The inflammation of tooth pulp or periapical tissue is the most common diseases in the dental emergency. Many studies have demonstrated that persistent endodontic infections are frequently caused by *Enterococcus Faecalis* (*E. faecalis*). When grown to biofilm, they become 1000-fold more resistant to phagocytosis, antibodies, or antimicrobials than planktonic bacteria. Eliminate and inactivate the bacteria in root canal system completely is the key in root canal treatment.

In this study, the *E. faecalis* was incubated in the root canal for 7 days to form the biofilm which consisted of a compact and homogeneous structure in root canal system. We demonstrate a new promising method for tooth root canal disinfection by a single electrode based non-thermal atmospheric pressure Ar/O2 (2%) plasma source. The traditional interappointment intracanal medication with calcium hydroxide was used as control. A significant decrease in the number of Colony-Forming Units (CFU) was observed after prolonged cold plasma treatment (from 2 minutes to 10 minutes). Compared with the control group, cold plasma treatment of 8 or 10 minutes had a significantly higher antimicrobial efficacy. The SEM analysis showed that the bacteria membrane was ruptured and the structure of the biofilm was fully destroyed by the plasma. CSLM studies indicated that the plasma treatment induced *E. faecalis* death and destruction of the biofilm. Reactive oxygen species were detected by Electron Spin Resonance (ESR) spectroscopy in liquid and optical emission spectra in air. Possible pathway for the disinfection will be discussed.

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