1 h after heat exposure applied to the stimulating cells. ROS level in the medium was also maximum at around 46°C 1 h after heat exposure. In both cell subpopulations as well as in the medium, the ROS level returned to background level 3 h after heat exposure.

Conclusion: Our data suggest that heat-induced ROS formation plays a key role in the ATBE effect, and may be a direct mediator. As the ATBE is expected to have a role in (fractional) laser treatment, burn trauma and cancer treatment, further research is warranted related to ROS and ATBE *in vivo*.

#38

FIBER DELIVERY SYSTEM FOR ABLATION OF HARD AND SOFT TISSUES USING NEAR-INFRARED FEMTOSECOND LASER PULSES

Jinze Qiu, Joseph Neev, Tianyi Wang, David Gamez, Thomas Milner

The University of Texas at Austin, Austin, TX; FemtoSec Tech, Inc., Aliso Viejo, CA

Background: Near-infrared femtosecond lasers have recently received much attention as pulsed laser ablation causes minimal thermal and mechanical collateral damage. Despite these advantages, fiber delivered applications of femtosecond lasers are limited due to availability of few fiber waveguides and requirement of focusing lens. We demonstrate a fiber waveguide delivery system for both transmitting and focusing high energy femtosecond laser pulses.

Study: Light emitted from a femtosecond laser (Coherent Hidra 10) was coupled into a one-meter long metal coated hollow waveguide optimized for near-infrared femtosecond laser transmission. The hollow waveguide was end-capped with a 1 mm diameter sapphire hemisphere lens. Planar surface of the sapphire hemisphere was attached to the distal end of the hollow waveguide, allowing focus of femtosecond light only after the beam had passed through the curved hemispherical air-sapphire surface. The system was tested for transmission efficiency with both straight and bent (bending radius: 25 cm) hollow waveguides and applied to ablate *ex vivo* soft (skin) and solid tissues (stape and tooth). Each tissue was irradiated with multiple pulses in a raster scanning mode to create a rectangular ablation area. Images of ablation sites were recorded by optical microscopy and optical coherence tomography.

Results: Femtosecond laser pulses up to 200 uJ/pulse were transmitted by the fiber delivery system with no damage to the fiber and the hemisphere lens. The transmission efficiency of the system was above 85%. Precise ablation was observed on both soft and solid tissues. The square-shaped ablated region was over 100 um deep and 1000 um in width in tested tissues. Edges of the ablated area ended abruptly with no damage to the surrounding area.

Conclusion: The fiber delivery system can transmit and focus near-infrared femtosecond laser pulses for the purpose of tissue ablation. Precise ablation was achieved on both soft and solid tissues with sharp edges and minimal surrounding damage.

#39

DIFFUSE OPTICAL SPECTROSCOPY FOR NON-INVASIVE DIAGNOSIS OF SKIN CANCER: AN OPTIMIZED LOOKUP TABLE-BASED MODEL FOR DETERMINING TISSUE OPTICAL PROPERTIES

Narasimhan Rajaram, Brandon Nichols, Jason Reichenberg, James Tunnell, Michael Migden

The University of Texas at Austin, Austin, TX; The University of Texas Medical Branch, Austin, TX; University of Texas MD Anderson Cancer Center, Houston, TX

Background: Approximately a million new cases of non-melanoma skin cancer in the United States every year. Diffuse optical spectroscopy (DOS) may offer a means to non-invasively characterize tissue properties and avoid several unnecessary biopsies. We recently developed a look-up table (LUT)-based model for determining tissue optical properties that is accurate at short source-detector separations and in highly absorbing tissue. The LUT was developed from reflectance measurements on 24 calibration standards of known optical properties ($\mu_s' = 2.2$–$71\ cm^{-1}$; $\mu_a = 0$–$53.3\ cm^{-1}$). The objective of this study was to develop an optimized LUT based on the minimum number of standards that spanned the same range and demonstrate its use for the analysis of clinical spectra acquired from basal cell carcinoma (BCC). Such an optimized model could potentially be adapted to any probe geometry for DOS-based studies.

Study: We measured the spectrally resolved diffuse reflectance of calibration standards that contained polystyrene beads and red ink to simulate scattering and absorption, respectively. These reflectance measurements were mapped to their respective scattering [μ_s'(?)] and absorption [μ_a(?)] parameters to create a LUT of reflectance values. We validated the LUT using tissue-simulating phantoms containing polystyrene beads and hemoglobin. We also used the LUT in an *in vivo* clinical study on 14 patients with BCC to extract skin optical properties.

Results: We fabricated a LUT with only 5 calibration standards that span a physiologically relevant range of optical properties. The optimized LUT demonstrated a high level of accuracy in extracting the optical properties of tissue phantoms (error $< 5\%$). Our *in vivo* clinical analysis shows that DOS can differentiate between normal skin and BCC with a sensitivity and specificity of 92 and 91%, respectively.

Conclusion: We have developed an optimized and accurate LUT-based model based on only 5 calibration standards. We have also demonstrated the use of the model for non-invasive diagnosis of skin cancer.

#40

THIRD-DEGREE BURN TREATMENT WITH ULTRASHORT PULSE LASER DEBRIDEMENT

Moisés Santos, Anderson Zanardi, Ricardo Samad, Davi Lacerda, Telma Zorn, Denise Zezell, Nilson Vieira

IPEN—CNEN São Paulo, Brazil; IPEN—CNEN São Paulo, Brazil; HC—USP São Paulo, Brazil; ICB—USP São Paulo, Brazil; IPEN—CNEN São Paulo, BR

Background: The burn is a tissue injury resulting from thermal, electrical, chemical or radioactive trauma. The treatment prognosis for burn victim requires knowledge of extension burned surface area, depth and location of lesion and/or chronic diseases and age of the patient. Significant improvements in burn treatments have reduced the mortality and morbidity related to burn injuries. Good burn care includes cleansing, debridement and prevention of sepsis. The aim of this study is to propose a debridement method with ultrashort pulses laser.

Study: Three male adult Wistar rats were subjected to three third-degree burns on dorsum with 7 mm of diameter. At 5 day post-exposure, one lesion of each rat was irradiated with

Ti:Sapphire laser pulses, without overlapping, centered at 800 nm, with pulse width of 30 fs and intensities in range of 200 to 300 J/cm^2. The optical coherence tomography (OCT) images were obtained before and after each burn irradiation. Punch biopsy of lesion was excised at 0, 1, 2, 7 and 10 days post-irradiation and analyzed by histology and micro-ATR-FTIR spectroscopy.
Results: Histological evaluation of the skin biopsies revealed third-degree burns and micro-ATR-FTIR analysis demonstrated changing at Amides I and II bands indicating collagen degradation. At maximum intensity the OCT images indicated that skin ablation depth reached 230 μm $\pm$ 18, removing whole burn eschar until pinpoint red dots appear, causing bleeding that may promote rapid wound healing.
Conclusion: The results presented herein may represent an alternative debridement method which more *in vivo* studies being carried out. Support by: FAPESP CEPID (05/51689-2), CAPES/Procad (0349/05-4), Rede de Nanofotônica—MCT/CNPq (555170/2005-5), FAPEAM—RH-POSGRAD Program.

#41

EFFECT OF TEMPERATURE ON FLUORESCENCE: AN ANIMAL STUDY

Alex Walsh, D.B. Masters, A.J. Welch, Anita Mahadevan-Jansen

Vanderbilt University, Nashville, TN; The University of Texas, Austin, TX

Background: The fluorescence yield of a tissue sample depends on the temperature of the sample. We studied the effect of temperature on the fluorescence properties of enucleated porcine eyes, excised porcine cornea, and rat skin.
Study: We used a dual-excitation system to collect fluorescence and diffuse-reflectance spectra from the samples. A thermal camera was used to determine the temperature of the tissue at the time of fluorescence measurement. The samples were mounted in a saline bath and measurements were made as the tissue temperature was increased from -20°C to 70°C.
Results: Results indicate that temperature affects several fluorescence spectra characteristics. The peak height decreased as temperature increased and at temperatures above 60°C and the peak position shifted to lower wavelengths. Heating and cooling experiments of the cornea indicated that the process is reversible with heating to 50°C but irreversible past 60°C. The diffuse reflectance spectra indicated a change in optical properties past 60°C, but prior to the denaturation temperature for collagen at 57°C, no change in optical properties was observed.
Conclusion: Our results suggest that the fluorescence decrease as tissue temperature is increased is due to both optical property changes and a change in fluorescence properties.

#42

A NOVEL DIAGNOSTIC ULTRASOUND TOOL FOR OPTIMAL BODY CONTOURING TREATMENT

Ruthie Amir, Yossi Adanny, Avner Rosenberg, Dima Dubitsky, Boris Vaynberg

Syneron Medical, Ltd., Yokneam Illit, Israel

Background: As the demand for body contouring continues to rise, the search also continues for new technologies offering improved non-invasive therapies. The combination of bi-polar RF and optical energies delivered directly to the dermis/hypodermis via tissue manipulation has been long considered to be an efficient modality for reshaping. As the thermal modification of both connective and adipose tissues is temperature and time dependent, monitoring tissue temperature at different layers being treated is important. Particularly when a high power combined radiofrequency, optical and mechanical manipulation platform is being used, real-time regulation of tissue temperature during and following body contouring treatments becomes imperative.
Study: We developed a novel ultrasound diagnostic tool for real-time measurement of tissue temperature at different layers that is based on the variation in sound velocity during and after the treatment and its linear correlation with temperature alteration.
Results: We found significant differences in the speed of sound between different tissue layers (dermis $\sim$1750 m/s, muscle $\sim$1580 m/s and hypodermis $\sim$1460 m/s), therefore enabling accurate determination and classification of the tissue layer that is in the treatment volume. Moreover, spectral analysis allows us to evaluate changes in tissue composition in response to treatment. Quantitative data is shown for the temperature change profile at different layers during treatment and up to few hours later, thereby providing objective assessment of treatment efficacy.
Conclusion: Controlled thermal modification of both connective tissue architecture and adipose tissue volume by means of enhanced lipids turnover, neocollagenesis and angiogeneisis are temperature dependent. Therefore, the unique features of the technology; online monitoring of tissue temperature and composition and the precise control on the layer being treated may be used to optimize treatment of a wide variety of patients via the induction of the desired biological responses achieving a more aesthetically ideal body shape.

#43 Late Breaking

KTP LASER TISSUE ABLATION: DEVELOPMENT AND EXPERIMENTAL VALIDATION OF A NEW NUMERICAL MODEL

Hossam Elkhalil, Taner Akkin, John Bischof

University of Minnesota, Minneapolis, MN

Background: Increasingly KTP lasers are used to perform prostatectomy in patients with benign prostatic hypertrophy (BPH). Optimal outcomes maximize the ablated tissue volume while minimizing the coagulation within the remaining tissue. Here we present a new computational model that can quickly test and optimize surgical parameters for KTP and other laser ablation treatments.
Study: Laser ablation was modeled as an explosive water vaporization process. The energy of ablation (E_{ab}) of the tissue (rat hindlimb muscle) was calculated based on tensile strength and water content. Light propagation and energy deposition was calculated using a Monte Carlo simulation. The moving boundary phase change problem was calculated using an explicit multi-dimensional finite-difference-method (FDM). The code was validated against a 1D analytical solution. Laser ablation was conducted using a Green Light KTP laser system operating at 80 W and 532 nm (AMS, Minnetonka, MN). Rat hind limb muscle tissue was ablated via optical fiber held at a specific working distance (WD) above the tissue (0–5 mm) while scanning (SS) at 0.5 to 4 mm/s. Outcomes of ablation rate (AR) and therapeutic index (TI = ablated/coagulated tissue volumes) were measured.
Results: Experimentally a maximum AR of 7.7 ± 1.34 (SD) mm^3/s and TI of 0.51 ± 0.09 (SD) were obtained for SS of 1 mm/s. These