

Efficacy of Laser Photobiomodulation on Morphological and Functional Repair of the Facial Nerve

Daniela Vieira Buchaim, PhD,¹ Jesus Carlos Andreo, PhD,² Rui Seabra Ferreira Junior, PhD,³ Benedito Barraviera, PhD,³ Antonio de Castro Rodrigues, PhD,² Mariana de Cássia Macedo, BS,² Geraldo Marco Rosa Junior, PhD,⁴ Andre Luis Shinohara, PhD,² Iris Jasmin Santos German, MS,² Karina Torres Pomini, MS,² and Rogerio Leone Buchaim, PhD²

Abstract

Objective: Evaluate the efficacy of low-level laser therapy (LLLT) on qualitative, quantitative, and functional aspects in the facial nerve regeneration process. **Materials and methods:** Forty-two male Wistar rats were used, randomly divided into a control group (CG; $n = 10$), in which the facial nerve without lesion was collected, and four experimental groups: (1) suture experimental group (SEG) and (2) fibrin experimental group (FEG), consisting of 16 animals in which the buccal branch of the facial nerve was sectioned on both sides of the face; an end-to-end epineural suture was performed on the right side, and a fibrin sealant was used on the left side for coaptation of the stumps; and (3) laser suture experimental group (LSEG) and (4) laser fibrin experimental group (LFEG), consisting of 16 animals that underwent the same surgical procedures as SEG and FEG with the addition of laser application at three different points along the surgical site (pulsed laser of 830 nm wavelength, optical output power of 30 mW, power density of 0.2586 W/cm², energy density of 6.2 J/cm², beam area of 0.116 cm², exposure time of 24 sec per point, total energy per session of 2.16 J, and cumulative dose of 34.56 J). The animals were submitted to functional analysis (subjective observation of whisker movement) and the data obtained were compared using Fisher's exact test. Euthanasia was performed at 5 and 10 weeks postoperative. The total number and density of regenerated axons were analyzed using the unpaired *t*-test ($p < 0.05$). **Results:** Laser therapy resulted in a significant increase in the number and density of regenerated axons. The LSEG and LFEG presented better scores in functional analysis in comparison with the SEG and FEG. **Conclusions:** LLLT enhanced axonal regeneration and accelerated functional recovery of the whiskers, and both repair techniques allowed the growth of axons.

Keywords: lasers in dentistry, low-level laser therapy, nerve regeneration, peripheral nerve injury, tissue regeneration and healing

Introduction

PERIPHERAL NERVE TRAUMAS caused by both crushing and sectioning are common, resulting in reduction or loss of sensory and motor functions in the innervated area.¹ Injuries involving the facial nerve, which is responsible for the maintenance and dynamics of facial expression muscles, are clinically important as the resulting social and functional problems lead to a significant reduction in quality of life.^{2,3}

Peripheral facial palsy may be caused by trauma, accidental injuries, viral infections, inflammations, metabolic

diseases, and tumors. The incidence of this condition is 20–30 cases in 100,000 individuals. It may lead to complications in verbal communication through facial expressions, which are very important in social relationships.^{4–9}

Injuries involving peripheral nerves are classified, according to Seddon (1943), functionally and anatomically into neuropraxia, axonotmesis, and neurotmesis.¹⁰ In 1951, Sunderland described five types of nerve lesions: the first type corresponds to neurapraxia and the second to axonotmesis. The third, fourth, and fifth types involve injury, respectively, to endoneurial tubes, perineurium, and epineurium.¹¹

¹Human Morphophysiology (Anatomy), University of Marília (UNIMAR), Marília, Brazil.

²Department of Biological Sciences (Anatomy), Bauru School of Dentistry, University of São Paulo, Bauru, Brazil.

³Center for the Study of Venoms and Venomous Animals, São Paulo State University (UNESP–Univ Estadual Paulista), Botucatu, Brazil.

⁴Health Sciences Center, University of the Sacred Heart, Bauru, Brazil.