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Recovery of Inferior Alveolar Nerve by Photobiomodulation Therapy Using Two Laser Wavelengths: A Behavioral and Immunological Study in Rat

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Abstract

Postoperative sensory disturbances of inferior alveolar nerve (IAN) are major challenges in dental procedures. We aimed to investigate the effect of photobiomodulation therapy (PBMT) with 810 nm and 980 nm diode lasers on behavioral and immunological factors in a rat IAN crush model. Seventy-two rats were randomly assigned to the four groups of 810 nm laser (crush injury+810 nm laser; 6 J/cm², 15 sessions, every 48 h), 980 nm laser (crush injury+980 nm laser; same protocol), control (crush injury without irradiation), and sham surgery (no crush injury and no irradiation). The neurosensory response of IAN was evaluated by Von Frey behavioral test before (baseline) and post-surgery in a period of one month. Changes of nerve growth factor (NGF), brain-derived neurotrophic factor (BDNF), nuclear factor-kappa B (NF-κB), TNF-α, and IL-1β, were assessed on days 2 and 30 post injury. Data were analyzed for significant differences by repeated measures and one-way ANOVA (p < .05). One day after surgery, all rats subjected to nerve injury showed significant increase in the withdrawal threshold of von Frey test compared to the baseline (p = .02 for control and p = .03 for laser groups). The threshold gradually returned to the baseline scores in 810 nm, 980 nm, and control groups from days 11, 17, and 29, respectively. There was a significant lower withdrawal threshold in 810 nm and 980 nm laser groups compared to the control group in days 11 to 19 and 9 to 23, respectively. At both time points, the levels of NGF and BDNF were significantly higher in 810 nm laser group compared to the control group. There was a significant difference between laser and control groups regarding NF-κB expression (all p values < .001). TNF-α and IL-1β were significantly lower in laser groups compared to the control group (all p values < .001). PBMT with 810 and 980 nm diode laser protocol used in this study, promoted the neurosensory recovery of IAN after crush injury in rats. In addition, application of 810 nm diode laser was associated with more improvement in immunological responses compared to that of 980 nm laser.

Keywords: Inferior alveolar nerve; Low-level laser therapy; Nerve crush; Nerve regeneration; Photobiomodulation therapy.

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