

Efficacy of Sodium Hypochlorite and  
Er,Cr:YSGG Laser Energised Irrigation Against an  
*Enterococcus faecalis* Biofilm

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# Abstract

## **Aim:**

Laser energised irrigation (LEI) may enhance the chemo-mechanical disinfection of the root canal system. Sodium hypochlorite (NaOCl) is the most widely used endodontic irrigant, however it is cytotoxic. LEI at high laser power settings may extrude the irrigant. In order to minimise iatrogenic injury to the patient, there is the need to minimise the concentration of sodium hypochlorite and/or laser output power whilst achieving maximum antimicrobial efficacy. The aim of this study was two-fold. Firstly, to determine an appropriate laser output power for LEI. Secondly, to establish the efficacy of various concentrations of sodium hypochlorite, with and without Er,Cr:YSGG laser energy, in extracted teeth with an *Enterococcus faecalis* biofilm.

## **Methodology:**

One hundred and seventy six decoronated single rooted extracted human teeth (preliminary studies (Studies 1 & 2) n = 71, Study 3 n = 96) were prepared to a size 40, 0.06 taper 1 mm beyond the apex. Tooth roots were mounted within a flow cell, which was sterilised before pumping a nutrient media through the root canals. The flow cell was inoculated with *E. faecalis* (ATCC 700802) and cultivated for 4 weeks. The root ends were then sealed prior to treatment.

Preliminary studies: A range of irrigants (saline, 0.5% NaOCl, 1% NaOCl, 4% NaOCl) and laser output powers (0.1W, 0.25W, 0.5W, 1W) were compared. Following treatment, teeth were crushed and viable bacteria were quantitated by serial dilution and plating (n = 54). Scanning electron microscope images were also used to qualitatively compare groups (n = 17).

In a larger study, (Study 3), ninety six teeth were randomised to one of six groups: control (saline irrigation); 1% NaOCl standard irrigation (SI); 4% NaOCl SI; 0.5% NaOCl with laser energised irrigation (LEI); 1% NaOCl with LEI; 4% NaOCl with LEI. Following treatment, teeth were crushed and viable bacteria were quantitated by serial dilution and plating. The number of colony forming units (cfu) were compared between groups using a Kruskal-Wallis test and analysis of variance with post-hoc Wilcoxon tests. A *P* value of < 0.05 was considered statistically significant.

## **Results:**

Preliminary studies: A laser output power of 0.5 W was determined to be the most appropriate power setting.

Study 3: Post-hoc analysis showed a significant difference between the control group and the 5 other treatment groups ( $P < 0.001$ ). Significant differences were shown between 1% NaOCl (SI) and 4% NaOCl (SI) ( $P = 0.036$ ), 1% NaOCl (SI) and 1% NaOCl LEI ( $P = 0.045$ ) and between 1% NaOCl (SI) and 4% NaOCl LEI ( $P = 0.11$ ). Statistical differences were not shown between the other groups.

**Conclusion:**

The study concluded that standard irrigation with 4% NaOCl was more effective than standard irrigation with 1% NaOCl. However lower concentrations (0.5% and 1% NaOCl) when energised with an Er,Cr:YSGG laser (at 0.5 W) were as effective as standard irrigation with 4% NaOCl.

## **Declaration**

I, Jonathan Christo, certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Declared by:

Date:

Dr Jonathan Christo

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