UV and Visible Laser Ablation Rates in Canine and Human Arteries

M. Sartori, P.D. Henry, R. Roberts
Baylor College of Medicine
R. Sauerbrey, F.K. Tittel
Rice University

Ablation rates measured as the depth of tissue excavation per unit time were determined in human and canine aortas subjected to radiation with UV excimer (ArF 193 nm, KrF 248 nm, XeF 351 nm) and visible lasers (continuous wave (cw) and 50 ms chopped argon ion, 478 nm – 514 nm; pulsed double frequency Nd:YAG, 532 nm). For UV and pulsed double frequency Nd:YAG lasers, ablation rates were constant and depended linearly on average laser power, but for cw argon lasers, ablation rates varied with irradiation time and were non-linearly dependent on laser power. In human aortas exposed to air, ablation rates for ArF, KrF, and XeF (average power .375 W/mm^2) were 4.8, 8.2, and 4 $\mu m/s$. Respective values in aortas superfused with saline were lower and averaged 0, 6.1, and 0.06 $\mu m/s$. At the same power density of .375 W/mm^2, double frequency Nd:YAG produced no ablation. With a threefold increase in average power (1.12 W/mm^2), ablation rates for pulsed Nd:YAG were 43 $\mu m/s$ in air and 2.5 $\mu m/s$ with saline superfusion. In human aortas, atherosclerosis without gross calcification had no influence on ablation rates. Charring and tissue disruption were observed with cw and chopped argon ions, whereas excimer and pulsed Nd:YAG lasers produced only minimal injury to surrounding tissue. We conclude that measurement of ablation rates are useful for the selection of laser wavelength and power density for use in angioplasty and that UV and pulsed visible lasers permit a better control of ablation compared to continuous wave lasers.

For further information contact:
Dr. R. Sauerbrey
Department of Electrical and Computer Engineering
Rice University
Houston, TX 77251-1892 (713) 527-8101, ext. 3638

Fourth Annual Meeting of the Houston Biomedical Engineering Program