

# Treatments for traumatic brain injury with emphasis on transcranial near-infrared laser phototherapy

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**Abstract:** Traumatic brain injury (TBI) is a growing health concern affecting civilians and military personnel. In this review, treatments for the chronic TBI patient are discussed, including pharmaceuticals, nutraceuticals, cognitive therapy, and hyperbaric oxygen therapy. All available literature suggests a marginal benefit with prolonged treatment courses. An emerging modality of treatment is near-infrared (NIR) light, which has benefit in animal models of stroke, spinal cord injury, optic nerve injury, and TBI, and in human trials for stroke and TBI. The extant literature is confounded by variable degrees of efficacy and a bewildering array of treatment parameters. Some data indicate that diodes emitting low-level NIR energy often have failed to demonstrate therapeutic efficacy, perhaps due to failing to deliver sufficient radiant energy to the necessary depth. As part of this review, we present a retrospective case series using high-power NIR laser phototherapy with a Class IV laser to treat TBI. We demonstrate greater clinical efficacy with higher fluence, in contrast to the bimodal model of efficacy previously proposed. In ten patients with chronic TBI (average time since injury 9.3 years) given ten treatments over the course of 2 months using a high-power NIR laser (13.2 W/0.89 cm<sup>2</sup> at 810 nm or 9 W/0.89 cm<sup>2</sup> at 810 nm and 980 nm), symptoms of headache, sleep disturbance, cognition, mood dysregulation, anxiety, and irritability improved. Symptoms were monitored by depression scales and a novel patient diary system specifically designed for this study. NIR light in the power range of 10–15 W at 810 nm and 980 nm can safely and effectively treat chronic symptoms of TBI. The clinical benefit and effects of infrared phototherapy on mitochondrial function and secondary molecular events are discussed in the context of adequate radiant energy penetration.