

# Effects of Continuous and Pulsed Infrared Laser Application on Bone Repair Using Different Energy Doses. Study in Rats

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## Summary

The Laser Therapy effects on the cellular proliferation are extensively searched and widely known. However, there are controversies on the best output power used in the applications, the ideal fluency and irradiance, better emission mode and the adequate number of sessions in order to obtain the best results. The aim of this paper was to search for the best application fluency and emission mode, using an infrared laser in the repair of bone defects in the rat tibia. Thus, the histological quality of the neo-formed bone was evaluated by analysis using common optic microscopy and polarized light. Application Parameters: 100 mW, 830 nm, spot diameter = 0,06 mm, CW and 10 Hz, 3 sessions with 72 h of interval, energies and respective fluencies: 2 J =70 J/cm<sup>2</sup>, 4 J =140 J/cm<sup>2</sup>, 6 J =210 J/cm<sup>2</sup>, 8 J =160 J/cm<sup>2</sup>, 10 J =200 J/cm<sup>2</sup>. Conclusions: Laser Therapy has increased and accelerated the time bone repairing process (in the initial period of 10 days). This laser effect showed to be dose-dependent with the presence of an effective therapeutic window presenting biostimulation of the bone tissue between 4J and 8 J of total energy for both emission mode. The use of the laser with 10 J of energy generated, characterized by the bioinhibition of the tissues (in the initial period of 10 days). This inhibition took place at the exact irradiation spot).

## Introduction

The Laser Therapy effects on the cellular proliferation are extensively researched and widely known. However there are controversies on the best output power used in the applications, the ideal fluency and irradiance, and the adequate number of sessions in order to obtain the best results (ALMEIDA-LOPES, et al. 2001; BAXTER, 1997; PRETEL, et al. 2007). An incorrect use of Laser Therapy may provoke inhibitory effects however a small number of papers in the literature has proven this effect (GIMENEZ, 1985; BOLTON, 1995). The aim of this paper was to search for the best application fluency, using a 830nm pulsed diode laser in the repair of bone defects in the Rat tibia. Thus, the histological quality of the neo-formed bone was evaluated by analysis using common optical microscopy and polarized light.

## Methods

The sample consisted by 72 *Holtzman* rats, weight was 300 g on average were used in this study, obtained from the Dentistry School of Araraquara – UNESP – Brazil)

The research project was reviewed and approved by the Ethics in Animal Research Committee of the Dentistry School of Araraquara, UNIARA, Brazil (process number 462/06).

After shaving and asepsis of the tibia with 2% chlorhexidine, a incision was made, skin and periosteal flaps were elevated, the underlying bone tissue was exposed and a trephine cylindrical blade was prepared using stainless steel bur at low speed under constant sterile saline coolant (Fig.1). Thereafter, the animals were randomly assigned to two groups (n=36) according to the treatment of the bone defects.

The histomorphological analysis was performed under light microscopy. Each specimen was independently examined by two trained examiners blinded to the treatment of each group. The followed histomorphological event tissue repair were evaluated.

*Table 1 – Application parameters and distribution of the animals*

<b>Application Parameters</b> Potency: 100 mW Wavelength: 830 nm laser beam diameter = 0.06 mm laser operation: CW and 10 Hz Treatment: 3 sessions with 72 h of interval	<b>Periods (10<sup>th</sup> and 30<sup>th</sup>)</b>  <b>Continuons laser</b> <b>Pulsed laser</b>  Three rats for period and group
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### Treatment groups

Fluency (J/cm <sup>2</sup> )	0	70	140	210	280	350
Energy (J)	0	2	4	6	8	10



Figure 1 – Surgery procedure and treatment of the animals

## Results

The mesoscopic and histological results showed by the slides.

### *Continuous Laser*

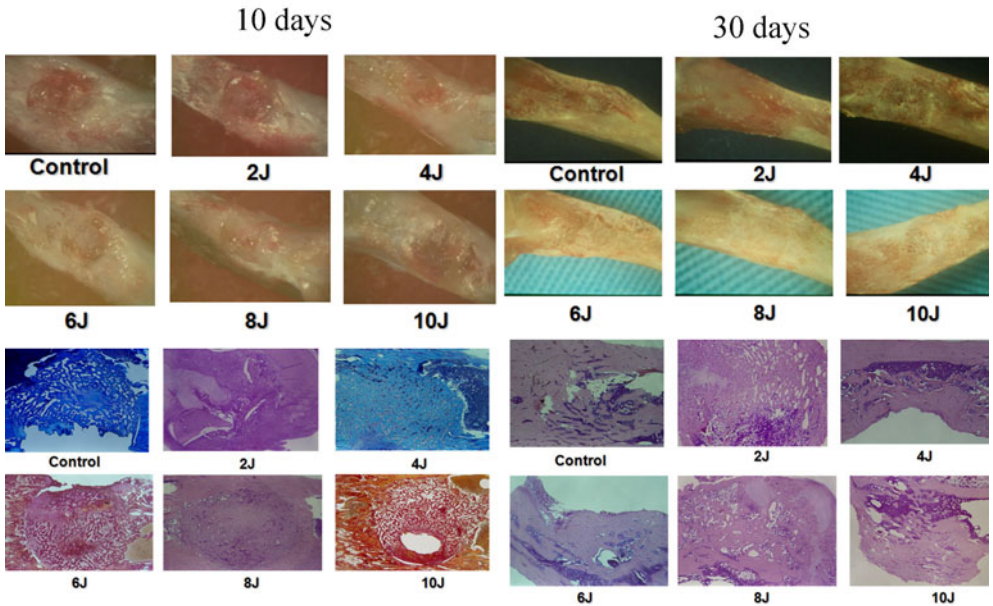


Figure 2 - Mesoscopic and histological results by continuous laser at 10th and 30th

*Pulsed Laser*

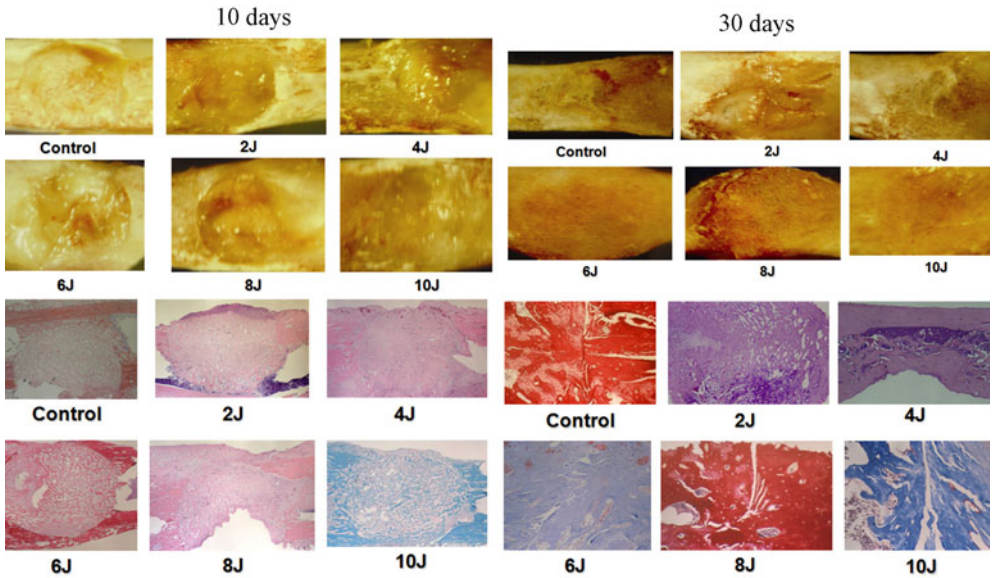


Figure 3 - Mesoscopic and histological results by pulsed laser at 10<sup>th</sup> and 30<sup>th</sup>

**Conclusions**

- Laser Therapy continuous and pulsed has increased and accelerated the tissue bone repairing process (in the initial period of 10 days).

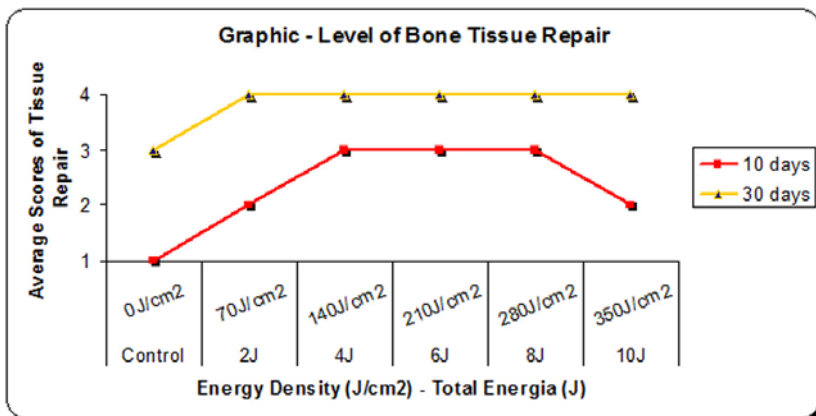


Figure 4 - showing average scores of tissue repair in function of the energy density with continuous laser mode.

- This Laser effect showed to be dose-dependent with the presence of an effective therapeutic window presenting biostimulation of the bone tissue between 4J and 8J of total Energy in both modes.
- The use of the Laser with 10J of Energy, CW generated local damage, characterized by the bioinhibition of the tissues (in the initial period of 10 days). This inhibition took place at the exact irradiation spot.

## **References**

1. Almeida–Lopes L., et al.. Comparison of the low level laser therapy effects on cultured human gingival fibroblasts using different irradiance and same fluency. *Lasers Surg. Med.* 2001; 29 (2):179-84.
2. Pretel H, Lizarelli RF, Ramalho LT. Effect of low-level laser therapy on bone repair: histological study in rats. *Lasers Surg Med.* 2007; Dec;39(10):788-96.
3. Baxter, G. D.. *Therapeutic Lasers: theory and practice.* United States of America: Ed. Churchill Livingstone, 1997.
4. Gimenez R., Casado F.. Influência de extractos biológicos sobre la respiración tisular. *Inv. Clin. Laser*, 1985; 2:11-15.
5. Bolton P., Young S., Dyson M.. The direct effect of 860 light on cell proliferation and on succinct deshydrogenate activity of human fibroblast in vitro. *Laser Therapy*, 1995; 7:55 -60.