



# Efficacy of ultrasonic and Er:YAG laser activated EDTA irrigation in removing bacteria from ex vivo root canal system

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## Abstract

**Purpose** Due to the limited effectiveness of irrigation to reduce the bacterial load inside root canals, the efficacy of activated irrigation techniques was evaluated.

**Methods** Sixty endodontically prepared single-rooted human teeth were sterilized, infected with *Enterococcus faecalis*, and divided into six groups: (A) endodontic treatment positive control, (B) irrigation with EDTA 17%, (C) Er:YAG laser activated irrigation with tip 1 mm from working length, (D) Er:YAG laser to the coronal third, (E) ultrasonic irrigation applied 1 mm from working length, (F) US irrigation to the coronal third.

**Results** The positive control group had significantly more bacteria than all other groups. EDTA irrigation had low efficiency. US irrigation 1 mm from the working length was significantly more effective than controls. Laser treatment to the coronal third was the most efficient.

**Conclusions** Laser activated irrigation caused the greatest bacterial reductions.

**Keywords** Biofilm · Ultrasonic · Laser · Root canal · Irrigation

## Introduction

The major goal of biomechanical cleaning of the root canal system is to eliminate bacteria and irritants which can cause periapical lesions [1]. Biomechanical instrumentation reduces the microbial load; however, complete bacterial eradication is difficult [2–4] because some areas of the canal wall are inaccessible to the instruments, including advanced rotary systems

[5]. Ethylenediaminetetraacetic acid (EDTA) is a widely used irrigant in endodontic treatment because it reacts with the calcium ions in dentin and forms soluble calcium chelates. The use of antimicrobial canal irrigation agents such as NaOCl with EDTA 17% in combination with mechanical instrumentation further reduces the bacterial content [6]. Nevertheless, some bacteria still persist [7, 8]. Endodontic instrumentation reduces bacteria on the root canal wall; however, a smear layer is created. This layer is amorphous and irregular, containing inorganic debris, pulp tissue, odontoblastic residue, necrotic debris, as well as microorganisms and their metabolic products [9]. Furthermore, the smear layer itself may be infected, preventing efficient cleaning by irrigation [10–12].

Almost 700 bacterial species can be found in the oral cavity [13]. Once the root canal is infected coronally, infection progresses apically until bacterial products or bacteria themselves stimulate the periapical tissues, leading to apical periodontitis. The dominant bacteria remaining following intra-canal disinfection procedures and after root canal treatment is the gram-positive bacteria *E. Faecalis*. This bacterium has been identified in cases of failed endodontic therapy and in canals with persistent infections [14]. *E. Faecalis* has many features which enable survival in the root canal.

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