Proceedings of 20th International Congress on Acoustics, ICA 2010

23-27 August 2010, Sydney, Australia

Ultrasonic cleaning of the root canal

Bram Verhaagen (1), Simon Lea (2), Lei-Meng Jiang (3), Lucas W.M. van der Sluis (3) and Michel Versluis (1)

(1) Physics of Fluids group, Faculty of Science and Technology and Institute for Biomedical Technology and Technical Medicine MIRA, University of Twente, Enschede, The Netherlands
(2) School of Dentistry, University of Birmingham, Birmingham, United Kingdom
(3) Department of Cariology, Endodontology and Pedodontology, Academic Center for Dentistry, Amsterdam, The Netherlands

PACS: 43.40.Cw, 43.40.Rj, 47.63.mf

ABSTRACT

A crucial step during a root canal treatment is the irrigation, where an antimicrobial fluid is injected into the root canal to eradicate all bacteria from the root canal system. Agitation of the fluid using an ultrasonically vibrating miniature file has shown a significant improvement in the cleaning efficacy over conventional syringe irrigation. However, the exact cleaning mechanisms, being acoustic streaming, cavitation of the fluid or a combined chemical effect, are not fully understood. Here we investigate ultrasonically activated irrigation through experiments and numerical simulations in order to understand the relative importance of the three cleaning mechanisms. We combine high-speed imaging and micro-Particle Imaging Velocimetry to visualize the flow pattern and onset of cavitation in a root canal model (sub-millimeter dimensions), at timescales relevant to the cleaning processes, which is of the order of microseconds. High-speed microPIV measurements of the acoustic streaming around an ultrasonically oscillating file at frequencies of 20, 30 and 40 kHz are coupled to the oscillation characteristics of the file as simulated numerically and measured with a laser vibrometer. Comparison between the streaming pattern inside the root canal and in the free field shows the importance of the confinement of the root canal on the acoustic streaming. The results give new insight into the role of acoustic streaming for the cleaning of root canals.