Effectiveness and Acceleration of Bone Repair in Critical-Sized Rat Calvarial Defects Using Low-Level Laser Therapy

Aline Muniz de Oliveira, PhD,[1] Igor Iuco Castro-Silva, MSD,[2] Gustavo Vicentis de Oliveira Fernandes, MSD,[2] Bruno Raposo Melo, MSD,[2] Adriana Terezinha Neves Novellino Alves, MSD,[2] Arley Silva Ju´ nior, PhD,[3] Inaya´ Correa Barbosa Lima, PhD,[4] and Jos_e Mauro Granjeiro, PhD [5]_

[1]Fluminense Federal University (UFF), School of Dentistry of Nova Friburgo, Rua Silvio Henrique Brauner, 22, Centro, Nova Friburgo, RJ, Brazil 28625-650

[2]Fluminense Federal University (UFF), Post-graduation Program in Dentistry, Rua Sa˜o Paulo, 28, Campus do Valonguinho, Centro, Nitero_i, RJ, Brazil 24020-150

[3]Federal University of Rio de Janeiro (UFRJ), Department of Oral Pathology, Av. Carlos Chagas Filho, 2. andar, Bloco K, sala 56, Cidade Universita´ria, Rio de Janeiro, RJ, Brazil 21941-902

[4]Federal University of Rio de Janeiro (UFRJ), Nuclear Instrumentation Laboratory, Centro de Tecnologia, Bloco I, sala I-133, Ilha do Funda˜o, Rio de Janeiro, RJ, Brazil 21941-972

[5]National Institute of Metrology, Standardization and Industrial Quality (INMETRO), Bioengineering Program, Av. Nossa Senhora das Grac¸as, 50 - Pr_edio 6 - Sala da DIPRO, 1. andar, Xer_em, Duque de Caxias, RJ, Brazil 25250-020

Background and Objective: Tissue regeneration remains a challenge for orthopedic and craniomaxillofacial surgery to treat bone loss. The use of low-level laser therapy suggests a promise on this road with positive results for narrow defects. However, temporal and quantitative evaluations are required to understand the healing process of large injuries. The aim of this study was to investigate the repair of critical-size bone defects in rat calvaria using a GaAlAs laser.

Study Design/Materials and Methods: Bone defects (9mm in diameter) were created on the skull of 30 Wistar rats separated in control or irradiated group. GaAlAs laser (l¼830 nm, energy density¼2.5 J/cm2 and output power ¼50mW) was applied after surgery and six times more at 48 hours intervals. The animals were euthanized after 2, 4, and 8 weeks. Digital radiographs, descriptive histological and histomorphometric analyses were carried out.

Results: Radiographic analysis showed greater bone formation in the irradiated group than control at 8 weeks, covering 45% and 28% of the defect, respectively ($P<0.05$). Histological analysis showed in the irradiated groups a higher amount of bone neoformation and greater maturity at 4 and 8 weeks.Histomorphometric analysis showed that the volume density of bone tissue at 4 weeks in the irradiated group was two times higher than the control ($P<0.01$).

Conclusion: The biomodulation of low-level laser therapy using 830nm wavelength light was effective in promoting bone healing in critical defects despite the unfavorable prognosis as well as it accelerated the maturation of bone tissue.
Lasers Surg. Med. 46:61–67, 2014._ 2013 Wiley Periodicals, Inc.