Controlling Cells Function by Light Technology

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Technologies using lasers and light have numerous applications in the medical field, such as photo-diagnosis, endoscopy, laser dissection, and photodynamic therapy. In the field of basic biological research, lasers and light are essential tools not only in detection devices but also with microscopy and imaging techniques.

The focus of my research is the response of living organisms and/or their tissues after laser radiation or light exposure. Since 1970, Mester *et al*. have reported that low-level laser therapy (LLLT) induces wound healing, cell proliferation, ATP synthesis, collagen synthesis, anti-inflammation, pain relief, osteogenesis, and many other biological effects. The detailed mechanisms of these effects are still not clear, although there are some molecular biology-based studies in the literature.

For controlling cell function and homeostasis, genetic technology, such as transgene and knock-in or knock–out methods, and medications are widely used. However, non-invasive technology, such as stem cell therapy and cell-based diagnosis, could prove to be useful in the fields of medicine and biology. These technologies could obviate the need for conventional methods, which are often invasive and can have adverse side effects.

In this lecture, I will present my results showing that using lasers alone, cell function can be controlled without any need for genetic technologies. Moreover, I will introduce the recent progress of Optogenetics. Optogenetics comprises a growing family of related techniques in which genetically modified cells are stimulated by light in order to influence cellular behaviors. I will discuss the potential significance of optogenetics in the development of clinical therapeutics. Although less than a decade old, optogenetics is already responsible for enormous progress in disparate fields, and its future is unquestionably bright.

This work was supported by Scientific Research on Innovative Areas, a MEXT Grant-in-Aid Project (26116728), “Crosstalk between transcriptional control and energy pathways, mediated by hub metabolites”.