstract

# Effects of Electrical Stimulation on Proteins Related to Signal Transduction, c-Src and Focal Adhesion Kinase in Fibroblasts <sup>†</sup>

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**Abstract:** In the field of acupuncture and moxibustion, electrical stimulation of the skin and muscles is known to increase blood flow and metabolism locally and maintain the body in a sustained healthy state. However, little is known about the changes in cellular morphology in response to the electrical stimuli or how the localization of specific proteins is regulated by such stimulation. To gain greater understanding in this respect, the present study examined the effects of electrical stimulation on the cytoskeletal system of cultured fibroblasts. Cultured fibroblastic cells were subjected to periodic electrical stimulation for 0 (unstimulated control), 2, 5, and 20 hours. After approximately 2 hours, the stress fibers and focal adhesions in the cells had become enlarged, the stress fibers exhibiting an increase in thickness, while the cells had a contracted appearance. During 20 hours of periodic stimulation, both the stress fibers and focal adhesions gradually became larger and thicker. After the electrical stimulation, the cells exhibited increased staining of focal adhesions with anti-phosphotyrosine antibody (PY-20). They also exhibited increased staining of tyrosine-phosphorylated focal adhesion kinase (FAK) (pY397) and tyrosine-phosphorylated c-Src (pY418), indicating that the electrical stimulation had affected proteins related to signal transduction. ELISA analysis showed that 20 hours of electrical stimulation gradually increased the activity of tyrosine-phosphorylated c-Src until it was approximately tripled, whereas 5 hours of electrical stimulation approximately doubled the activity of tyrosine-phosphorylated FAK, this being the maximum reached. These results strongly suggest that electrical stimulation induces changes in the activation of c-Src and FAK signaling-related proteins and affects the formation of the cytoskeletal system.

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