



# Effect of a high power diode laser irradiation in root canals contaminated with *Enterococcus faecalis*. “In vitro” study

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## Abstract

The purpose of this study was to evaluate the effectiveness of a high power diode laser irradiation to reduce bacteria in contaminated canals, and to analyze the effect of irradiation associated with paste of calcium hydroxide plus paramonochlorophenol camphorated. Eighty-two human teeth root canals, infected with *Enterococcus faecalis* suspension ( $1 \times 10^8$  CFU/ml), were irradiated with a high power diode laser (830 nm), using 2.5W and 3W (CW), 360  $\mu$ m fiber. Temperature was monitored at apex with a K-pipe thermocouple. Maximum  $\Delta T$  was 7.45 °C. Aliquots were plated and CFU of all groups was counted. The results showed a significant reduction of bacteria on all groups after laser irradiation. The structural and morphological changes of root canal walls dentin produced by the diode laser irradiation were evaluated under a scanning electron microscope (SEM).

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*Keywords:* Diode laser; Endodontics; *Enterococcus faecalis*; Disinfection

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## 1. Introduction

Diode laser irradiation of *Enterococcus faecalis* infected root canal systems reduced bacteria population when combined with Ca(OH)<sub>2</sub> plus PMCC paste. *E. faecalis* was

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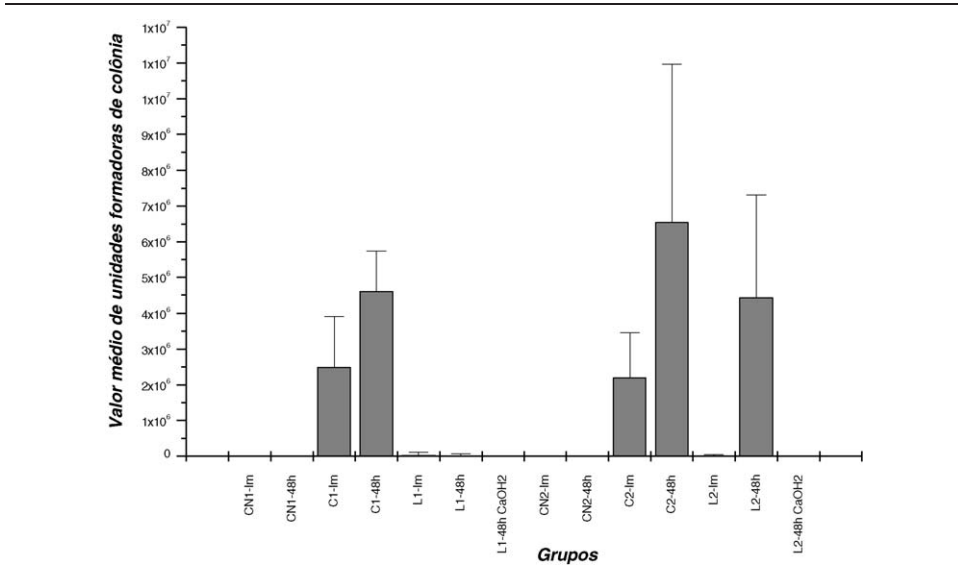
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chosen for this experiment because of its high resistance to conventional treatment technique [1–7]. This crossed procedure proved to be very efficient to reduce bacteria population.

**2. Material and methods**

The study was aimed to evaluate the effect of 830 nm diode laser irradiation and Ca(OH)<sub>2</sub> plus PMCC paste in root canals infected with *E. faecalis*. Eighty-two human teeth stored in physiological solution directly after extraction were used. Root canals were instrumented until file #50. EDTA removed smear layer and opened dentinal tubules [2] followed by a 1 m ultrasonic bath. Specimens were nail polish covered [2], kept in eppendorf vials and autoclaved. At 0 h, all the specimens were inoculated with 10 µl of *E. faecalis* suspension except the negative control groups. All of them were incubated during 72 h at 37 °C. They were divided into control and laser. Laser specimens were irradiated using helicoidal movements during 5 s, four times. After irradiation, laser groups were classified by parameters and time of incubation. Immediate positive and negative control and laser groups were plated after 72 h. The other specimens were divided into two other groups: the first was incubated during 48 h. After that time, the 48 h lasers’ group, positive and negative groups were plated. The second 48 h lasers’ group received a Ca(OH)<sub>2</sub> plus PMCC paste and was incubated during 48 h. After 48 h, the paste was removed and 10 µl of TSB was

Table 1  
CFU average group



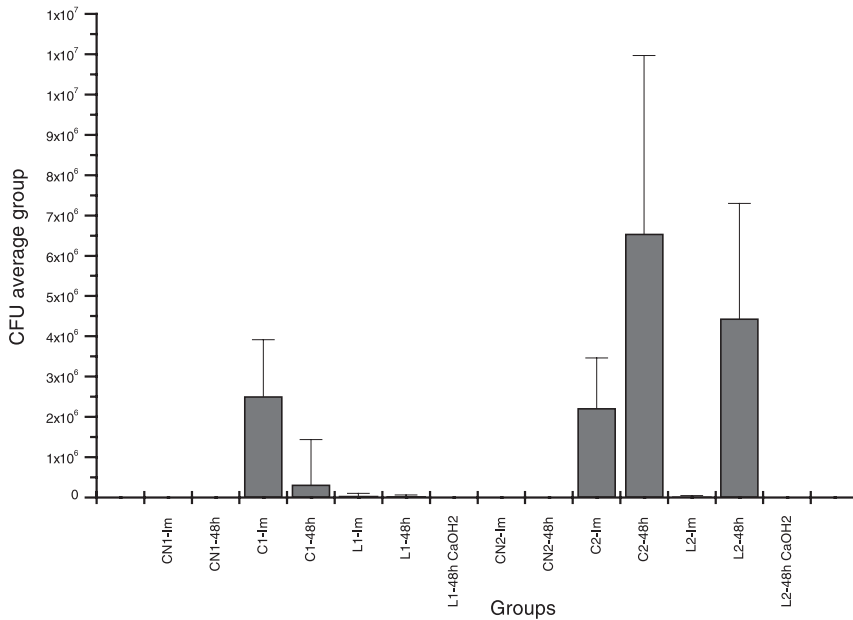


Fig. 1.

inserted into the root canals. Specimens were incubated for 24 h and dilutions were plated.

### 3. Results

Temperature measurements revealed the maximum  $\Delta T$  was 7.45 °C. The rate of reduction in the immediate laser groups was (a) 98.5%—3W, (b) 99.2%—2.5W. The reduction rate in the 48 h laser groups was (a) 96.5%—3W, (b) 57.6%—2.5W. The remaining bacteria were viable and able to infect the root canal again. The association of laser irradiation plus the  $\text{Ca}(\text{OH})_2$  and PMCC paste reduced the population up to 100%. The scanning electron microscope (SEM) procedures in control group showed open tubules with smear layer covering some areas (Table 1). The laser groups showed smooth, uniform, clean surface,

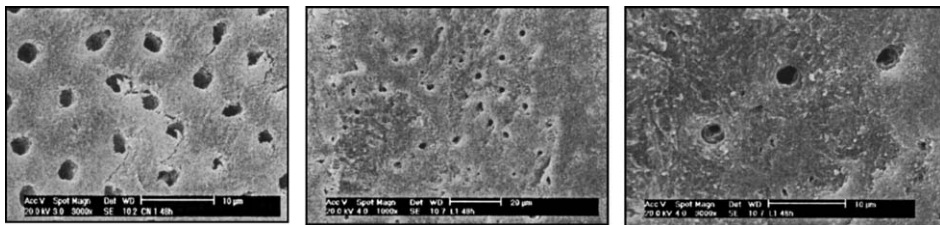


Fig. 2. SEM of control group, SEM of laser group, SEM of calcium hydroxide 48 h laser group.

large areas of closed dentinal tubules alternately with small areas of exposed open tubules. Root canal walls showed a degree of fusion (Table 1) (Figs. 1 and 2).

#### 4. Discussion

This study tries to recreate a closer condition to the similar in vivo situation. An *E. faecalis* suspension with  $10^8$  bacteria in 10  $\mu$ l was used to inoculate the specimens' root canals, which correspond to the maximum concentration in vivo under infected conditions [3]. The specimens were prepared as if in vivo. The laser parameters were safe to use in a vivo condition. *E. faecalis* bacteria are found in chronic apical periodontitis. This suggests that the effect of laser therapy in the framework presented here can be also achieved in vivo in clinical cases. The settings 2.5W and 3W in a CW mode are effective to reduce *E. faecalis* population in immediate moment. After 48 h, reproducing in vivo conditions, a decrease of reduction could be observed, and viable bacteria were able to grow and reinfect the canal system, decreasing the effectiveness of the treatment, mainly in the 2.5W 48 h laser group (57.6% of bacteria reduction). The association of laser irradiation and a  $\text{Ca}(\text{OH})_2$  plus PMCC paste proved to be an efficient and good therapy option.

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