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COLLAGEN AUTOFLUORESCENCE OF THE HUMAN CERVIX AND MENOPAUSAL STATUS

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Background and Objective: Fluorescence spectroscopy is a promising tool for diagnosis of cervical pre-cancer and cancer. This study characterizes the relationship between autofluorescence of normal cervical tissue and biographical factors including age and menopausal status, to establish a reference for interpretation of fluorescence from dysplastic tissues.
Study Design/Materials and Methods: Fluorescence images at excitation, emission wavelengths of 440, 520 nm and 365, 465 nm were obtained from epithelia and stroma of freeze-trapped cervical tissue blocks. Fluorescence images from 27 normal samples were quantitatively analyzed and average epithelial and stromal autofluorescence intensities were obtained.
Results: Data grouped according to menopausal status (pre vs. peri/post) showed statistically more significant differences than the same data grouped according to patient age (<40 years vs. >40 years). The stroma showed significantly greater average fluorescence intensity, inter-sample and intra-sample variability in the fluorescence intensity in peri- and post-menopausal women, relative to pre-menopausal women ($P < 0.04$).
Conclusion: We conclude that the task of differentiating dysplasia from normal tissue will be less affected by inter-patient and intra-patient variability in pre-menopausal patients, relative to that in peri/post-menopausal patients. These results also provide evidence for changes in collagen cross-linking with menopause. We hypothesize that exogenous hormone treatments such as hormone replacement therapy and oral contraceptives may also influence cervical autofluorescence.

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FEASIBILITY STUDY OF Er:YAG LITHOTRIPSY

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Background and Objective: Due to higher absorption, Er:YAG laser ($\lambda = 2940$ μm) can ablate calculi 2–3 times more efficiently than Ho:YAG laser ($\lambda = 2120$ μm). However, optical fibers for $\lambda > 2500$ μm are limited. We tested two optical fibers (sapphire and germanium) currently available for Er:YAG transmission at near ablation threshold energy.
Study Design/Materials and Methods: Optical fibers made of sapphire and germanium were tested. Er:YAG laser energy was coupled into both fibers by a convex lens. (1) Struvite stones were ablated in water in contact mode up to 1500 pulses. Initial output energy was set to 100 mJ and 200 mJ. Energy output was measured with an energy detector at 10–1500 pulses. (2) We compared laser-induced ablation crater sizes between the fibers for identical energy output. Each pulse was confirmed to deliver 50 mJ. The crater sizes were measured by optical coherence tomography.
Results: (1) There was a rapid and sharp decline in measured optical energy output using the germanium at 100 mJ and the sapphire at 200 mJ. Both fibers reached steady state outputs of $< 70\%$ of stated energy values. (2) Crater depths (μm, mean $\pm$ standard deviation) for sapphire and germanium fibers were 136 ± 15 vs. 131 ± 16, respectively, $p = 0.51$. Craters widths (μm) were 448 ± 28 vs. 504 ± 80, respectively, $p = 0.05$.
Conclusions: Neither sapphire nor germanium fibers are ideal. Sapphire is more durable than germanium fibers. A better laser delivery system is required at higher pulse energies. The saturation of ablation at high energy needs to be investigated to make Er:YAG lithotripsy practical.

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FINITE ELEMENT MODEL OF AN RF TISSUE HEATING SYSTEM

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Background and Objective: The Thermage® ThermaCool system consists of a capacitively coupled treatment tip, handpiece, RF generator, and cryogen delivery system. In an effort to predict the thermal treatment to different tissue types, a three-dimensional finite element model was developed to simulate the RF tissue heating system. A model was created to help develop treatment tip electrodes that would deliver energy to specific tissue depths.
Study Design/Materials and Methods: A multi-physics finite element model was created to simulate RF heating and cryogen cooling in the dermal tissue layer. The finite element program coupled electrical and thermal models to predict the electric field and consequent heating in tissue. The electrical portion of the model was compared to measurements from an in-house electric field mapping system. The thermal section of the model was compared to temperature profiles from an IR camera and thermocouple measurements. The model predictions were evaluated for a variety of monopolar electrode designs.
Results: The finite element model was verified for electrical and thermal modes. Potential and electric field predictions were compared to measurements from the field mapping system. The RF energy model prediction and experimental measurement for depth of treatment were found to be similar. Also, significant differences were not found between the thermal model predictions and experimental measurements.
Conclusion: The finite element model produced e-field and temperature predictions comparable to experimental measurements. The finite element model shows significant potential as an R&D tool to predict heating in different tissues at target depths.