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Transcranial near-infrared laser therapy applied to promote clinical recovery in acute and chronic neurodegenerative diseases

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Abstract

One of the most promising methods to treat neurodegeneration is noninvasive transcranial near-infrared laser therapy (NILT), which appears to promote acute neuroprotection by stimulating mitochondrial function, thereby increasing cellular energy production. NILT may also promote chronic neuronal function restoration via trophic factor-mediated plasticity changes or possibly neurogenesis. Clearly, NILT is a treatment that confers neuroprotection or neurorestoration using pleiotropic mechanisms. The most advanced application of NILT is for acute ischemic stroke based upon extensive preclinical and clinical studies. In laboratory settings, NILT is also being developed to treat traumatic brain injury, Alzheimer's disease and Parkinson's disease. There is some intriguing data in the literature that suggests that NILT may be a method to promote clinical improvement in neurodegenerative diseases where there is a common mechanistic component, mitochondrial dysfunction and energy impairment. This article will analyze and review data supporting the continued development of NILT to treat neurodegenerative diseases.

Keywords

acute ischemic stroke; Alzheimer's disease; LLLT; mitochondria; neuroprotection; NILT; Parkinson's disease; photobiomodulation; photobiostimulation; TLT; traumatic brain injury

Photobiostimulation or photobiomodulation is a novel noninvasive method used to promote neuroprotection and repair of injured neuronal pathways by activating endogenous mechanisms that are involved in both processes. Currently, we hypothesize that near-infrared laser therapy (NILT) efficacy requires at least a two-step process, an acute phase response followed by a chronic phase response that requires activation of survival and plasticity elements [1]. The wavelength-specific two-step process, which is not thermal based [2–4], appears to be effective when near-infrared (NIR) irradiation with 808 nm infrared light is used [5–13], but lower wavelengths of approximately 630 nm have also been shown to have therapeutic efficacy [14]. Photobiostimulation directly affects cellular

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