AMERICAN SOCIETY FOR LASER MEDICINE AND SURGERY

ABSTRACTS

BASIC SCIENCE AND TRANSLATIONAL RESEARCH

#1

SKIN REJUVENATION: A REVIEW OF CURRENT TECHNOLOGY

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Background: Many technologies have been developed for skin rejuvenation applied for promoting skin remodeling without damage to the epidermis, including ablative and non-ablative therapies. Because of the prolonged recovery period associated with ablative procedures that injure the epidermis, non-ablative skin treatments have grown increasingly popularity. This review compares the technology used in professional systems for skin rejuvenation.
Study: Studies investigating the use of ablative and non-ablative technologies for skin rejuvenation with quantitative measurements are systematically reviewed. A literature review of a minimum 35 clinical studies for each technology platforms. Technologies reviewed include radiofrequency, carbon dioxide laser, light emitted diodes, pulsed dye laser, frequency-doubled KTP 532 nm Nd:YAG laser, 980 nm diode laser, Q-switched Nd: YAG laser, 1320 nm Nd:YAG laser, 1540 nm Er:Glass laser, 1450 nm diode laser, intense pulsed light (IPL), long-pulse Nd: YAG laser, plasma, fractional selective photothermolysis, copper bromide laser. Number of patients, side effects and complications were recorded.
Results: Light-emitting diodes statistically produce the lowest efficacy with the lowest side effects. IPL statistically have the widest range of reported efficacy, explained by the broad range of device fluence, pulse duration, wavelengths. Ablative lasers statistically have the greatest efficacy with the highest recorded side effects.
Conclusion: The evolution of the non-ablative and fractionally ablative resurfacing treatments has been spurred on by the demand for smaller but acceptable improvements in various or all aspects of skin aging. Non-ablative treatments do not produce the same degree of improvement as resurfacing techniques, but they are an excellent alternative for people who want aesthetic improvement with a minimal recovery period and reduced side effects.

#2

SAFETY AND EFFICACY OF 1540 nm LASER TO STIMULATE ELASTIN AND COLLAGEN PRODUCTION *IN VIVO*

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Background: Non-ablative fractional laser (NAFXL, 1540 nm, Er:Glass) and ablative fractional CO_2 laser (AFXL, 10,600 nm) are commonly used to induce collagen and elastin remodeling in human skin. Next to non-invasive profilometry skin biopsies represent the golden standard to investigate dermal remodeling. Recently an optical biopsy has been introduced using multiphoton tomography with subcellular spatial resolution based on near infrared femtosecond laser technology (JenLab, Saarbruecken, Germany). To compare the safety, efficacy, tolerability, and ability to induce collagen and elastin remodeling by means NAFXL and AFXL over time by means of multiphoton spectroscopy (MPS).
Study: A prospective, single-center, proof of principle single case study was designed to evaluate the safety, efficacy, and tolerability of NAFXL, 1540 nm, Er:Glass laser and a AFXL CO_2 laser 10,600 nm in a series of treatments over time. Subjective assessments, clinical photographs, and optical biopsies by means of multiphoton spectroscopy (MPS) were taken to evaluate the ability to induce collagen and elastin remodeling.
Results: The new NAFXL, 1540 nm, Er:Glass laser and the traditional AFXL CO_2 laser 10,600 nm were found to be highly tolerable. The NAFXL system has been proven to be less painful and showed reduced down- and healing times. In both systems' optical biopsies revealed the safety of the procedures and healing over time was accompanies with substantial collagen and elastin induction. The MPT findings illustrate the superior capability of the AFXL procedure to induce collagen while after NAFXL more elastin seems to be present.
Conclusion: The new fractional non-ablative 1540 nm laser is as effective and safe as the traditional 10,600 nm fractional CO_2 laser. Additionally, the treatment with the 1540 nm laser was found to be less painful. Optical biopsies over time revealed for the first time the induction of collagen and elastin remodeling.

#3

OPTICAL COHERENCE TOMOGRAPHY FOR *IN VIVO* IMAGING OF ALOPECIA

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Background: Androgenetic alopecia (AGA) is the most common type of alopecia in men and women, characterized by progressive hair follicle miniaturization primarily of the frontotemporal and vertex scalp. There is a need to better understand the etiology of AGA and obtain effective treatments. Non-invasive imaging technologies can advance the characterization of hair loss processes. Optical Coherence Tomography (OCT) is non-invasive and non-ionizing tomographic imaging technique that produces high resolution three-dimensional tissue cross-sectional images. In this study, we demonstrate the capability of OCT to differentiate and quantify hair loss in patients with androgenetic alopecia.
Study: This study was approved by the institutional review board at University of California, Irvine. We utilized a portable Optical Coherence Tomography system and a hand-held 3D scanning probe to analyze scalp hair in human subjects. The OCT system used comprised of a 1310 nm center wavelength super luminescent diode in fiber based Michelson interferometer setup with a spectrometer based detection. The probe realized a rapid 2D raster scan pattern by employing two galvanic scanning mirrors and an objective lens to focus the scan pattern onto the scalp. Patients with the diagnosis of androgenetic alopecia and healthy subjects were recruited from the dermatology clinic. Three dimensional OCT scans were obtained from distinct and corresponding scalp areas in patients. The OCT images were then analyzed using ImageJ to quantify hair follicle and hair shaft measurements.
Results: OCT scans allowed for visualization of a 4 mm field of view and provided accurate assessment of the number and character of hairs per field. In patients with AGA, we detected a decrease in hair diameters with an increased hair follicle – hair shaft diameter ratio. In addition, even in areas of AGA that clinically corresponded to complete hair loss, we were still able to detect miniaturized hairs.
Conclusion: While histological analysis is the gold standard for diagnosing and monitoring alopecia, OCT demonstrated to be a promising and invaluable tool to non-invasively and rapidly assess and quantify hair loss. We intend to use OCT to study changes in hair density, hair follicle and fiber diameter in different hair loss diseases.

#4

COMPARISON STUDY OF SKIN PROPERTIES CALCULATED FROM DIFFUSE REFLECTANCE SPECTROSCOPY OF NORMAL AND DISEASED SKIN

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Background: The diffuse reflectance model of skin is widely used to solve the inverse problem of calculating skin properties, such as oxygenation and blood volume, from spectrometric measurements. It offers convenience, speed and non-invasiveness, making it attractive to study and monitor skin physiology under different circumstances. Diffuse reflectance is measured experimentally, and the concentration of the different absorbers is adjusted in the model until the calculated spectrum fits the experimental data. In this work, we investigated if the technique is adequate to estimate the properties of skin affected with inflammatory disease by comparing its calculated parameters with those of healthy control sites.
Study: A visible light fiber spectrometer equipped with a reflectance probe was used to collect the diffuse reflectance of the affected skin of several patients suffering from different inflammatory conditions. The corresponding site on the opposite side of the body was also measured as a healthy reference. The measurements were taken continuously (every 40 ms) and under three different conditions: undisturbed skin, applying pressure on skin, and releasing pressure from skin, each for 30 seconds. The inverse problem was solved from the diffuse reflectance using MATLAB to find the oxygenation, blood volume and melanin concentration of the skin.
Results: The parameters calculated from the healthy sites were consistent with the literature (40–70% oxygenation, 20–40% blood volume, 1–20% melanin concentration). However, the melanin results for the affected sites are very different from the healthy sites, despite of both sides being similarly pigmented. Furthermore, the model fits the data poorly on the affected sites.
Conclusion: According to our results, the calculation of skin parameters, especially melanin concentration, from the diffuse reflectance model is limited to normal skin. A different model may be needed for the calculation of the characteristics of skin affected by inflammatory diseases.

#5

TRANSCUTANEOUS LASER LYPOLISIS WITH 1,064 nm Nd:YAG: EXPERIMENTAL AND NUMERICAL EVALUATION

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Background: The aim of this study was to develop experimental and numerical models for a better understanding of transcutaneous laser lypolisis.
Study: A 4 cm thick porcine fat sample was irradiated over $10 \times 10\,cm^2$ area for 2 minutes by a 1,064 nm Nd:YAG laser using $1.2\,W/cm^2$ irradiance. Two irradiation scenarios were considered: without and with forced air cooling. Following the irradiation, the sample was left to cool down by natural convection. During the irradiation period, the surface temperature of the sample was continuously recorded by an infrared camera. Additionally, temperature depth profiles during the cooling period were also obtained. A one-dimensional model of the laser irradiation procedure was developed, including light and heat transport. The model was used to determine absorption coefficient of the fat and heat convection coefficients from the measured data, and to evaluate the treatment by varying the parameters.
Results: The measured temperature depth profiles revealed a maximum temperature (45.5 °C) at the surface for a non-cooled sample, and a surface temperature of 38 °C with a subsurface temperature peak of 42.6 °C at the depth of 5.7 mm for a cooled sample. This agreed well with the measured surface temperature increase following the irradiation as a result of heat diffusion from the heated deeper fat layers. The numerical model is used to fit the measured data. A good agreement between the model and the measurements is obtained. By varying the treatment parameters, basic empirical relations connecting treatment, PTR signal, and temperature depth profile parameters were found.

Conclusion: This study results provide a better understanding of transcutaneous laser lipolysis. The developed numerical model can be extended to transcutaneous laser lipolysis of human subjects.

#6

FRACTIONAL LASER-ASSISTED TOPICAL DELIVERY LEADS TO ENHANCED, ACCELERATED AND DEEPER CUTANEOUS 5-FLUOROURACIL (5-FU) UPTAKE

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Background: Topical 5-Fluorouracil (5-FU) exhibits suboptimal efficacy for thick forms of nonmelanoma skin cancer, attributed to insufficient intracutaneous penetration. This study investigates the impact of ablative fractional laser (AFXL) at different laser-channel depths on cutaneous 5-FU pharmacokinetics and biodistribution.

Study: *In vitro* porcine skin underwent AFXL-exposure using a fractional 10,600 nm CO_2 laser, generating microscopic ablation zones (MAZ) reaching the dermo-epidermal junction (MAZ-ED), superficial (MAZ-DS), or mid-dermis (MAZ-DM). 5-FU diffusion in AFXL exposed ($n = 46$) and control ($n = 9$) skin was measured in Franz diffusion cells at 4 and 24 hours. HPLC quantified 5-FU in full-thickness skin, specific skin depths of 100 μm–1500 μm, and transcutaneous receiver compartments. Qualitative matrix-assisted laser-desorption/ionization mass-spectrometry imaging (MALDI-MSI) visualized 5-FU in selected samples.

Results: Overall, AFXL led to enhanced and accelerated 5-FU uptake compared to unexposed controls, with increased accumulation in deep skin layers ($p < 0.01$). Median total 5-FU uptake in unexposed skin was 0.096 mg/cm^3 at 24 hours, corresponding to 0.19% of applied 5% 5-FU concentration. In contrast, AFXL delivered 2.294 mg/cm^3 (MAZ-ED; 4.59% uptake), 4.124 mg/cm^3 (MAZ-DS; 8.25% uptake) and 4.707 mg/cm^3 (MAZ-DM; 9.41% uptake), representing a 24-, 43-, and 49-fold enhancement respectively ($p = 0.002$, 24 hours). Indicating accelerated uptake, intracutaneous 5-FU delivery at 4 hours was at least 10-fold that of unexposed 24-hour controls (control *vs* AFXL samples $p = 0.002$). Impact of AFXL was most pronounced in deep skin layers; after 24 hours, MAZ-DM provided up to 82-fold increased deposition at 1500 μm versus unexposed skin (0.11% *vs* 9.03% uptake) (control *vs* MAZ-DM $p = 0.002$). Uptake increased with laser-channel depth, and deeper MAZs enhanced delivery throughout the skin (MAZ-ED *vs* MAZ-DM $p < 0.01$). Qualitative MALDI-MSI confirmed enhanced, accelerated, deeper and more uniform 5-FU distribution after AFXL compared to unexposed controls.

Conclusion: AFXL offers laser channel depth-dependent, enhanced and accelerated 5-FU uptake, with most pronounced effect in deep skin layers.

#7

MOLECULAR EFFECTS OF NON-SEQUENTIAL FRACTIONAL ULTRAPULSED CO_2 LASER IRRADIATION ON HUMAN THREE-DIMENSIONAL *IN VITRO* SKIN MODELS

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Background: Molecular effects of laser treatments on human skin cells – especially epidermal keratinocytes and dermal fibroblasts – are not completely understood. A novel *in vitro* human full-thickness 3D skin model for the study of effects of laser irradiation on human skin has been recently developed and allows standardized investigation of time-dependent molecular changes *ex vivo*. Utilizing this 3D model system we studied morphological and molecular changes caused by non-sequential fractional ultrapulsed ablative CO_2 laser treatment on human skin cells at various time points and applying different laser fluence.

Study: A fractional non-sequential ultrapulsed CO_2 laser was used to irradiate organotypic 3D models. Laser treatments were performed at two different settings using pulses with a laser fluence of 80 mJ or 100 mJ respectively. Specimens were harvested at specified time points and qRT–PCR and microarray studies were performed. Frozen sections were examined histologically.

Results: Fractional CO_2 laser treatment on skin models consisting of normal human epidermal keratinocytes and dermal fibroblasts led to a marked increase in procollagen content in an energy dose-dependent manner (COL3A1, COL4A3, COL5A1, COL15A1). Also, expression of chemokines (CXCL6, CXCL12, CCL8), IFNα5, leptin, fibroblast growth factor (FGF7), cell migration inducing and hyaluronan binding protein (CEMIP) and cytokines such as IL-7 and its inductors (PTX3) were markedly upregulated. On the other hand, expression of epidermal differentiation markers such as keratin-associated protein 4 (KRT4), loricrin, antimicrobial peptides (S100A7) as well as proteins of matrix metalloproteinases (MMP3, MMP12, MMP28) and IL1α was diminished. Laser treatment resulted in morphological changes and effects on diverse gene regulations. Histologically, all treatment settings resulted in a complete regeneration of the epidermis five days after irradiation.

Conclusion: Fractional non-sequential ultrapulsed CO_2 laser treatment could markedly increase collagen synthesis and inhibit collagen degradation. Treatment resulted in histological alterations and shifts in the expression of various genes related to epidermal differentiation, inflammation and dermal remodeling even in the absence of inflammatory mononuclear cells such as monocytes, macrophages or lymphocytes. A standardized *in vitro* 3D human skin model proved to be a reliable, accurate and reproducible tool to explore the effects of various laser setting both on skin morphology and gene expression during wound healing. It provides novel data on gene expression and microscopic architecture of the exposed skin. These may additionally enhance our understanding in time-dependent molecular changes after CO_2 laser treatment.

#8

THE COAGULATION ZONE ACTS AS A RESERVOIR FOR SODIUM FLUORESCEIN

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Background: Ablative fractional laser (AFXL) is an acknowledged technique for increased uptake of topical agents in skin. Laser scanning confocal microscopy (LSCM) enables non-invasive imaging of individual microablation zones (MAZs) and fluorescence of sodium fluorescein (NaF), a small hydrophilic test molecule (370 MW, log P −1.52), which may mimic uptake, bio-distribution and kinetics of small hydrophilic drugs. Thus, the aim was to investigate uptake, bio-distribution and kinetics of NaF in AFXL-exposed skin by LSCM.
Study: Excised human abdominal skin samples (n = 6) were exposed to AFXL at 15 mJ, density 2%, 120 μm beam diameter, 10,600 nm. NaF gel (10 μl, 1000 μg/ml) was applied on AFXL-exposed and intact skin. MAZ dimensions and resultant fluorescence intensities were assessed in the coagulation zone (coag. zone) and surrounding skin in various skin compartments by LSCM at 15 min, 60 min and 4 hours after NaF application.
Results: AFXL-generated coag. zone thickness and channel width remained unchanged over time ($p>0.05$). High, similar fluorescence intensities were detected within the coag. zone at 15 min, 60 min and 4 hours after NaF application (15 min: 75 AU, 60 min: 67 AU, 4h: 72 AU, $p>0.05$). In surrounding skin fluorescence intensities were lower than in the coag. zone itself at all time points ($p<0.05$), but increased significantly at 4 hours (15 min: 20 AU, 60 min: 20 AU, 4h: 39 AU, $p<0.03$).
Conclusion: A small hydrophilic test molecule, NaF is quickly taken up by the AFXL-induced coag. zone, which serves as a reservoir for subsequent diffusion into surrounding skin.

#9

HYPERTROPHIC BURN SCARS MODULATION THROUGH LASER ASSISTED DELIVERY OF ADIPOSE DERIVED STEM CELLS *vs* BONE-MARROW MESENCHYMAL STEM CELLS WITH THE CO_2 *vs* Er: YAG LASER

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Background: Burn scars represent a significant cause of morbidity in the injured warrior and civilian. Despite advances in the acute management of burn injury, scarring with subsequent contractures remains a major problem. Here we studied adipose-derived (AD) and bone-marrow derived (BM) mesenchymal stem cells (MSCs) using laser assisted delivery systems (LADs) with both CO_2 *vs* Er:YAG laser for hypertrophic burn scars.
Study: An *in vivo* Red Duroc model was used to evaluate the effect of AFL on hypertrophic third degree burn scars. Scars received treatment with either CO_2 or Er:YAG ablative fractional lasers at various settings with or without AD-SCs or BM-MSCs (allogeneic or autologous). Biopsy samples were taken from burn scars at various days post treatment for histologic evaluation, protein expression and cell culture analysis.
Results: Epidermal and superficial dermal remodeling was noted to varying degrees in specimens treated with BM-MSCs and ADSCs by both lasers. Further Western blot, cell culture and Quantitative PCR analysis along with additional studies performed on uninjured skin have indicated that CO_2 laser can have a more tissue thermal effect than Er:YAG laser. We also found that cells derived from autologous stem cell treated burns have a more immature morphology and collagen which is an indicative of dermal remodeling may be more persistent when burns are treated with autologous BM-MSCs. Immunohistochemistry analysis revealed reduced αSMA expressions in burn scars treated with laser/stem cells suggesting a lower myoblast transformation.
Conclusion: These findings indicate LAD of autologous SCs may benefit treating hypertrophic burn scars. They also suggest that repeat administration is likely to be beneficial, favoring the use of autologous cells. This study supports that hypertrophic third degree burn scars can be modified by fractional laser and SCs treatment with favorable clinical, histological and molecular changes.

#10

LIGHT-ACTIVATED ERYTHROCYTE-DERIVED NANOPARTICLES FOR COMBINED PHOTOTHERMAL AND CHEMOTHERAPEUTIC EFFECTS

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Background: Erythrocytes provide a promising biocompatible platform for the *in vivo* delivery of various agents over prolonged times. We have engineered an erythrocyte-derived nanoparticle (NP) system that incorporates indocyanine green (ICG) and doxorubicin (DOX) as respective optical and pharmaceutical agents. Once activated by near infrared (NIR) excitation, a photothermal response of the nanoparticle induces the drug release into surrounding environment. Herein, we study the potential of these nanoparticles for enhanced therapeutic effects by combining phototherapy and chemotherapy.
Study: Erythrocytes were isolated from whole blood and depleted of hemoglobin by hypotonic treatment. The resulting erythrocyte ghosts (EGs) were mechanically extruded to form nano-EGs. ICG and DOX were then loaded hypotonically into the nano-EGs. To access for successful co-localization and cellular uptake, nanoparticles were incubated with SKOV3 ovarian cancer cells, and imaged by fluorescence microscopy. To investigate the capabilities of combined photothermal-chemotherapeutic response, SKOV3 cells were incubated with the nanoparticles, and subjected to 808 nm laser irradiation ($1.5\ W/cm^2$, 5 mins) followed by cell viability assessment.
Results: Microscopic fluorescence imaging demonstrated the successful co-delivery of DOX and ICG by NPs into SKOV3 cells. Cell viability assays revealed that chemotherapy (DOX) alone caused negligible cell death while phototherapy (ICG) alone elicited a slight increase in dead cells. However, when NPs co-loaded with both ICG and DOX were used, the combined photothermal and chemotherapeutic effects induced a major increase in cell death.
Conclusion: This study demonstrates successful co-loading of erythrocyte-derived NPs with ICG and DOX. Further, while chemotherapy and phototherapy alone cause only minor cell death, ICG and DOX co-loaded NPs induce a drastic increase in cell death. ICG and DOX co-loaded erythrocyte-derived NPs can potentially serve as a potent agent in a therapeutic strategy that combines photothermal and chemotherapeutic effects.

#12

PULSED AND CW LASER IRRADIATION EFFECTS OF TiN NANOPARTICLES ON CANCER CELLS *IN VITRO*

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Background: Photothermal Therapy (PTT) is one the most promising techniques under development in recent years for destroying cancer cells. Titanium Nitride (TiN) nanoparticles are well-suited for PTT applications, as they have low toxicity, are chemically stable at high temperatures and have a broad absorption peak spectrally positioned in the biological transparency window. In this study, we investigate the effects of pulsed and continuous wave (cw) laser irradiation of prostate cancer (PC3) cells incubated with TiN nanoparticles.

Study: TiN nanoparticles were synthesized from Titanium tetrachloride (TiCl4) and ammonia (NH3) in a reactor, using Argon (70 sccm) as a carrier gas. TiN nanoparticles were collected downstream from the reactor in a stainless-steel mesh filter. PTT was conducted by 40 second laser irradiation treatments of PC3 cells incubated with TiN nanoparticles (3.3 mg/ml) with cw, pulsed, or both lasers simultaneously. Efficacy of the PTT is evaluated through cell viability tests.

Results: ~30 nm diameter TiN nanoparticles were synthesized and a spectrophotometric analysis shows that the absorption peak is located around 800 nm, which is in the biological transparency window. Irradiating the PC3-TiN nanoparticles solution with the cw laser at 810 nm and 3 W for ~40 seconds causes the temperature to increase from 37.5 to ~45.5 °C, which damages some cancer cells *via* the heat shock response within the cells. This resulted in a decrease in the viability of treated cultures compared to controls. Addition of simultaneous pulsed laser treatment may further increased the PTT efficacy.

Conclusion: These experiments show that is possible to cause hyperthermia by irradiating the PC3-TiN solution with a cw laser, and that in addition to causing apoptosis due to heat shock, that the sensitivity of the cells to the mechanical stress of pulsed laser-induced shockwaves it may also be increased.

#13

ENCAPSULATION OF INDOCYANINE GREEN (ICG) INTO ERYTHROCYTE-DERIVED PARTICLES EXTENDS THE HALF-LIFE OF ICG IN MICE CIRCULATION

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Background: Intravenous injection of ICG can potentially improve the treatment of port wine stain lesions using near infrared (NIR) lasers, which penetrate deeper into the skin, and are less absorbed by epidermal melanin. Unfortunately, the half-life of ICG within circulation is on the order of only a few minutes, which limits the ability to treat lesions of medium to large area. Our objective was to determine if encapsulation of ICG into particles derived from erythrocytes could prolong the availability of ICG within the circulation.

Study: Ten mice with dorsal window chambers were used for this study. The blood vessels in the window can be directly observed through an inverted microscope. Two methods were used to measure the half-life of ICG: 1) fluorescence emission in response to photo-excitation at 785 nm wavelength from a blood vessel; and 2) absorbance measurements over the 750-800 nm spectral band. Under general anesthesia, ICG or erythrocyte-encapsulated ICG (E-ICG) with similar absorbance values and injection volumes were administered into the mice's retro-orbital sinus. The diameter of E-ICGs was $\approx 4\,\mu$m. During and within one hour after the injection, images of the window were recorded with an EMCCD camera, and processed with ImageJ.

Results: The half-life values of ICG and E-ICG as determined by the fluorescence measurement method were 7 and 24 minutes, respectively. Those values were ≈ 9 and 19 minutes for ICG and E-ICG, respectively, as determined by the absorbance method.

Conclusion: The half-life of ICG in the mice circulation can be significantly extended when encapsulated into erythrocyte-derived particles. Use of E-ICG in conjunction with NIR laser irradiation may potentially provide an effective approach to treat port wine stains.

#14

HANDHELD LASER SPECKLE IMAGING FOR POINT-OF-CARE BLOOD-FLOW MEASUREMENTS

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Background: Laser Speckle Imaging (LSI) has shown its potential to assist clinicians in treating a variety of conditions by provide real-time blood-flow maps. These conditions include burn wound injuries, Port-Wine Stains, and other micro-vascular diseases. However, the form factor of current LSI devices is not easily maneuverable in a clinical setting, which limits its ability to provide point-of-care measurements. A handheld LSI device could be the solution.

Study: We developed a handheld LSI device that utilizes a Microsoft Surface tablet, a CCD camera, and near-infrared laser light source. The tablet processes the data acquired by the CCD and displays real-time blood flow maps. During data collection, a fiducial marker is placed onto the sample and is used as a selection criterion to discard images with motion artifact above a predetermined threshold. The fiducial marker is also used for image alignment in batch processing the data set to provide average blood-flow maps. *In-vitro* flow phantom and *in-vivo* pig burn experiments were performed to compare the blood-flow values acquired by the LSI device in a handheld versus mounted configuration.

Results: After the fiducial marker was used to remove the images below the predetermined threshold and align remaining images, we were able to show that the handheld and mounted data were similar in value. We observed the same trends in blood-flow values in both the *in-vitro* flow phantom experiments and the *in-vivo* pig burn experiments with increasing flow rates and increasing burn times, respectively.

Conclusion: Handheld LSI is a viable option for providing blood flow maps in a clinical setting if motion artifact is addressed properly, and it may provide clinicians with the ability to obtain point-of-care blood-flow measurements.

#15

MOBILE PHONE-BASED UV FLUORESCENCE MICROSCOPY FOR THE IDENTIFICATION OF DERMATOPHYTES

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Background: Skin and nail conditions such as "athlete's foot", "ringworm" and onychomycosis result from infection by fungi known as dermatophytes. It can be challenging for clinicians to differentiate dermatophytic infections from other common dermatologic conditions by visual inspection alone. To improve diagnostic accuracy, standard dermatologic practice involves the microscopic examination of skin scraping (KOH preparation) to visualize fungal structures. Fluorescence microscopy after Calcofluor white staining is an inexpensive alternative method to standard KOH prep that offers improved diagnostic accuracy relative to traditional KOH preparation. The primary goal of this project was to design a compact, lightweight, low-cost, mobile, phone-based fluorescence microscope to aid in the diagnosis of skin disease, and validate its use with fungal samples.
Study: Optimal excitation wavelengths for excitation of calcofluor fluorescence were determined by spectrofluorimetry. An ultraviolet LED, lens, power supply, and slide-holding cassette were integrated into a 3D- printed housing for use with the imaging software and hardware of an iPhone. Calcofluor white, an inexpensive stain that fluoresces when bound to the fungal cell wall, was applied to cultured samples of Trichophyton rubrum and visualized using the system.
Results: Calcofluor staining and UV excitation produced fluorescence that could be imaged by our smartphone system. Images obtained with both our prototype and a high end, commercially available fluorescence microscope were found to be of comparable quality for identification of fungal structures after Calcofluor staining.
Conclusion: We have designed and built an iPhone-based fluorescence microscope for dermatophyte detection, and demonstrated its use in successful detection of the most common dermatophyte, Trichophyton rubrum.

#16

A THERMAL CONTRAST AMPLIFICATION READER YIELDING 8-FOLD ANALYTICAL IMPROVEMENT FOR DISEASE DETECTION WITH LATERAL FLOW ASSAYS

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Background: There is an increasing need for highly sensitive and quantitative diagnostics at the point-of-care. The lateral flow immunoassay (LFA) is one of the most widely used point-of-care diagnostic tests. Most LFAs use antibody-labelled gold nanoparticles (GNP) as a contrast agent to provide a red color for positivity on the test line within 15 min. However, LFAs suffer from low sensitivity and lack of quantification. To overcome these limitations, thermal contrast amplification (TCA) is a new method that is based on the laser excitation of gold nanoparticles (GNP), the most commonly used visual signature, to evoke a thermal signature. To facilitate the clinical translation of the TCA technology, we present the development of a TCA reader, a platform technology that significantly improves the limit of detection and provides quantification of disease antigens in LFAs. This TCA reader provides enhanced sensitivity over visual detection by human eye or a colorimetric reader.
Study: The development and validation of a 20 lb desktop TCA reader device is described. For the instrumentation, the laser (515-532 nm), infrared camera, other components of the reader and their integration into a working reader are systematically characterized. We also developed the data acquisition and reduction algorithm to allow a fully automatic control system. Then a validation study of 3 commercial LFAs (influenza, malaria, and Clostridium difficile) was performed. The positive control samples were 1:2 serially diluted and applied to LFAs. The results are evaluated by visual reading and TCA reader.
Results: The TCA reader is fully automatic and able to work in other lab/clinical settings. It demonstrated an 8-fold enhanced analytical sensitivity and quantification among LFAs for three important infectious diseases. The Mayo Clinic was able to reproduce the results in malaria with the reader externally.
Conclusion: The development of laser-GNP excitation based TCA reader enables simple, highly sensitive quantification of LFAs at the point-of-care.

#17

BUERGER'S EXERCISE EFFECTS ON IMPROVEMENT OF DORSAL FOOT SKIN CIRCULATION ASSESSED BY WIRELESS NEAR-INFRARED SPECTROSCOPE IN PATIENTS WITH VASCULPATHIC DIABETES FOOT ULCERS: A COHORT PROSPECTIVE STUDY

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Background: Peripheral circulation improvement is crucial for the care of vasculopathic diabetic foot ulcer (DFU). The technique of near infrared spectroscopy (NIRS) is planned to investigate the Buerger's exercise effects on dorsal foot skin circulation by the absorption difference between oxyhemoglobin ($Hb0^2$) and deoxy-hemoglobin (HbR).
Study: The patients with vasculopathic DFU who could persistent repeat the Buerger's exercise three times a day at home at least 8 weeks were enrolled. They were divided into two sub-groups. Group A1 was vasculopathic DFU without percutaneous transluminal angioplasty (PTA) procedure, and Group A2 was vasculopathic DFU with previous PTA respectively. We applied the wireless NIRS on patients' dorsal foot to detect the signal penetrating the tissues so as to assess the peripheral circulation in the following-up clinics check. The patients' wound condition, following up time, and the concentration of Hbo2 and total hemoglobulin (HbT) before and after exercise rehabilitation program were documented and analyzed.

Results: From May 2015 to February 2016, there were 14 patients with average age of 70.2 ± 11.2 (Gr. A) enrolled in this study, including 8 in Gr. A1, and 6 in Gr. A2. The signals for HbO2 and HbT were significantly increase after exercise rehabilitation program training in Gr.A ($p = 0.024$ in Hbo2, $p = 0.02$ in HbT, $n = 15$), and in Gr. A2 ($p = 0.021$ in $Hb0^2$, $p = 0.028$ in HbT, $n = 6$). However, the patients in Gr A1 were improved but showed borderline significantly after exercise program ($p = 0.055$ in $Hb0^2$, $p = 0.058$ in HbT, $n = 8$). The $Hb0^2$ and HbT improvement was higher in Gr A1 than Gr A2 (30.2% *vs* 12.4 % in HbT, $p = 0.171$, 29.1% *vs* 9.7% in $Hb0^2$, $p = 0.143$) after exercise program. The majority of the ulcers was either completely healed ($11/14 = 78.57\%$) or still improving ($3/14 = 21.43\%$).
Conclusion: The Buerger's exercise could increase the peripheral circulation in patients with vasculopathic DFU. The wireless apparatus is a novel and efficient tool for rehabilitation program monitoring and promotion.

#18

SMARTPHONE IMAGING OF SUBCUTANEOUS VEINS
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Background: The identification of veins by medical personnel is a critical skill that is necessary to draw blood or administer intravenous fluids and medications. Clinical observation of veins is accomplished by palpation and visual inspection; however, it may be challenging to identify veins in patients with high BMI, dark skin pigmentation, or small vein caliber (such as pediatric or hypovolemic patients). Because a normal consumer camera can act as a multispectral imaging apparatus, operating with 3 broadband detectors, we hypothesized that a standard smartphone camera might be employed for video-rate enhanced visualization of veins in human skin.
Study: Video and images of forearm veins were acquired using the rear-facing iSight camera from an iPhone 6, with a fixed aperture of f/2.2, and Sony Exmor RS back-illuminated CMOS image sensor with pixel generation of 1.5 microns. A custom program was written for the iOS system that performs a scaled matrix subtraction of different spectral channels and displays results as a grayscale image.
Results: A scaled subtraction of green channel pixel values from red channel pixel values enabled greatly improved identification of subcutaneous veins. Wavelengths of light at which the green detector is most sensitive (520-580 nm) correspond to local absorption maxima of both oxyhemoglobin (542 nm and 576 nm) and deoxyhemoglobin (556 nm); consequently, the algorithm obtains images of light transport weighted toward deeper skin layers. Red light was more strongly absorbed by deoxyhemoglobin than oxyhemoglobin by a factor of 10, enhancing contrast of veins in surrounding tissue.
Conclusion: We identified and developed a simple algorithm by which a standard smartphone camera can be employed for video-rate visualization of veins in human skin. A custom program was written for the iOS system for deployment on an iPhone and is available for free download from the App Store (Apple Inc.) under the name VeinSeek.

#19

LABEL-FREE ANALYSIS OF DYNAMIC METABOLIC CHANGES USING FLIM
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Background: The evaluation of complex metabolic changes during treatment are often not feasible using traditional methods due to their destructive behavior and missing visual information. Two-photon excited fluorescence of intrinsic fluorophores such as nicotinamide adenine dinucleotide (NADH) and flavin adenine dinucleotide (FAD) facilitate a label-free and non-destructive evaluation of metabolic activities. This study investigates pharmacological, temperature and light induced metabolic changes of adipocytes and adipose tissue and the potential of fluorescence lifetime imaging microscopy (FLIM) to obtain highly sensitive visual information with subcellular resolution.
Study: Two-photon FLIM experiments were carried out on murine adipocytes using a 60x water objective (NA 1.2). The excitation wavelength for NADH and FAD was set to 755 nm and 860 nm respectively. Two different temperatures (25 °C and 37 °C), low-level laser light therapy (LLLT) and pharmacological reagents such as Oligomycin, 2-DG, FCCP, Rotenone, and Glucose, which interact with different parts of the metabolic pathway, were used to induce changes of the cell metabolism.
Results: We established several ratios and phasor plots between four distinct lifetimes of NADH after treatment and compared the results to oxygen consumption rate and extracellular acidification rate. The NADH and FAD fluorescence were used to mask several compartments of the cell and their lifetime distribution showed the shortest lifetimes in the nucleus and mitochondria, longer lifetimes in the cytosol, and lipid droplets. As cells were treated significant changes in amplitude and fluorescence lifetime occurred in all compartments, suggesting that higher metabolic demand results in fluorescence lifetime changes throughout the cell.
Conclusion: We showed that different temperatures, LLLT, and pharmacological reagents change the metabolic activity of adipocytes and that FLIM has the potential to become a powerful tool to evaluate metabolic activity of adipocytes with subcellular resolution.

#20

pHLIP FLUORESCENCE IMAGING FOR DELINEATING BREAST CANCER
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Background: Breast cancer is the most prevalent non-skin-related cancer among women in the United States. Without intraoperative margin control, the re-excision rate is up to 60%. Recently, a molecular marker, pH low insertion peptide (pHLIP), has been developed for cancer imaging. The objective of this study was to investigate the feasibility of using fluorescent pHLIP for delineating breast cancer.

Study: Excess breast tissue samples were obtained from UMass Medical School after surgery. pHLIP was conjugated with Alexa532 for fluorescence imaging. Fresh samples were stained with 5 μM pHLIP-Alexa532 at ambient temperature, and then imaged with wide-field and confocal systems. Reflectance and fluorescence images of pHLIP were acquired and compared to histology.
Results: pHLIP-Alexa532 wide-field imaging successfully identifies breast cancer. Imaging results correlate well with histology. High-resolution images show that pHLIP-Alexa532 stains the cytoplasm of cancer cells.
Conclusion: pHLIP fluorescence imaging has potential for intraoperative delineation of breast cancer.

#21

OPTICAL COHERENCE TOMOGRAPHY IMAGE-GUIDED SMART LASER KNIFE

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Background: In review, current state-of-the-art techniques in tumor resection (like NICO Myriad, Medtronic StealthStation, Zeiss OPMI) employ techniques like iMRI, iCT, fluoroscopy and preoperative CT/MRI to provide information on the location of the tumor and a navigation path to the location. Other current state-of-the-art techniques, the surgeries are being done under intra-operative ultrasound with prior knowledge from MRI and CT. There is a limitation of the resolution achievable using these techniques and also, preoperative imaging only provides information of the location and the pathway to the tumor. For cases like iMRI, the whole surgical space needs to be changed (plastic surgical tools) in fully utilize the accuracy of MRI technique which is still limited in millimeter resolution. Although fluorescence imaging offers much higher micron/sub-micron resolution the imaging is mostly on the surface and information about the sub-surface delicate structures remains inaccessible. Pathologist recommendation on resected tissues remains to be the gold standard in these techniques even today resulting in long surgery durations, involving the patient to be under anesthesia during that period. Considering these limitations, Optical Coherence Tomography (OCT) occupies an effective surgical spot in terms of resolution and imaging depth. Plaque classification using OCT offers an example of how effective the procedure has been in providing less than 10 micrometer resolution in comparison to IVUS (intravascular *Ultra* Sound) of 100s of micrometers. Thus, employing a surgical tool guided by the imaging technique of OCT offers effective resection of tissue or tumors in neurological surgeries. Neurological cancer surgeries require such specialized tools that enhance imaging for precise cutting and removal of tissue without damage to adjacent neurologic structures.
Study: The novel combination of high-resolution fast Optical Coherence Tomography (OCT) alongside short pulsed nanosecond thulium (Tm) lasers offers stark advantages over conventional surgical lasers utilizing the superior beam quality, high volumetric tissue removal rates of thulium lasers with minimal residual thermal footprint in the tissue, and avoiding damage to delicate sub-surface structures (e.g., nerves and microvessels); which has not been showcased before. A bench-top system is constructed, using a 15 W 1940 nm nanosecond pulsed Tm fiber laser (500 μJ pulse energy, 100 ns pulse duration, 30 kHz repetition rate) for removing tissue and a swept source laser (1310 ± 70 nm, 100 kHz sweep rate) for OCT imaging, forming a combined Tm/OCT system − a smart laser knife. The OCT image-guidance informs the Tm laser for cutting/removal of targeted tissue structures.
Results: Tissue phantoms were constructed to demonstrate surgical incision with blood vessel avoidance on the surface where 2 mm wide 600 μm deep cuts are executed around the vessel using OCT to guide the cutting procedure. Cutting up to delicate subsurface blood vessels (2 mm deep) is demonstrated while avoiding damage to vessel walls. A tissue removal rate of 5 mm3/sec is obtained from the bench-top system. We constructed a blow-off model to characterize Tm cut depths taking into account the absorption coefficients and beam delivery systems to compute Arrhenius damage integrals. The model is used to compare predicted tissue removal rate and residual thermal injury with experimental values in response to Tm laser-tissue modification.
Conclusion: In this work we describe a system that combines optical coherence tomography (OCT) and laser tissue modification with thulium (Tm) laser. A modeling of the process is carried out using COMSOL and Zemax simulation tools. The simulation results of the cutting depth show good relation to the experimental Tm etching for tissues. The OCT image guided smart laser knife demonstrates the use of tomographic imaging to differentiate between types of tissues can help prevent bleeding (by avoiding vessels/isolating them), and still offer high speed micro-precision cutting of up to 5mm3/sec

#22

MULTIMODALITY OPTICAL CHARACTERIZATION OF IMPAIRED WOUND HEALING IN A PRINCIPAL MODEL OF DIABETES MELLITUS

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Background: Diabetes Mellitus (DM) is becoming an epidemic throughout the world, so far affecting almost 194 million people. This number is expected to increase to 344 million by the year 2030. Major complications result from the accumulation of Advanced Glycation End Products (AGEs), leading to delayed wound healing and persisting skin ulcers. The high mortality rate and lack of ability to treat these wounds and ulcers raise an urgent necessity for early detection of non-healing wounds. This allows physicians the ability to provide treatment for these wounds at an early stage. In this study, using Streptozotocin (STZ) injected rats; we evaluate and find non-invasive methods for the detection of biomarkers for delayed wound healing.
Study: To this end, we compared the wound healing process of STZ induced diabetic rats with a control population using Spatial Frequency Domain Imaging (SFDI), Laser Spackle Imaging (LSI), and Multiphoton Microscopy (MPM). Using SFDI, oxyhemoglobin, deoxyhemoglobin, and water content was evaluated in the area next to the wound and within the wound itself. The changes in blood flow were assessed using LSI, and the accumulation of AGEs was measured using MPM.

Results: Our results indicate that only 2 weeks after confirmation of diabetes, accumulation of AGEs is clearly visible in collagen fiber. There is also an indication that changes in water content and deoxyhemoglobin levels during this process can be an indicator for delayed wound healing.
Conclusion: Accumulation of AGEs in the skin and especially in the collagen of diabetic animals can be detected and visualized using MPM. The accumulation of AGEs is correlated to the delay in wound healing of diabetic rats compared to non-diabetic controls. The high level of deoxyhemoglobin measured using SFDI is also a potential indicator of impaired wound healing. More investigation is needed to calculate the ratio between oxy- and deoxyhemoglobin concentration, the role of water content and inflammation during diabetic wound healing, and thus determining the potential of this assay for predicting the duration of wound healing in diabetic patients.

#23

OCT IMAGING OF SMALL BLOOD VESSEL REMODELING AFTER FRACTIONAL PHOTOTHERMOLYSIS

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Background: Fractional photothermolysis is an established procedure in modern dermatology providing convincing results of skin resurfacing and rejuvenation. However, the immediate effect on the dermal network of micro-vasculature and its impact on wound healing is not fully unveiled yet. Optical coherence tomography (OCT) allows *in vivo*, sectional imaging of dermal tissue non-invasively and is even capable to display vessel perfusion with a μm-resolution.
Study: A commercial OCT-device is used to perform imaging before and multiple times after treatment of fractional photothermolysis on rat skin for up to 3 weeks. The treatments are varied in power per pulse and density of lesions. A custom made software was implemented to generate 3D maps of the vessel network within the dermis.
Results: An instantaneous effect of fractional photothermolysis on the capillary network can be observed using OCT imaging. Perfusion is corrupted in the areas of treatment immediately after irradiation and even interrupted completely when a high density of lesions is chosen.
Conclusion: The results presented in this study lead to reconsider the parameter of fractional photothermolysis in clinical studies by also respecting the induced damage to the capillary network and its effect on the wound healing process and outcome.

#24

DERMATOSCOPE INCORPORATING LASER SPECKLE IMAGING TO ENABLE SIMUTANOUS BLOOD FLOW QUANTIFICATION AND VISUAL INSPECTION OF SKIN

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Background: Dermatoscopes are commonly utilized for the qualitative visual inspection of skin lesions. While automated image processing techniques and varied illumination strategies have been used to aid in structural analysis of lesions, robust quantification of functional information is largely unknown. We have therefore developed a compact, handheld dermatoscope which enables real time blood flow measurements of skin during conventional visual inspection.
Study: Blood flow measurements were achieved by integrating a compact laser speckle imaging (LSI) system into a dermatoscope. LSI measurements using illumination from a 785 nm laser diode was performed simultaneously with visual inspections under white LED illumination *via* spectral filtering of co-registered images. Flow measurements using the LSI-dermatoscope were validated by acquiring LSI data from a tissue-simulating phantom with syringe pump-controlled flow of optically scattering fluid across the physiologically relevant range. Measurements were also performed during post-occlusive reactive hyperemia tests ($n = 10$) on the forearm of healthy volunteers to assess the correlation of the LSI-dermatoscope measurements to a validated benchtop LSI system and to perform repeatability and signal to noise analysis.
Results: The LSI-dermatoscope was able to measure known flow rates in a tissue-simulating phantom with a correlation coefficient of 0.98. Data acquired from volunteers during post-occlusive reactive hyperemia showed the expected physiological blood flow response of decreased blood flow during occlusion and the return of blood flow above baseline (hyperemia) following occlusion release. LSI-dermatoscope data was significantly correlated ($p < 0.05$) to data acquired simultaneously using a traditional benchtop LSI system. The coefficient of variation between measurements was relatively low (0.0023) and exhibited a signal to noise ratio of 17.
Conclusion: We have developed and validated a dermatoscope that enables simultaneous blood flow measurements and visual inspection of skin. The simplicity and accuracy of LSI dermatoscope facilitate straightforward integration into the dermatology workflow and future investigation of blood flow dynamics within various cutaneous pathologies.

#25

PHOTOOXIDATION OF TRYPTOPHAN DURING PHOTOCROSSLINKING TREATMENT FOR KERATOCONUS

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Background: A recent FDA-approved clinical treatment option for keratoconus involves the use of UV-initiated photo-crosslinking with riboflavin to increase corneal stiffness. Fluorescence excitation-emission spectroscopy can be used to probe the creation and destruction of fluorescent species in cornea; we hypothesized that loss of tryptophan fluorescence would occur in the presence of riboflavin, due to the production of reactive oxygen species from tryptophan oxidation.
Study: 81 *ex vivo* rabbit eyes were treated with either riboflavin-dextran solution plus UV light, dextran solution plus UV light, or riboflavin-dextran solution only for 20, 40, and 120 minutes. Uniaxial tensiometry was performed on all samples after treatment to determine the degree to which mechanical photo-crosslinking had occurred. UV fluorescence spectroscopy to assess tryptophan fluorescence was performed after crosslinking treatment.

Results: Fluorescence at the 290/340 nm excitation/emission wavelength pair associated with tryptophan was decreased after photo-crosslinking treatment, and its loss corresponded with increased corneal stiffening ($p < 0.01$) for standard (40 minutes) and increased treatment (120 minutes) times. No significant change in this excitation/emission pair was observed in the dextran plus UV or riboflavin only treatment groups.
Conclusion: The oxidation of tryptophan in the presence of riboflavin generates multiple reactive oxygen species; loss of tryptophan fluorescence corresponded with increased stiffness in photo-crosslinking treatment for keratoconus. Our results suggest that a tryptophan-mediated process may be responsible for the protein crosslink formation that is the basis of photo-crosslinking treatment.

#26

POLARIZATION-SENSITIVE OPTICAL COHERENCE REFLECTOMETRY ALLOWS REAL-TIME MONITORING OF LESION DEPTH DURING RADIOFREQUENCY CARDIAC CATHETER ABLATION: EXPLORATORY STUDY BASED ON IN SILICO MODEL
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Background: Radiofrequency catheter ablation (RFCA) is a well-established and minimally invasive medical procedure to thermally destroy the focus causing a cardiac arrhythmia (e.g. in treatment for atrial fibrillation, flutter, etc.). Since it is crucial to control the depth of the created thermal lesion in order to ensure transmurality, new tools based on optical imaging technologies have been developed to guide RFCA. It has recently developed a new RF catheter which detects the dynamic changes of accumulated phase retardation measured by polarization-sensitive optical coherence reflectometry (PS-OCR) in the tissue up to a maximum depth of 0.75 mm. Previous experimental results showed a strong relation between these optical changes and birefringence loss, which is due to fibers denaturation that occurs around to 70 °C.The new RF catheter is able to measure just the time when fibers denaturation is produced (denaturation time). Due to this, with this catheter is not possible to measure irreversible thermal damage in the tissue that occurs at 50 °C. Our goal was to explore by means of computer modeling the relationship between the lesion depth and denaturation time.
Study: A two-dimensional model based on a coupled electric-thermal problem was built and solved using the finite element method. The model comprised of cardiac tissue, blood and a non-irrigated catheter ablation with a sensor embedded within its tip to control and maintain the electrode temperature at a specific target. Computer simulations were conducted by varying the tissue characteristics, whose specific values were chosen by a Latin hypercube sampling design. The thermal lesion depth was estimated by the 50 °C isotherm (D50), while the 'denaturation time' (t-d) was estimated as the time when the 70 °C isotherm reached a depth of 0.75 mm.
Results: A strong correlation ($R>0.99$) between the depths of 50 °C and 70 °C isotherms (D50 and D70, in mm) for different ablation times (times in seconds) was found. Specifically, the analysis of the ablations with duration ranging from 15 to 40 s provided the following relation: $D50 = 0.87x\ D70 + 0.031x\ t + 1.05$, with a limited residual standard deviation of 0.06 mm. More importantly, we found that the predictor t-d allowed a good estimation ($R2 = 0.98$, $p < 2 \times 10E\text{-}16$) of the time required to reach a thermal lesion of 4 mm depth (t–4 mm), specifically, t-4 mm = 2.55x t-d + 0.2. This proportionality still held when the analysis was extended to target lesion thicknesses of 2 mm and 3 mm, at least for t-d shorter than 30 s.
Conclusion: Computer results showed a strong correlation between the thermal lesion depth and the ratio 'total ablation time' to 'denaturation time'. Since the denaturation time can be physically measured in real-time during the first seconds of the RFCA by means of PS-OCR, the total ablation time could be accordingly extended depending on the target of lesion depth.

#27

EFFICACY AND SAFETY PROFILES OF VARIOUS LASER THERAPEIS AS COMPARED TO TRANS-URETHRAL RESECTION OF THE PROSTATE
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Background: Secondary to significant improvements in International Prostate Symptom Score (IPSS) and urodynamic parameters, including postvoid residual (PVR) and urinary flow rates, transurethral resection of the prostate (TURP) is regarded as the gold-standard surgical therapy for benign prostatic hyperplasia (BPH). Despite these benefits, the rate of TURP has been decreasing with a corresponding increase in alternative minimally invasive laser surgical therapies such as holmium laser enucleation of the prostate (HoLEP) and green light photovaporization of the prostate (GL-PVP). The primary objective is to analyze the efficacy and safety profiles of these therapies as compared to TURP.
Study: All patients who underwent TURP, GL-PVP, and HoLEP from January 1, 2012 through December 31st, 2014 were followed. All patients were scheduled for a return visit and uroflow test 3 months postoperatively. Safety parameters recorded included blood loss, length of hospital stay, duration of catheterization, transfusion rate, urinary retention, clot retention, and readmission. Efficacy parameters included postsurgical differences in IPSS, maximum flow velocity (Qmax), average flow velocity (Qavg), and PVR.
Results: Two hundred and ninety-one consecutive patients underwent outlet procedures during the study period: TURP ($N = 199$; mean age, 71 years; mean BMI, 28.5), HoLEP ($N = 60$; mean age, 68 years; mean, BMI 28.1), or GL-PVP ($N = 32$; mean age, 72 years; mean BMI, 29.3). No statistically significant difference was observed for age, BMI, preoperative American Urological Association symptom score, or preoperative maximum flow velocity between the 3 groups. Differences were evident regarding pre/postoperative change in Qavg ($p = 0.018$) favoring HoLEP, pre/postoperative change in PVR ($p = 0.020$) favoring TURP, pre/postoperative change in hemoglobin ($p = 0.004$) favoring GL-PVP, length of hospital stay ($p < 0.001$) favoring TURP/HoLEP, and duration of catheterization ($p < 0.001$) favoring TURP/HoLEP.
Conclusion: The use of alternative minimally invasive laser therapies for the treatment of bladder outlet obstruction secondary to BPH has particular advantages with respect to decrease blood loss (GL-PVP) and improved uroflow parameters (HoLEP). Adoption of these new therapies can reduce TURP-related morbidity.

CUTANEOUS APPLICATIONS

#28

TREATMENT OF ACTINIC KERATOSIS OF THE CHEST USING A HYBRIDIZED 1470 nm/2940 nm FRACTIONAL LASER

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Background: Photorejuvenation of skin may include the correction of ultraviolet damage not just dyschromia and laxity. Ablative and non-ablative laser treatments have demonstrated a beneficial effect on actinic keratosis and non-melanoma skin cancers. Hybridized fractional lasers (HFLs) have only recently been added to the discussion. We wanted to determine the effect of a 2940 nm/1470 nm hybridized fractional laser on clinical actinic keratosis (AKs).
Study: Eighteen women undergoing HFL treatment for photo rejuvenation of the chest were enrolled. Patients were treated twice, one month apart, with 325 micron depth 1470 nm diode laser delivered in the same microscopic treatment zone as 20 micron depth 2940 nm Er:YAG, (20% treatment coverage). AKs were counted by a non-treating investigator before treatment, one month after each treatment, and three months after the last treatment.
Results: AK count went from 268 to 41 (84.7% decrease). Actinic keratosis count one month after the first treatment improved from mean 13.4 to 2.0 (85.2%, $p < 0.0001$). Baseline compared to one month after the final treatment also showed significance (90.7%; 13.4 to 1.25; $p < 0.0001$) and baseline to three months after final treatment (85.2%; 13.4 to 2.0; $p < 0.0001$). There was also statistically significant improvement between the first and second treatments, but not between the first treatment and three-month follow-up. Two patients underwent biopsy of persistent lesions. One revealed a nodular basal cell carcinoma and the second a hyperkeratotic actinic keratosis.
Conclusion: A single treatment using hybridized fractional 2940 nm/1470 nm yielded a significant improvement in actinic keratosis. A second treatment further significantly improved actinic keratosis count but at three-month follow-up significance was only observed between baseline and three-month follow-up. Non-responding lesions should be considered for biopsy. Treatment with the hybridized laser improves actinic keratosis on the chest, contributing to overall photorejuvenation.

#29

AN EXPANDED STUDY OF LONG-PULSED 1064 nm Nd:YAG LASER TREATMENT OF BASAL CELL CARCINOMA

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Background: Basal cell carcinoma (BCC) is rarely life threatening, but can cause significant cosmetic and functional morbidity. Surgical treatments often result in disfigurement, while topical therapies frequently result in recurrence. This has led to the investigation of lasers as a nonsurgical alternative. We have previously conducted a pilot study which showed 100% histologic clearance. Treatments were well tolerated with no significant adverse events. The objective of this larger study was to confirm preliminary results that the 1064 nm Nd:YAG laser is a safe and effective method for treating BCC off the face.
Study: This is an IRB-approved, prospective, multi-center study evaluating the efficacy and safety of the 1064 nm Nd:YAG laser for the treatment of BCC on the trunk and extremities. Thirty-three subjects seeking treatment for biopsy-proven BCC that did not meet the criteria for Mohs surgery were recruited. Subjects on current anticoagulation therapy, or with a history of immunosuppression were excluded. Subjects received one treatment with the 1064 nm Nd:YAG laser as follows: 5–6 mm spot, fluence of 125–140 J/cm^2 and a pulse duration of 7–10 ms. Standard excision was performed at 30 days after laser treatment to evaluate clinical and histologic clearance of BCC. Standardized photographs and adverse assessments were taken at the baseline visit, immediately after laser treatment and on the day of excision.
Results: 31 subjects completed the study. BCC tumors had a 90% (28 of 31 BCC tumors) histologic clearance rate after one treatment with the long-pulsed 1064 nm Nd:YAG laser. Treatments were generally well tolerated without any anesthesia. Immediate side effects included edema and erythema. At 1-month follow-up, some patients had residual crusting. No significant adverse events occurred.
Conclusion: The 1064 nm long-pulsed Nd:YAG laser is a safe, scarless and effective alternative for treating BCC off the face for those that are poor surgical candidates.

#30

SAFE AND EFFECTIVE TREATMENT OF ACNE VULGARIS IN SKIN TYPES V AND VI USING EXCLUSIVELY LASER THERAPY

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Background: Acne remains a challenging disease to treat. Having a darker Skin Type (ST) increases the therapeutic difficulty especially when considering laser therapy. Patients with higher ST are limited in the choice of therapeutic laser wavelengths. Shorter wavelengths have greater melanin absorption which can be associated with hypo- and hyperpigmentation and not allow sufficient energy to reach the dermis. This study evaluates the use of both long-pulsed (LP) and Q-switched (QS) 1064 nm YAG lasers for the treatment of adult acne in patients with ST V and VI.
Study: Six adult acne patients ages 20 to 56 years (mean 33 years) with Skin Types V and VI (3 ST V and 3 ST VI) received laser therapy. All patients were off both topical acne medications and oral antibiotics. Therapy was administered first using a LP YAG laser, immediately followed by low energy treatment with a QS YAG. Patients received treatment every 2 to 6 weeks depending on acne severity. Before and after photographs were evaluated by 2 blinded observers. The observers were not informed which photos were before or after.
Results: The observers correctly chose all before and afters. Acne severity was graded at 3.5 out of 5 (most severe). Overall acne resolution was at 75% graded immediately after the last treatment to 18 months post treatment (mean 3.8 months). The 3 patients who received 6–7 treatments had 53% acne

resolution. The 3 who had 14–17 treatments had 94% acne reduction. The overall appearance of the skin for those receiving more treatments improved by 85%. Aside from occasional transient erythema and edema, there were no other side effects.
Conclusion: Combination therapy with LP and QS YAG lasers can safely treat ST V and VI acne patients. The acne resolution and overall skin appearance in those patients receiving multiple treatments was excellent.

#31

ACNE TREATMENT BASED ON SELECTIVE PHOTOTHERMOLYSIS OF SEBACEOUS FOLLICLES WITH LIGHT ABSORBING GOLD MICROPARTICLES: A EUROPEAN STUDY

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Background: Selective photothermolysis of sebaceous follicles is possible with near-IR laser optical pulses after localized delivery of external chromophores consisting of plasmon resonant gold microparticles to the follicles. Here, we report results from a trial conducted in Denmark (Copenhagen, Aalborg) and Switzerland (Geneva).
Study: An Ethics Committee approved, before-after clinical study was conducted. Sub-micron particles, consisting of inert gold shell and silica cores, were formulated for selective delivery into sebaceous follicles. Treatment consisted of topical application and massage of the suspension followed by pulses from an 800 nm diode laser. 23 subjects (mean age 20.3 years, skin types 1–3, 43% female) were treated three times at 1-week interval with optical pulses with parameters: average exposure 31.7 J/cm^2, pulse duration 30 ms, 9×9 mm or 12×12 mm spot with cooling, two passes. Repeat treatment sessions were offered to sub-responders ($< 40\%$ reduction of inflammatory lesions). Subjects were asked to rate discomfort on a 0–10 scale. Lesion counts were performed at baseline and 12 weeks. Weighted acne lesion count scores (weights; comedone: 0.5, papule: 1.0; pustule: 2.0; nodule: 3.0) were computed at both time points and compared.
Results: At 12-weeks, the mean weighted acne lesion count change was -53% from baseline (sd $= 23\%$, n $= 23$). Overall, 61% (14 out of 23) of subjects demonstrated $>40\%$ reduction in the weighted lesion count, while 39% (9 of 23) experienced $<40\%$ reduction in weighted lesion count. Transient erythema, edema were noted post treatment. Subjects tolerated the treatment well (mean discomfort 3.9/10). Data will be presented on efficacy from repeat treatment sessions.
Conclusion: In a three-center, before-after trial, the combination of topically delivered gold microparticles, followed by 800 nm optical pulses appears to be successful, well tolerated, and safe for treating acne vulgaris.

#32

TREATMENT OF MODERATE TO SEVERE ACNE WITH SNA-001-MEDIATED SELECTIVE PHOTOTHERMOLYSIS: A PROSPECTIVE, CONTROLLED FEASIBILITY STUDY

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Background: SNA-001, a topical suspension of ultra-efficient light absorbing silver particles, facilitates selective photothermolysis of the pilosebaceous unit. It is being studied as an accessory to laser therapy for moderate to severe acne; results from a feasibility study are presented.
Study design: In this prospective, evaluator-blinded, controlled study of acne, SNA-001 was evaluated using a split back design. SNA-001 was applied topically to an area of the back, then massaged using vibration. Both the SNA-001 and a control area were treated with 810 nm diode laser at low (40 J/cm^2 fluence, 100 ms pulse width, 1–2 passes) or high (25–30 J/cm^2, 30 ms, 1 pass) power. Subjects received 4, once-weekly treatments and were followed for 12 weeks (primary endpoint). Adverse events were assessed.
Results: At this interim analysis, 10 subjects completed 4 treatments. Mean total lesion count (TLC) ($\pm$SD) at baseline was 9.1 (3.9) in the SNA-001 area and 10.2 (5.4) in the control or laser only (LO) area. Mean TLC improved in both areas (SNA-001 [–60%]; LO [–59%], NS). In the 6 subjects who received at least 1 of 4 treatments with high power, mean change from baseline in TLC was -5.3 (2.7) (–73%, $P < 0.01$) for SNA-001 and -4.2 (4.8) (–54%, NS) for LO. Mean TLC at 12 weeks was lower for SNA-001 (2.0 [0.9]) compared with LO (3.7 [1.4]). Percent reduction in mean inflammatory lesion count was -76% ($P < 0.001$) for SNA-001 and -57% (NS) for LO. No treatment related AEs or SAEs were reported. Local tolerabilities including pain, erythema, and perifollicular edema were assessed.
Conclusion: In this feasibility study, SNA-001 enhanced the efficacy of laser treatment (high power) of back acne with an acceptable safety profile. This study has limitations: sample size is small and laser settings are variable. These results need to be confirmed in larger trials, which are ongoing.

#33

SNA-001-MEDIATED SELECTIVE PHOTOTHERMOLYSIS FOR PERMANENT REDUCTION OF LIGHT PIGMENTED HAIR: A RANDOMIZED EVALUATOR-BLINDED FEASIBILITY STUDY

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Background: SNA-001, an investigational suspension of silver particles, is a topical accessory to laser therapy. When illuminated with laser, SNA-001 facilitates thermal damage of the hair follicle. We report a feasibility study of SNA-001 plus laser for reduction of unwanted light pigmented hair.
Study design: This evaluator-blinded, controlled study had a randomized, within-subject (left vs right axilla) design to compare SNA-001 to vehicle used with 810 nm diode laser (30 J/cm^2, 30 ms pulse width, 1 pass). SNA-001 or vehicle were applied to the epilated treatment area, massaged into the skin using mechanical vibration, and then treated with the laser. Subjects received 3 treatments, 2 weeks apart, with hair count measured 12 weeks after last treatment. Adverse events were assessed.
Results: Ten female subjects completed the study. In this interim analysis, the percentage change in hair count was -29.4% (95%CI:

−51.2, −7.5) for SNA-001 and −10. 4% (95%CI: −36.5, 15.7) for vehicle; mean difference between the 2 treatments: −18.9% (95% CI: −37.1, −0.8; $P = 0.04$). An analysis of efficacy stratified by hair color revealed that the significance between SNA-001 and vehicle was likely driven by the lighter pigmented hair cohort ($n = 5$). Although SNA-001 (plus laser) effectively reduced hair counts in both lighter and darker hair cohorts, vehicle (plus laser) reduced hair counts only in darker hair individuals due to the presence of substantial melanin in the follicles of darker hair. No SAEs were reported and only one treatment related AE (i.e., folliculitis) was observed in the SNA-001 group.
Conclusion: This controlled feasibility study suggests that SNA-001 (plus laser) may be effective in reducing unwanted light pigmented hair, currently an unmet need with standard laser hair reduction. It may also enhance efficacy of laser therapy alone for reduction of dark hair. These results need to be confirmed in large trials, which are ongoing.

#34

USING STANDARD AND HIGH PULSE COVERAGE WITH PICOSECOND LASER TREATMENT OF WRINKLES AND ACNE SCARRING: LONG TERM CLINICAL OBSERVATIONS
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Background: The picosecond pulse duration laser at 755 nm has demonstrated consistent clinical efficacy for tattoo removal, pigment conditions, wrinkle and acne scarring. The use of a diffractive lens array accessory was used in a split face study to investigate the possible role of the number of pulses on efficacy.
Study: 6 subjects consented to split face treatment with the 755 nm picosecond laser (Cynosure Inc. Westford MA) using the diffractive lens array. Indications were acne scarring (2 subjects) or rejuvenation (4 subjects). Skin types were II to IV and the mean age of the acne scar group was 33 +/− 1 year and the rejuvenation group was 62 +/ − 10 years. One half of the face was treated with the recommended pulse coverage (3301 +/− 155 pulses) while the other half of the face was treated with 1.7 times the number of pulses of the standard site (5867 +/− 500 pulses). Treatment parameters were a 6 mm spot size and 0.57 J/cm^2 for 550 picosecond pulses. Pulses were delivered at 10 Hz and 50% overlap. More passes were used to deliver more pulses. The aim was to investigate long term clinical effect and subsequent sequelae at one to six months following on from last treatment.
Results: Previous results presented suggested that wrinkle patients treated with the standard number of pulses has excellent clinical outcomes. At interim analysis suggests that clinical outcome from using standard or high numbers of pulses at is similar. Except for mild transient post-inflammatory hyperpigmentation in 1 subject with phototype IV, no increased incidence of side effects was observed.
Conclusion: When using the diffractive lens array with a 755 nm picosecond laser, no more benefit can be obtained from a higher number of pulses.

#35

COMBINED 1064 nm AND 532 nm FRACTIONAL PICOSECOND LASER TREATMENT OF FACIAL WRINKLES
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Background: Picosecond lasers have been used for tattoo removal in recent years. This study presents initial results from a single center of picosecond pulses on facial wrinkles.
Study: Subjects received four treatments at 1-month intervals with combined fractionated 1064 nm and 532 nm pulses, using a Nd:YAG picosecond laser. Wrinkle reduction was evaluated prior to each successive treatment and 12 weeks after the last treatment, using Fitzpatrick's 9-point wrinkle and elastosis scale. Subjects reported on discomfort, using a 0 (no discomfort) to 10 scale.
Results: 20 subjects (19 females; mean age 55 ± 7 years, range 41–66 years; Fitzpatrick Skin Types II–IV) received combined 1064 nm and 532 nm pulses to the full face, following topical anesthetic application. Baseline wrinkle scores were 6 ± 1 and decreased significantly ($p < 0.001$, Wilcoxon Signed-Rank Test for paired data) to 4 ± 1 after three treatments. Seventeen subjects (85%) had at least a 1-point reduction in their wrinkle score compared to baseline after three treatments, while five had a 2-point reduction, and one had a 3-point reduction. The wrinkle scores remained statistically decreased ($p < 0.01$) with 75% of the 12 subjects, assessed at the 12-week follow-up (data is pending for 8 subjects), having a further 1-point or 2-point decrease after the fourth treatment. Treatments were associated with none to mild discomfort (mean discomfort 3.7 ± 1.9). Immediate responses following treatment were limited to mild-moderate erythema (98%), edema (7.5%) and one case of mild purpura (1%). All responses resolved spontaneously, generally within several hours of treatment. No adverse events were observed
Conclusion: Combined treatment with 1064 nm and 532 nm picosecond pulses shows promise in improving the appearance of facial wrinkles with little to no downtime. Clinical effect was improved with multiple treatments and remained stable at 12-weeks after the last treatment. Findings from the other investigational sites may further elucidate optimal treatment parameters.

#36

HISTOLOGICAL FINDINGS OF FLUENCE-ASSOCIATED INJURY IN CREATION OF LIOB BY PICOSECOND TREATMENT AND CORRELATION TO CLINICAL OUTCOME
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Background: Novel picosecond laser devices originally designed to remove tattoos, now provide fractional hand pieces to treat fine wrinkles, acne scars and melasma. The underlying mechanism of action (laser-tissue interaction) has not been extensively studied in human skin *in vivo*. A study using picosecond 532 and 1064 nm fractional hand pieces was conducted in 16 patients with facial photoaging and acne scars to assess: 1) Histologically: the mechanism of action in "*in vivo*" skin biopsies immediately after treatment; 2) Clinically: results after 4 treatments and, 3) Safety.
Study: 532 nm and 1064 nm fractional hand pieces with holographic diffractive optic from a picosecond laser (Syneron-Candela) were used. Sixteen patients (15 female and 1 male, ages 28–55 y/o) were selected, divided in 3 groups and received 4 laser sessions (1 every 2–4 weeks): Group I: 4 passes with 1064 nm at 1.9–2.6 mJ; Group II: 4 passes with 532 nm at 0.5 mJ and, Group III: 3 passes with 1064 nm at 1.9 mJ and 3 passes

with 532 nm at 0.3 mJ. A 2–4 mm punch on the skin of the neck (jaw line) immediately after the treatment was performed and stained with H&E. Clinical pictures before and 2 months after the last treatment were taken.
Results: Both 532 nm and 1064 nm fractional hand pieces produced Laser-induced optical breakdowns (LIOBs) either in epidermis or dermis. The location of the LIOBs in the epidermis *vs* dermis was more related to the fluence than to the wavelength; higher the energy, more superficial the LIOBs: Epidermal LIOBs with intact stratum corneum with 532 nm and 1064 nm observed with higher energies (>0.5 mJ for 532 nm and >2.4 mJ for 1064 nm). Dermal LIOBs at 500–600 μ with 532 nm and 1064 nm observed with lower energies (0.5 mJ for 532 nm and 1.9 mJ for 1064 nm). All patients from 3 groups showed improvement in texture and wrinkles and those with acne scars had the best outcome.
Conclusion: The histological and clinical results are promising since they demonstrate fractional injury *via* cavitation and plasma formation (LIOB) in the epidermis and dermis always with intact stratum corneum which resulted in safe treatments for facial photoaging and acne scars with minimal or no down time.

#37

THE COMPARATIVE CUTANEOUS AND HISTOLOGICAL CHANGES OF SKIN TYPES I–VI OVER 24 HOURS WITH FRACTIONAL PICOSECOND 532 nm, 1064 nm, AND 755 nm
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Background: We have previously described the histological and clinical features of fractional picosecond 755 nm with the creation of intra-epidermal vacuoles. This appears to result from the creation of an area of laser induced optical break down (LIOB) with melanin as the primary absorbing chromophore. Clinically we observed erythema and heat lasting for a few hours. This technology is approved to treat acne scars, photo damage and abnormal pigmentation. Recently fractional 532 nm and 1064 nm has been available. The immediate clinical features have not been well characterized. This study was designed to prospectively study the clinical and histological changes with fractional 532 nm, 1064 nm and 755 nm over 24 hours.
Study: Eight female patients were treated on their backs with the three fractional wavelengths at three different energies. MI from 11 to 95 were studied with photographs obtained 15 minutes and 24 hours after treatment with three passes with each wavelength. Biopsies were taken at 24 hours after treatment and processed with hematoxylin and eosin.
Results: Areas of erythema and petechial hemorrhage were observed with fractional 532 nm and 1064 nm. This was more noticeable with the higher energies. Histologically localized areas of epidermal damage, epidermal vacuole formation and dermal hemorrhage. The erythema largely resolved at 24 hours, but the petechiae appear more noticeable 24 hours after treatment. Fractional 755 nm resulted in areas of erythema immediately after treatment with localized epidermal vacuole seen on histology. The erythema largely resolved over 24 hours.
Conclusion: Fractional 755 nm produced selective injury that appeared to result from the absorption of a laser light by melanin. Since the concentration of this chromophore was highest in the epidermis these LIOBs are located only in the epidermis. This results in erythema and heat which largely resolves 24 hours after treatment. Fractional 532 nm and 1064 nm did result in erythema suggesting epidermal injury and petechiae caused by dermal hemorrhage. This observation suggests there was significant absorption by hemoglobin and melanin.

#38

PHOTOREVITALIZATION USING A NOVEL DUAL-WAVELENGTH PICOSECOND PROCEDURE – A CASE STUDY WITH 10 SUBJECTS
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Background: Coarse skin texture, wrinkling, and pigmentation characterize photodamaged skin. Laser toning, using microsecond and nanosecond devices, has been deployed successfully for epidermal and dermal remodeling as a result of thermal injury which in turn, initiates a wound healing response. This novel dual-wavelength picosecond procedure devised to utilize high pulse energy of the enlighten (Cutera, Inc., Brisbane, CA) picosecond device to target unwanted epidermal/dermal pigmentation and superficial collagen for tone and texture improvement. Photomechanical damage induced by this procedure facilitates efficacy without the unwanted thermal side effects and minimal downtime. The objective of this study was to evaluate safety and efficacy of the novel dual-wavelength picosecond procedure for photorevitalization.
Study: Ten subjects, ages 35–70 years and Skin Types I – IV were enrolled in a single center, open label IRB approved study. Subjects received the novel dual-wavelength picosecond procedure treatments spaced 2–4 weeks apart. During treatment, dyschromia was treated first with 532 nm followed by 1064 nm to cause dermal modeling deploying painting technique. Patients were assessed at baseline, before every treatment, and at 6 weeks post final treatment using digital pictures and spectrophotometer measurements. Patient satisfaction metrics and adverse events duration were obtained at every follow-up visit. Clinical efficacy was determined by blinded assessment of improvement at 6 weeks post final treatment.
Results: Blinded evaluations of the pictures demonstrated a statistically significant improvement in skin texture and tone ($p < 0.01$) at the final follow-up with 60% of the subjects showing moderate to significant improvement. Spectrophotometer measurements revealed statistically significant reduction in redness contributing to the overall improvement in skin tone. 60% of the subjects experienced a very significant improvement (40% experienced significant improvement). 80% of the subjects were extremely satisfied with these treatments. The most common expected tissue reactions were mild erythema and edema, both lasting approximately one day.
Conclusion: The novel dual-wavelength picosecond procedure yielded effective photorevitalization with no serious adverse effects.

#39

A RANDOMIZED, DOUBLE-BLIND, STUDY EVALUATING A 755 nm PICOSECOND PULSED ALEXANDRITE LASER *vs* A NON-ABLATIVE 1927 nm FRACTIONATED THULIUM LASER FOR THE TREATMENT OF FACIAL PHOTOPIGMENTATION AND AGING
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Background: Non-ablative 1927 nm fractionated laser and the picosecond 755 nm pulsed alexandrite laser have been used for the treatment of photoaging. The objective of this randomized, double-blind study was to evaluate the efficacy of the 755 nm picosecond laser with the 1927 nm fractionated laser for the treatment of facial photopigmentation.
Study: 20 subjects with signs of facial aging and photodamage received four 755 nm picosecond laser treatments, spaced 3 weeks apart, or two fractionated 1550 nm/1927 nm laser treatments, spaced 6 weeks apart. Follow-up visits occurred at 4 and 12 weeks after the last treatments using standardized photographs, Investigator-blinded Global Aesthetic Improvement Score (GAIS) and subject self-assessments
Results: All subjects completed the study and no adverse effects were reported. Both laser treatment groups demonstrated similar improvement in the signs of photopigmentation and aging as assessed by blind investigators, clinical photography and patient self-assessments. Significantly less treatment related pain, discomfort and erythema was noted in the group that received the picosecond laser treatments.
Conclusion: Results of the study demonstrate that both fractional 1927 nm laser and the 755 nm picosecond laser can be used safely and effectively to treat signs of photopigmentation and aging, but the picosecond laser provides a superior safety and patient satisfaction profile.

#40

FRACTIONAL RADIOFREQUENCY FOR IMPROVING SKIN TEXTURE IN CHINESE
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Background: Fractional radiofrequency devices were shown to improve skin texture such as smoothness, rhytides, brightness as well as atrophic acne scars by increasing dermal thickness, dermal collagen content and dermal fibrillin content. Majority of clinical experiences with fractional skin rejuvenation were focused on Caucasian subjects. The objective of the study is to assess the efficacy and adverse effects of this device on Asian skin.
Study: 20 Chinese subjects age 21–60 with irregularities of skin texture, rhytides and acne scars were recruited. Subjects received six treatments at 2–4 week intervals. Treatment is initiated with maximum energy tolerated and is adjustable during treatment if subject feels excessive discomfort. A total of two passes were delivered at each session. Physician assessment and standardized photographs were taken at baseline, all treatment visits and one, two and six-month long term follow up.
Results: The study is still ongoing with 18 subjects recruited. One subject withdrew after the first treatment due to overreaction to local anesthesia. 10 out of 17 subjects completed treatment phase and enter the follow-up phase. Assessment was made before each treatment and on follow-up visits. At one month follow-up, 70% of the patients were satisfied and 30% were very satisfied while treatment physician reported various degrees of improvement based on the global assessment scale in 80% of the subjects. Anticipated side effects including erythema, edema, pinpoint bleeding and acne flare up were recorded but there were no serious adverse effects.
Conclusion: Fractional radiofrequency improves skin texture in Chinese. No serious adverse effect has been recorded.

#41

THE USE OF MULTI-SPECTRAL IMAGING TO OBJECTIVELY EVALUATE FACIAL SKIN CHANGES FOLLOWING 1927 nm FRACTIONAL THULIUM FIBER LASER TREATMENT
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Background: Multi-spectral imaging using standardized flash, polarized flash and UV light has been shown to provide a quantitative assessment of various skin features including melanin deposition, vascularity, wrinkles and overall texture. The purpose of this study was to determine whether prior reports of subjective improvement in skin appearance and pigmentation following 1927 nm fractional thulium fiber laser treatment can be supported with objective measurements.
Study: In an IRB approved study, twenty patients received a single treatment with the 1927 nm thulium fiber laser at energy level 10 mJ, treatment level 4 and 6–8 passes. Photographs and quantitative scores of melanin, vascularity, texture, and wrinkle were obtained at baseline and each follow-up visit using the VISIA-CR (Canfield Scientific Inc, Fairfield, NJ) multi-spectral imaging system. Study investigators also recorded subjective improvements regarding dyspigmentation, texture, and wrinkle severity. As secondary outcome, patients were randomized to apply Neocutis Micro-Day/Micro-Night or Neutrogena *Ultra* Sheer Dry-Touch Sunscreen/Aquaphor post-treatment, and were evaluated with respect to tolerability and clinical outcome.
Results: There was significant reduction in average melanin ($P = 0.002$), vascularity ($P = 0.0007$), and texture ($P = 0.0004$) scores at 30-day post treatment, whereas average wrinkle score was also reduced but not statistically significant ($P = 0.1$). Melanin score was reduced by an average of 9% (95%CI 3–15%), vascularity score by 14% (95%CI 5–22%), texture score by 24% (95%CI 13–34%), and wrinkle score by 16% (95%CI 0–32%). Regarding subjective outcomes, investigator reported average scores of 1.9 ± 0.5 for improved dyspigmentation, 1.5 ± 0.4 for improved skin texture, and 0.3 ± 0.3 for improved wrinkle severity (0–3 scale; 0 = <25% improvement, 1 = 25-50% improvement, 2 = 51-75% improvement, 3 = >75% improvement). There was no significant difference between the post-treatment care groups measurable by multi-spectral imaging, although cutometer scores demonstrated changes in hydration. No serious adverse effects were encountered.
Conclusion: The 1927 nm fractionated thulium fiber laser provides a significant improvement in skin pigmentation and texture, as demonstrated by objective and photographic evaluation.

#42

LASER OPERATOR LAWS AND REGULATIONS IN THE UNITED STATES
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Background: Office-based laser surgery procedures are among the most commonly performed elective procedures. Insurance reimbursement for medical procedures continues to decrease making the addition of elective laser procedures appealing for many medical practices as a way to increase income. Many of these procedures are performed or supervised by non-physicians with limited training resulting in an increase in complications and litigation. Laser operator laws and regulations vary from state to state. The objective of this study is to describe state-to-state laser operator laws and regulations on the delegation of laser procedures, level of supervision required, and limitations on who can perform laser procedures within the United States.
Study: We performed an online database search of state-to-state laser operator laws and regulations in the United States.
Results: The laws and regulations governing laser operators vary considerably state-to-state. Only one state's laws and regulations restrict the operation of lasers to physicians only and do not allow physicians to delegate laser procedures to non-physicians. Seven states require on-site physician supervision for all laser procedures, while eleven states allow laser procedures to be performed without any supervision or under the supervision of a non-physician. Regulation of the level of supervision in the remainder of states varies based upon the nature of the laser procedure and some states allow the supervising physician to decide on whether or not a procedure requires supervision. In most states, only a supervising physician can delegate laser procedures, however, in nine states, any laser procedure can be delegated by non-physicians and performed by non-physicians without physician oversight. Five states have regulations specifying which laser procedures can be delegated to non-physicians, while four states do not regulate delegation of certain laser procedures. Nineteen states have specific limitations on who can operate a laser. Some states classify laser procedures as part of the practice of medicine, but have no specific restrictions on who can perform laser procedures. Eleven states have no limitations, restrictions, or specifications on who can perform a laser procedure.
Conclusion: The laws and regulations for laser operators are variable across the United States. Physicians and laser operators should be aware of the laws and regulations regarding supervision and delegation of laser procedures in their own state.

#43

RANDOMIZED, CONTROLLED STUDY OF NON-THERMAL, PULSED ULTRASOUND TREATMENT FOR FAT THICKNESS REDUCTION IN FLANKS WITH UNTREATED CONTROL

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Background: Non-invasive techniques have been developed for reducing localized subcutaneous adipose tissue. This study investigated the clinical performance of a pulsed ultrasound device for non-invasive fat layer reduction in the treated flank compared to the untreated control, as measured by ultrasound imaging, skin caliper, and standardized photography.
Study: Subjects underwent three biweekly 15 to 20 minute treatment sessions to unilateral flanks randomized for treatment, using a small 10 gram transducer with single-pass mode. Fat layer thickness was measured by ultrasound and skin caliper at the flank, midline at baseline and at the 16-week follow-up after the third treatment. Standardized photographs were taken at each study visit. Additionally, subjects reported on discomfort level associated with treatment.
Results: A total of 15 subjects (9 females, 6 males) were treated at a single site, as part of a multi-center study. The 15 subjects (mean age 47 ± 8 years, range 33-57; weight 66 ± 7 kg; body mass index 26 ± 2, range 25–29) underwent 45 treatment sessions. Weight remained stable during the study with less than 1% change. Ultrasound imaging of the fat layer decreased significantly by 17.4% for the treated flank compared to baseline ($p < 0.01$, Wilcoxon signed-rank test for paired data). Fat layer measurements by skin caliper also decreased slightly, but significantly ($p < 0.01$, Wilcoxon signed-rank test for paired data) compared to baseline. Ultrasound and skin caliper measurements for untreated control flanks were not significantly reduced compared to baseline ($P > 0.05$,Wilcoxon signed-rank test for paired data). Treatments were associated with very little discomfort with a mean score of 0.31 on a scale of 0 to 10 (0 = no discomfort at all; 10 = intolerable pain). There was no immediate skin response, other than expected erythema, following treatment or any side effects during the study.
Conclusion: Non-thermal, pulsed ultrasound treatments resulted in significant improvement in the fat layer reduction of treated flanks. Results were maintained at 16 weeks after the third treatment. Untreated control sites did not demonstrate significant improvement. Non-surgical flank fat reduction was achieved safely, with no downtime and no apparent risks. Additional data from the other study sites will be evaluated for variability of treatment outcomes in different populations.

#44

ABDOMINAL CIRCUMFERENCE REDUCTION USING A NON-INVASIVE MONOPOLAR RADIOFREQUENCY DEVICE – A PIVOTAL STUDY WITH 70 SUBJECTS

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Background: Radiofrequency (RF) technology has been extensively used to address wrinkle and cellulite reduction, treatment of hyperhidrosis, and even subcutaneous adipolysis. Safety and efficacy of a monopolar RF device for adipolysis of the flank region was demonstrated in a case study with seven subjects earlier in 2016. The objective of this study was to evaluate the safety and efficacy of an optimized treatment algorithm of the monopolar RF device for circumferential reduction in the abdominal and flank region.
Study: Seventy subjects, ages 24–60 years with BMI ≥ 20 and ≤ 30 were enrolled in a blinded randomized IRB approved study. Subjects were randomly designated to receive either sham or therapeutic treatment. All subjects received one treatment on the abdominal and flank region using an optimized treatment algorithm with the 40 cm^2 hand piece. The duration of each imprint was 4 minutes and average target temperature was 45 °C. Primary clinical efficacy was determined by the difference in circumferential measurement of therapeutic group relative to the sham group at 12 weeks post-treatment. Patients were assessed at baseline, at 4 weeks, and at 3 months post treatment. Patient self-improvement and satisfaction metrics were obtained at the 3 month follow-up visit.
Results: Subjects in the therapeutic group demonstrated a statistically significant reduction in circumference of the treated

flanks and *abdomen* (1.9 cm ± 0.1 cm) at 12 weeks following treatments, compared to the subjects in the Sham group (Fisher's exact test, two-tailed, $p < 0.0001$). Subject satisfaction was high among subjects in the therapeutic group and improvement was reported by 98% of Therapeutic group subjects.
Conclusion: The optimized treatment algorithm on the Radiofrequency device was found to be safe and effective for circumferential reduction, with no serious adverse effects.

#45

BILATERAL SUBMENTAL CRYOLIPOLYSIS FOR NON-INVASIVE FAT REDUCTION

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Background: Previously, submental cryolipolysis was investigated in a clinical study treating the central submental area with a single cycle per visit. Many patients, however, have excess fat that would benefit from treatment that addresses the entire submental region. This study investigates the safety and efficacy of bilateral submental cryolipolysis.
Study: The study population consisted of 14 subjects treated in the lateral and central submental area. A small-volume cup cryolipolysis applicator was used to deliver 45-minute treatment cycles. In the first treatment session, patients received bilateral treatments with approximately 20% treatment area overlap. At the 6-week follow-up, subjects were reassessed by investigators to determine whether they would benefit from a second treatment and the number of cycles needed to achieve a desirable aesthetic effect. Patient surveys assessed tolerability and treatment satisfaction at 12 weeks following the second treatment. Caliper measurements were recorded to assess fat reduction. Treatment efficacy was evaluated by 2D and 3D imaging methods. Clinicians monitored side effects and adverse events to assess safety.
Results: Independent review of photographs revealed an overall correct pre- *vs* post-treatment identification rate of 81.0%. Caliper measurements demonstrated a mean fat layer reduction of 2.3 mm. Three-dimensional imaging found mean reduction in fat volume of 4.82 cm^3, skin surface area of 1.29 cm^2, and fat thickness of 3.77 mm. Side effects of the procedure were typically mild, including numbness and tingling which resolved without intervention by the final 12-week follow-up.
Conclusion: This is the first clinical study of cryolipolysis for treatment of the entire submental area using overlapping bilateral treatments and a shorter treatment duration. The study demonstrates that bilateral submental cryolipolysis is well tolerated and produces significant fat layer reduction.

#46

1060 nm DIODE LASER TO REMOVE FAT FROM INNER THIGHS AND UPPER ARMS

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Background: Non-invasive fat reduction techniques are emerging as popular treatments in aesthetic medicine. Per published data, temperature alterations as small as a 6 °C increase above normal body temperature can affect the cellular matrix of the adipose tissue as the lipid bilayer components of the cell membranes are held together only by forces of hydration. The 1060 nm wavelength is effective and well used in the surgical treatment of soft tissues and laser lipolysis. Here the same wavelength is used in a non-invasive technique for the outcome of fat reduction.
Study: 40 subjects were enrolled in this open labeled clinical study (18–60, all females), 20 patients in each group for inner thigh and upper arms. Fat thickness change from baseline was measured using ultrasound imaging and standardized photographs were taken with a high resolution digital camera system (Canfield). Four blinded evaluators reviewed photograph sets to identify pre-and post-treatment images. Follow up assessment was conducted after 6 weeks, 3 and 6 months' post treatment. Satisfaction and psychological questionnaires were used to assess the treating investigator and subject satisfaction using 6 point Likert scale range from "extremely satisfied" to "extremely unsatisfied."
Results: Correctly identification of post-treatment photographs occurred in 86% of the cases. Mean reduction of 9 mm was recorded on the arms and 11 mm on the inner thighs at the 6 months' review compared to the baseline measurements. Statistically significant reductions were achieved based on paired T-test ($p < 0.001$). 91% of the subjects stated that they were extremely satisfied or satisfied. The psychological data we obtained shows significant positive results in most items investigated. No significant adverse effects were registered.
Conclusion: Fat removal with a 1060 nm diode laser we used in this study shows significant fat reduction of the arms and inner thighs at 6 months. First effects were seen after 6 weeks.

#47

ONE YEAR FOLLOW-UP FOLLOWING TREATMENT WITH A 1060 nm HYPERTHERMIC LASER FOR NON-INVASIVE FAT REDUCTION

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Background: Previously presented data (Bass, ASLMS 2016) indicated fat reduction following treatment with a non-invasive 1060 nm diode laser was statistically significant and maintained at six months post-treatment with no long-term adverse events or serious adverse events. This study examines one year post-treatment efficacy from a 1060 nm hyperthermic laser for non-invasive reduction of adipose tissue.
Study: Patients who previously had treatment with the laser greater than one year prior and were willing to come in for photographic evaluation were enrolled in the study. Treatment areas included abdomen, flanks, back, or thigh. Follow-up weight and patient satisfaction were recorded. Two blinded evaluators were asked to choose the baseline photo from randomized pre- and post-treatment sets.
Results: 20 patients were recruited and photographs were taken. The mean weight difference from baseline to 1 year post treatment was −0.35lbs ± 6.53 (range −15.5 lbs to +12.8 lbs). On average, blinded evaluators were able to identify the post-treatment photograph 90% of the time. Patient satisfaction was high overall.
Conclusion: Photographic improvement in the treated area appeared to be maintained after 1 year post treatment with a 1060 nm hyperthermic laser which was confirmed by blinded graders, which supports long-term visible efficacy of

using a diode laser for hyperthermic reduction of adipose tissue.

#48

A RANDOMIZED, SPLIT-BODY STUDY EVALUATING THE EFFICACY OF A NOVEL CRYOLIPOLYSIS APPLICATOR FOR THE TREATMENT OF PSEUDOGYNECOMASTIA

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Background: Cryolipolysis reduces subcutaneous adipose tissue by bringing adipocytes to above freezing temperatures and inducing apoptosis. Several clinical trials have demonstrated the efficacy of this modality in achieving significant reductions in excess subcutaneous adipose tissue of the flanks and *abdomen*. Conventional cryolipolysis utilizes a suction cup applicator that requires a minimum pinchable fat layer in order to be optimally effective. With the development of a novel applicator, alternative body sites may now be amenable to cryolipolysis. The objective of this study is to investigate the efficacy of cryolipolysis treatment for male pseudogynecomastia utilizing a novel applicator.
Study: Ten male subjects 33–58 years of age with pseudogynecomastia were enrolled in the study. Both breasts underwent ultrasound imaging. The larger breast received two applications of cryolipolysis 6 weeks apart, each cycle running for 75 minutes. The primary endpoint was the thickness of adipose tissue measured by ultrasound at baseline, at week 6 prior to the second treatment, and at week 12. The secondary endpoint was a 4-point subject satisfaction questionnaire administered at week 12. The weight of each subject was recorded at all visits.
Results: In the interim analysis, all ten subjects have undergone at least one cycle of treatment, and five subjects have completed the study. At week 12, the mean adipose tissue thickness of the treatment and control breasts was 10.4 ± 4.7 mm and 15.3 ± 2.3 mm, respectively ($p = 0.04$). At baseline, this measurement was similar between the treatment and control breast (20.3 ± 6.9 mm; 18.7 ± 6.2 mm). Patient satisfaction was greater in the treatment breast ($p = 0.01$). There was no significant change in subject weight throughout the study.
Conclusion: The interim analysis shows a novel cryolipolysis applicator effectively reduced the thickness of breast adipose tissue in ten male subjects.

#49

LARGE FIELD RF FOR REDUCTION OF ABDOMINAL FAT – AN ULTRASOUND STUDY

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Background: Focused field or large field radiofrequency (RF) has been previously reported to reduce large volumes of fat on the *abdomen* non-invasively. There have been significant advances in the circuitry since that report, so the purpose of this study is to add objective data by ultrasound measurements to confirm greater efficacy.
Study: A total of 20 patients with excessive abdominal fat were treated under IRB protocol. The entire *abdomen* was treated for 3 treatments of 45 minutes each, one month apart. Body mass index ranged from 25–33. Outcomes were evaluated by ultrasound measurement of fat 1 cm below the umbilicus and with placement of the transducer over reproducible landmarks. Fat thickness between skin and muscle and below muscle (visceral) were measured.
Results: Ultrasound reduction of fat was accompanied by very noticeable improvement in abdominal contour. Average reduction was 1.3 cm at 3 months post final treatment. Three patients had a 1 cm reduction of visceral fat at one month. Progressive reduction of fat thickness was noted for 3 months post-treatment. At one month fat still had an edematous cloudy appearance, although patients were noticing improvement in contour. No side effects other than temporary soft nodules were noted in the treated area. These resolved within 2 months.
Conclusion: The new focused field RF is highly effective for abdominal fat, with results seen on ultrasound for both subcutaneous fat and visceral fat. This novel device may allow treatment particularly of male patients with visceral fat who were previously thought not to be treatable with other non-invasive fat reduction devices.

#50

CLINICAL STUDY TO EVALUATE THE PERFORMANCE OF A FOCUSED ULTRASOUND DEVICE FOR THIGH FAT AND CIRCUMFERENCE REDUCTION COMPARED TO CONTROL

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Background: Focused ultrasound, an FDA-approved technology for non-invasive abdominal fat reduction, produces localized mechanical cellular membrane disruption in adipocytes. This study seeks to determine the safety and efficacy of this device for use on the thighs.
Study: Fourteen women aged 33–60 were selected to receive three bi-weekly treatments to one thigh with the other thigh serving as an internal control. The subjects had a BMI range of 18–30 (mean ± SD: 24.5 ± 3.1) and a weight range of 54–83 kg (mean ± SD; 69.3 ± 9.2). After the third treatment, patients were followed at 4, 8, and 16 weeks. Fat thickness was measured by both caliper and ultrasound. In addition, thigh circumference and the patient's weight were measured. Pain, edema, erythema, and adverse events as well as investigator and patient overall satisfaction were recorded at all visits.
Results: In comparison to the control, there was an average reduction in fat thickness measured by calipers of 11.76% ($p = 0.0205$), 15.21% ($p = 0.0204$), and 22.20% ($p = 0.0165$) at 4, 8, and 16 weeks, respectively. By ultrasound, there was an 18.49% (3.92 mm; $p = 0.0033$)), 20.58% (4.32 mm; $p = 0.0077$), and 19.23% (4.03 mm $p = 0.0051$) reduction in fat thickness at 4, 8, and 16 weeks, respectively. At 16 weeks, thigh circumference improved, on average, 2.8% ($p = 0.0059$) at the midline. 90.0% of the subjects were satisfied with the results at 16 weeks, and investigators were 100% satisfied. No adverse events were reported; no edema was observed in any subject. All subjects experienced mild erythema. All reported zero pain on a 0–10 scale.
Conclusion: Focused ultrasound is safe, effective, and well tolerated to improve the circumference and fat thickness of the

thighs without significant side effects. There were no significant adverse events. Investigators and subjects were highly satisfied with the results.

#51

CRYOLIPOLYSIS FOR REDUCTION OF ARM FAT: SAFETY AND EFFICACY OF A PROTOTYPE COOLCUP APPLICATOR WITH FLAT CONTOUR

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Background: Cryolipolysis of the arms has been shown to be an effective but somewhat time consuming process. This study evaluated safety and efficacy of a prototype contoured cup cryolipolysis applicator for reduction of arm fat. The prototype was designed to maximize tissue contact with the cooling surface to improve patient comfort while reducing treatment time.
Study: Both arms of eligible subjects were treated using a prototype device that delivered treatment in 35 minutes at a temperature of −11 °C. Pain was assessed on a scale from 0 to 10 during and after treatment. Photographic and ultrasound documentation was captured at baseline and 12 weeks post-treatment. Efficacy was assessed by photo review by three blinded, independent physician reviewers and measurement of fat layer reduction in ultrasound images. Clinical assessments were performed to evaluate the treatment areas and sensory alterations following treatment.
Results: Thirty women were enrolled and completed treatments to both arms. The procedural mean pain score was 1.0 with standard deviation of 1.2. Immediately post-treatment, the most common side effects within the treatment area were erythema, edema, numbness, and tingling. By the 12-week visit, all subjects reported a pain score of 0 and all side effects resolved without intervention except for some cases of numbness in the treatment area. There were no unanticipated adverse device effects during the study. Ultrasound measurements found mean fat layer reduction of 3.2 mm with standard deviation 2.7 mm. Blinded independent photo review found 85.2% correct identification of baseline photos.
Conclusion: The prototype applicator increased direct tissue contact with the cooling surface, allowing reduction of treatment duration from 60 to 35 minutes and improved patient comfort, while maintaining clinical efficacy. These data suggest the CoolCup prototype applicator provides rapid, safe, and effective arm treatment.

#53

PARAMETERS IN FRACTIONAL LASER ASSISTED DELIVERY OF TOPICAL ANESTHETICS: ROLE OF LASER TYPE AND LASER SETTINGS

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Background: Efficacy of topical anesthetics can be enhanced by pretreatment of the skin with ablative fractional lasers (AFXL). However, little is known about the role of parameters such as laser modality and laser density settings in this technique. Aims of this study were to compare two different AFXL modalities, a CO_2 laser and an Er:YAG laser and to assess the role of laser density in AFXL assisted topical anesthesia.
Study: In 15 healthy subjects, four 10×10 mm test regions on the back were randomized to pretreatment (70–75 μm ablation depth) with [A] CO_2 laser at 5% density, [B] CO_2 laser at 15% density, [C] Er:YAG laser at 5% density and [D] Er:YAG laser at 15% density. Articaine hydrochloride 40 mg/ml + epinephrine 10 μg/ml solution was applied to all four test regions. After 15 minutes, an AFXL pass (1,500 μm ablation depth) was given as pain stimulus at each test region. A reference pain stimulus was given at unanesthetized skin. Pain was scored on a 0–10 visual analogue scale (VAS) after each pain stimulus.
Results: Median VAS scores were [A] 1.5 [B] 0.5, [C] 1.5 and [D] 0.43 and 4.5 [reference]. VAS scores for all test regions were significantly lower compared to the reference pain stimulus ($p < 0.01$). VAS scores were not significantly different regarding to pretreatment with the CO_2 laser *vs* pretreatment with the Er:YAG laser. However, VAS scores were significantly lower for region [B] (CO_2 laser, 15% density) compared to region [A] (CO_2 laser, 5% density; $p < 0.05$) and for region [D] (Er:YAG laser, 15% density) compared to region [C] (Er:YAG laser, 5% density; $p < 0.01$).
Conclusion: For AFXL assisted topical anesthesia the CO_2 laser and Er:YAG laser are equally effective. However, AFXL pretreatment of the skin with 15% density leads to more effective anesthesia compared to pretreatment with 5% density.

#54

COMPRESSED AIR CYCLES ENHANCE THE FILLING OF FRACTIONAL ABLATIVE LASER CHANNELS

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Background: Ablative fractional laser treatments create small channels in the skin that can be used to enhance cutaneous drug delivery. As incomplete filling of the channels may compromise drug delivery, this study evaluates the impact of mechanical pressure on laser channel filling, applied at different intensities and repetitions.
Study: A fractional Er:YAG laser ($\lambda = 2940$) generated 2000 m deep laser channels in porcine skin. A prototype device utilizing compressed air generated a mechanical pressure of 0.1 or 0.3 atmosphere (Atm; 30 s duration) delivered at 1–3 repetitions. Stereoscopic microscopy was used to quantitatively evaluate deposition of tissue dye in laser channels at specific skin depths (100, 500, 1000 and 1500 μm).
Results: Passive filling of the laser channels was 100% in the most superficial layer (100 μm), but declined rapidly with increasing channel depth (500, 1000 and 1500 μm). While a one-time application of 0.1 Atm did not impact channel filling, repeated applications (0.1 Atm; x2-3) significantly increased channel filling at all skin depths (500 μm, $p = 0.017$; 1000 μm, $p = 0.004$; 1500 μm, $p = 0.032$). When compared to 0.1 Atm, application of 0.3 Atm did not further improve the deposition of tissue dye within the laser channels.
Conclusion: Cycles of repeated pressure enhances laser channel filling. For optimal delivery, low pressure levels suffice, which may prove important for patient tolerability of the procedure.

#55

ABLATIVE LASER PENETRATION DEPTH AS A FUNCTION OF SCAR PROPERTIES

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Background: Ablative lasers have been used with varying degrees of success in the treatment of burn scars. A number of therapy delivery parameters, including laser power/penetration depth, are believed to control efficacy. We hypothesize that laser penetration depth is highly dependent on scar type and as a result, treatment with the same power will have vastly different efficacy based on the initial properties of the scar.
Study: Surgical discard tissues (hypertrophic, keloid, normal scar and normal skin) from revision procedures were collected. The mechanical properties of the scar tissue along with scar height and total collagen content were quantified for each scar using a torsional ballistometer, histology and a hydroxyproline assay, respectively. Each scar was divided into multiple pieces and treated, separately, with two different commercially available fractional CO_2 laser systems and one commercially available erbium:yttrium-aluminum-garnet (Er:YAG) laser system. Samples were sectioned and imaged to quantify laser hole depth and width. These parameters were evaluated based on laser type and scar properties.
Results: A substantial difference in fractional CO_2 laser penetration depth was observed between the two commercial, fractional CO_2 laser systems in both normal and scar tissue, despite both systems being set at 70 mJ/cm^2. An overall trend of lower laser penetration depth using the Er:YAG laser was observed along with narrower ablative regions. In general, ablation depth was inversely proportional to scar thickness. However, no significant correlation was found between scar biomechanics and laser penetration depth.
Conclusion: Variability in laser penetration depth was observed as a function of scar properties but also as a function of laser type and laser equipment. A greater understanding of the relationship between the settings of the laser and properties of the ablated region will allow for more uniform treatment of the wide variety of burn scars seen in the clinic.

#56

FRACTIONAL ABLATION OF *EX VIVO* HUMAN SKIN USING A NOVEL CO LASER

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Background: Most recent generation of 5,500 nm high power CO lasers could be a promising novel laser tool for applications in medicine and surgery. The optical penetration depth at this wavelength is about 35 μm, while that of CO_2 lasers is limited to 10 μm. Thus, additional coagulation for enhanced tissue tightening can be anticipated for CO lasers compared to CO_2 lasers after ablative fractional laser resurfacing. It is of great interest to firstly evaluate the feasibility of a CO laser for fractional ablation of skin.
Study: We used a CO laser (Coherent Inc., Santa Clara, CA, USA), and a commercially and custom-built, pulse-width-modulated CO_2 laser (Lumenis Ltd., Yokneam, Israel) to irradiate *ex vivo* human skin. Exposure parameters such as similar spot size, pulse duration, and pulse energy were adjusted for the different lasers. There were differences in temporal pulse structure. CO laser parameters were spot size of 113 μm, pulse width of 2 ms, and pulse energies of 10–200 mJ. The fractional lesions were quantified by histology. The ablation-to-coagulation-ratio (ACR) served as an indicator for evaluation of ablation properties of the three laser types.
Results: We found conditions under which an etch depth of 1 mm was achieved with different amounts of the coagulation zones. Compared to the commercial CO_2 laser (0.16 ms, 25 mJ), a 35% smaller coagulation zone was obtained by the custom-built CO_2 laser (2 ms, 43 mJ) and a 50% larger coagulation zone by the CO laser (2 ms, 55 mJ). For the same setting (2 ms, 190 mJ), an etch depth of 2 mm with a 30% larger coagulation zone was produced by the CO laser in comparison to an etch depth of 3 mm by the CO_2 laser. There is a trend of lower ACR with the increase of optical penetration depth.
Conclusion: In this initial setup, the CO laser is capable of generating fractional lesions with slightly larger coagulation zones than the CO_2 laser. We plan to achieve deeper etch depths and a variation in thermal damage by alteration of exposure parameters.

#57

COMPARATIVE ANALYSIS OF THE EVENNESS OF LASER IRRADIATION BY A ROBOT *vs* HUMAN HAND: A PILOT STUDY OF THE IMPLICATION ON THE EFFECTIVENESS AND SAFETY OF ENERGY-BASED MEDICAL DEVICES

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Background: Few studies have been performed on laser-beam irradiation in contrast to studies on laser-beam emission, like selective photothermolysis and fractional photothermolysis. The importance of irradiation accuracy is highlighted by reports on the adversities of laser treatment such as post-laser burns and spotty hypopigmentation. However, a thorough study was not possible because of the intrinsic limitations arising from the inaccuracy involved in manual irradiation. The purpose of this study is to demonstrate the improvement in evenness of laser irradiation using a robot by comparative analysis with manual irradiation.
Study: After irradiating 462 shots of laser (spot size 8 mm) in a 100×105 mm rectangular region of interest (ROI) divided into 100 fractions with a robot arm and a human subject at frequencies of 30 and 10 Hz, the area, distances between centers of laser beams, and number of shots in each fraction were statistically compared after 10 trials with each subject at each frequency. The robot was set to irradiate to overlap 25.96% of the area of the previous shots and the human subject was asked to overlap 20–30% area.
Results: Robotic irradiation ($p < 0.05$) demonstrated consistency in distances between beams and distribution in fractions at both frequencies, and was significantly superior to manual irradiation in the ratio of area covered by beams to ROI, distances between beams, distribution in fractions at each frequency.

Conclusion: Robotic irradiation is more even, consistent, accurate, and, consequently, safer than manual irradiation. As the discrepancy in the evenness of irradiation between robotic and manual irradiation is expected to be greater on a three-dimensional surface like human face than on a two-dimensional one, using robotic irradiation in energy-based medical devices would be highly beneficial.

#58

PILOT STUDY ON *IN VIVO* MULTIPHOTON-MICROSCOPY OF LASER-INDUCED OPTICAL BREAKDOWN IN HUMAN SKIN

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Background: Improvements in skin appearance resulting from treatment with fractionated, pico-lasers have been noted but optimizing the treatment efficacy depends on a thorough understanding of the specific skin response. Multiphoton microscopy (MPM) is an imaging technique that allows non-invasive label-free *in vivo* imaging for monitoring the skin response to treatment. The purpose of this study was to demonstrate the capability of MPM to image in-vivo the skin response to fractionated non-ablative, pico-laser treatment and to describe the changes in human skin following this treatment.
Study: Two areas on the arm of a volunteer were treated with a fractionated picosecond Nd:YAG laser at the Dermatology Clinic, UC Irvine. The skin response to treatment was imaged *in vivo* with a clinical MPM-based tomograph (JenLab, Germany) at 8 time points over the following 4 weeks. Imaging was performed at the Beckman Laser Institute & Medical Clinic, Irvine, CA.
Results: MPM revealed micro-injuries present in epidermis. Damaged individual cells were distinguished 3 hours post pico-laser treatment with the 532 nm wavelength, and 2 4 hours post-treatment with both 532 nm and 1064 nm wavelengths. Pigmented cells were particularly damaged in the process, suggesting that melanin is the main absorber and the primary target for laser induced optical breakdown. At later time points, clusters of cellular necrotic debris were imaged across the treated epidermis. After 2 4 hours of treatment, inflammatory cells were imaged in the proximity of epidermal micro-injuries.
Conclusion: This observational and descriptive pilot study demonstrates that *in vivo* MPM imaging can be used non-invasively to provide label-free contrast for describing changes in human skin following a fractionated non-ablative laser treatment. The results presented in this study represent the groundwork for future longitudinal investigations on expanded number of subjects to understand the response to treatment in different skin types with different laser parameters, critical factors in optimizing treatment outcomes.

#59

COMPARISON OF TAILORED PRETREATMENT REGIMENS WITH MICRODERMABRASION VERSUS ABLATIVE FRACTIONAL LASER PRIOR TO DAYLIGHT PDT – A RANDOMIZED TRIAL

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Background: Skin pretreatment has the potential to ensure adequate penetration of topical photosensitizing agents and improve efficacy of photodynamic therapy (PDT). We aimed to compare the relative efficacy and safety of microdermabrasion (MD) versus ablative fractional laser (AFL) in patients with actinic keratosis (AKs) and photodamaged skin.
Study: An intra-individual, randomized, controlled trial, approved by Ethics Committee and following Good Clinical Practice guidelines. Patients were exposed to one daylight PDT session in two comparable side-by-side skin areas, each larger than 50 cm^2. Treatments were initiated by MD or AFL pretreatment according to randomization, followed by MAL (methyl aminolevulinate) cream and two hours of continued daylight exposure. Interventions with MD (skin preparation pads) and AFL (fractional Er:YAG laser, $\lambda = 2{,}940$ nm) were individualized to AK severity grade, anatomical location and clinical appearance of photodamage; tailored to induce pinpoint bleeding, MD pretreatment without an upper limit of number of swipes. Blinded outcome measures included local skin responses (LSRs) evaluated 1–6 days after treatment, as well as AK clearance, cosmesis and side effects at 12-weeks follow-up (FU).
Results: 18 patients (age 52–87 years, 67% men, skin type I–III) received treatment on the chest ($n = 6$ patients), scalp ($n = 5$) or face ($n = 7$). Targeted MD was first applied to AKs to remove hyperkeratosis (1–30 swipes according to AK thickness), followed by field treatment of the entire test area surface (2–10 swipes according to anatomical location). Similarly, targeted AFL was initially applied to AKs (e.g. 22% density, 50–150 μm to grade 2 AK), followed by field treatment (5.5% density, depth of microchannels adjusted to skin thickness, median 40 μm). LSRs appeared notably intensified 1–6 days after AFL compared to MD (18 of 18 patients), and consisted of transient erythema, edema, oozing, crusting. Three patients experienced superinfection with s.aureus, requiring antibiotic treatment. 12-week FU data will be presented, including AK clearance, cosmesis and long-term side effects.
Conclusion: Compared to MD, AFL induces stronger LSRs 1–6 days after daylight PDT. Whether this translates into enhanced treatment efficacy will be revealed at ASLMS 2017.

#60

A RETROSPECTIVE MULTISTUDY ANALYSIS OF AXILLARY ODOR REDUCTION FOLLOWING MICROWAVE TREATMENT

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Background: Microwave technology to reduce axillary sweat and hair has also been reported to reduce underarm odor. Results of a retrospective multi-study analysis of underarm odor reduction data in patients treated with a microwave device are presented.
Study: A retrospective statistical analysis of the odor reduction data from four clinical studies was conducted. The studies consisted of two IRB approved clinical investigations and two post-market clinical registries. Subjects graded severity of underarm odor on a 10-point scale (1: not a problem, 10: severe problem) at baseline, 3 and 12 months post treatment. High odor subjects were defined as having a baseline value of >5. Data was analyzed utilizing the distribution-free signed rank test.
Results: The combined clinical studies had 446 subjects enrolled and treated. At baseline, mean odor score was 5.49/10.

Statistically significant reductions from baseline were noted at both the 3 (2.40; $p < 0.0001$) and 12 month follow up visits (2.19; $p < 0.0001$). More than half of those enrolled were "high odor subjects (62.1%)." In this group, baseline score was 7.55/10, and greater changes from baseline were seen at both follow up points (3-month: 2.79, $p < 0.0001$; 12-month: 2.58, $p < 0.0001$).
Conclusion: Consistent reduction in subjective odor scores were observed at both 3 and 12 month follow up, most notably for patients with a high baseline odor, demonstrating effectiveness of treatment with a microwave energy device in reduction of underarm odor in addition to sweat and hair.

#61

EFFICACY OF COMBINATION THERAPY WITH EFINACONAZOLE 10% SOLUTION AND 1064 nm Nd:YAG LASER FOR TREATMENT OF TOENAIL ONYCHOMYCOSIS

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Background: Onychomycosis is found in approximately 10% of Americans. Recently, a novel topical anti-fungal agent called efinaconazole has been developed specifically for the treatment of onychomycosis. In addition the FDA has approved the use of neodymium-doped yttrium aluminum garnet (Nd:YAG) lasers for this indication. The objective of this study was to evaluate whether combination therapy of topical treatment with efinaconazole together with Nd:YAG laser has a synergistic effect that results in greater, more rapid clinical and mycologic cure rates.
Study: A total of 30 subjects were enrolled in the study. Group A ($n = 15$) was treated with efinaconazole 10% solution to their infected toe nails once daily for 48 weeks. Group B followed the same treatment plan as Group A, but additionally receive six treatments with a 1064 nm Nd:YAG laser spaced 4 weeks apart at the beginning of the study. Clinical assessments of the toenails were conducted at week 16, week 32, week 48, week 52, and KOH tests and fungal cultures were performed at screening, week 20, week 34, week 48, and week 52.
Results: Patients in both groups showed significant clinical improvement at the end of the treatment. In the treated nails, complete cure rates were 52% and mycologic cure rates were 55% at week 48. Clinical improvement at 12 and 24 weeks was 40% and 49% for group B, and 25% and 35% for group A.
Conclusion: Combination of efinaconazole topical solution, 10% with Nd:YAG laser results in faster clinical and mycological improvement of onychomycosis.

#62

A RANDOMIZED, SPLIT-FACE, EVALUATOR-BLIND CLINICAL TRIAL COMPARING MONOPOLAR RADIOFREQUENCY TO MICROFOCUSED ULTRASOUND WITH VISUALIZATION FOR LIFTING AND TIGHTENING OF THE FACE AND UPPER NECK

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Background: Over the past decade, two major modalities for non-invasive skin tightening have emerged. Monopolar capacitively coupled radiofrequency (mRF) uses radiofrequency energy to bulk heat the dermis and underlying tissues to 50–60 °C. In contrast, microfocused ultrasound with visualization (MFU-V) utilizes focused ultrasound to create multiple 65 °C, 1 mm 3 microthermal zones of coagulation at specific tissue depths. Although both technologies achieve dermal collagen contraction, denaturation, and remodeling, no comparative clinical trials have been performed to date. The objective of this study is to compare the efficacy and safety of mRF and MFU-V for the lifting and tightening of the face and upper neck.
Study: Twenty healthy females ages 30 to 60 with mild to moderate skin laxity of the face and upper neck were enrolled. Each half of the face and upper neck was randomized to receive one treatment with mRF, while the opposite half received MFU-V. The primary endpoint was the score on the Fasil Face/Upper Neck Laxity Scale performed by a blinded evaluator at 1, 3, and 6 months post-treatment. Secondary endpoints were blinded investigator assessment of adverse events, including erythema, edema, bruising, and contour irregularity, subject pain assessment, and degree of subject-assessed improvement.
Results: In the interim analysis, all patients have received treatment and 8 have completed the study. For all face and neck areas except for eyelids, the Fasil grade significantly improved with both mRF and MFU-V. There were no differences in Fasil scores between the two procedures. While all adverse events were mild in nature, the presence of a lesser degree of edema, bruising, and pain in the mRF treated side trended towards significance ($p = 0.12$. 0.076, and 0.098, respectively). There was no difference in subject-assessed improvement.
Conclusion: MRF and MFU-V were similarly efficacious in lifting and tightening the face and upper neck, with trends in decreased adverse events and discomfort with mRF.

#63

A PILOT STUDY OF THE COMBINED USE OF 755 nm ALEXANDRITE PICOSECOND LASER AND INTRADERMAL AIR DISSECTOR IN THE TREATMENT OF ATROPHIC ACNE SCARS IN ASIAN PATIENTS.

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Background: Physical and emotional effects of acne can last much longer than breakouts. Permanent scarring that is both emotionally heartbreaking to patients and medically challenging to treat for physicians. Traditionally, fractional laser technology is routinely used in the treatment of scars with thermal injury resulting in collagen synthesis and remodeling, however downtime and post inflammatory hyperpigmentation most especially for Asian patients need to be considered. The emergence of picosecond laser with a diffractive lens array which delivers ultra-short bursts of energy to the skin in trillionths of a second providing photomechanical impact or pressure waves. Picocurie's pressure wave reaches the target without injury to the surrounding skin, combined with intradermal air dissection where ambient air is injected to break fibrosis brought about by scarring this combination may be a new technologic advancement in the treatment of acne scars.
Study: Single center Cohort study was conducted, 25 Asian Patients, FP IV–VI with severe acne scaring, with no previous laser treatment had 3 sessions of combined treatment of 755 nm alexandrite picosecond laser using focused tip and Intradermal Air Dissector 4 weeks apart, the diameter of the widest and

deepest scars was measured before and a month after last treatment. Results were computed and statistically analyzed. Before and after treatment photos were documented and rated by a 3rd party clinicians. Patient satisfaction was also assessed.
Results: 20 patients completed the study, 85% showed statistically significant improvement in scar contraction and resurfacing (by measurement of diameter) after 3 combination treatment. Skin tightening and marked improvement in skin laxity was also observed. Patient satisfaction noted at 90%. No complications were noted after the treatment.
Conclusion: Atrophic acne scarring can be significantly improved by combining 755 nm picosecond laser and Intradermal air dissector treatment, with a wide margin of safety for Asian skin.

#64

FRACTIONAL 1064 nm and 532 nm PICOSECOND-DOMAIN LASER TREATMENT OF ACNE SCARS
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Background: A novel fractionated laser delivering 532 nm and 1,064 nm picosecond-domain pulses was used to treat facial acne scars, and assessed for safety and effectiveness.
Study: A total of 31 subjects were treated with a novel 1,064 nm or 532 nm, Nd:YAG, picosecond-domain laser fitted with a novel hand piece incorporating holographic beam splitters to create small fractionated microbeams. One group of subjects was treated with 1,064 nm ($n = 21$), and the other with 532 nm ($n = 10$) for 4 monthly treatments. Improvement in the appearance of acne scars was evaluated by blinded assessors comparing parallel-polarized photographs pre- and 3 months post-treatment.
Results: A total of 27 of the 31 enrolled subjects completed all study visits. A total of 81 image assessments were available for this analysis (27 image pairs, 3 assessors). The treated image was correctly identified in 61 of the 81 image assessments (one sided $p < 0.0001$). For the 61 follow-up images that were correctly identified, the mean percent improvement was 26% (range = 10 to 60%) for the 532 nm group and 25% (range = 10 to 60%) for 1064 nm group. Side effects were limited to mild-moderate erythema, edema, purpura and petechiae.
Conclusion: This novel fractionated picosecond-domain, 1064 nm and 532 nm Nd:YAG laser safely and effectively improved the appearance of facial acne scars.

#65

A SPLIT SCAR COMPARISON STUDY OF HYPERTROPHIC SCAR TREATMENT WITH FRACTIONAL LASER *vs* FRACTIONAL LASER-ASSISTED TOPICAL CORTICOSTEROIDS DELIVERY
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Background: Intralesional corticosteroids injection remains a gold standard treatment for hypertrophic scars but it is associated with pain during injection and is often complicated with side effects including skin atrophy, telangiectasia, hypopigmentation, hypertrichosis and acneiform eruption. Recent studied suggest fractional ablative lasers (FALs) may be used to facilitate delivery of topical drugs into the skin by creating channels between epidermis and dermis. We sought to compare the effectiveness for scar therapy and side effects of FAL alone with FAL-assisted topical corticosteroids delivery.
Study: On each of 20 patients, hypertrophic scars were divided into two segments. Both segments on all patients were randomly treated with a fractional Er:YAG laser alone (a fluence of 28 J/cm^2, pulse widths of 300 μs and 5% coverage), and a fractional Er:YAG laser, followed by immediate post-operative topical application of clobetasol ointment to both segments, every 2 weeks for a total of four treatments. Scar thickness and the patient and observer scar assessment scale (POSAS) were assessed by two blinded dermatologists and all study subjects at baseline, 2 weeks after the 2nd treatment, and 1, 3, and 6 months after the final treatment.
Results: The scar thickness of segments treated with FAL alone and FAL plus topical clobetasol decreased significantly after two treatments ($p < 0.001$). Scar improvement progressed significantly from 1- to 6-month follow-up ($p < 0.001$). There was no significant difference in scar thickness reduction between two treatment methods at all follow-up visits ($p = 0.945$). Reduction in scar thickness corresponded to the subjective evaluation of scar vascularity, pigmentation, pigmentation, thickness, irregularity, pliability using POSAS score. No adverse effect was observed on any of the treatment sites.
Conclusion: FAL alone is safe and effective for treatment of hypertrophic scar. Application of clobetasol ointment provides no synergistic effect to FAL.

#66

COMPARING THE 585/1064 nm MULTIPLEX LASER TO THE 585 nm PULSED DYE LASER IN THE TREATMENT OF SURGICAL SCARS
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Background: Surgical excision of skin lesions such as skin cancer often produces unsightly post-surgical scars that can have a profound effect on quality of life. Seamless wound closure and the use of topical agents can reduce the appearance of these scars, but results are highly variable and often suboptimal. Laser therapy used post-operatively have been shown to be beneficial by targeting blood vessels and reducing collagen formation. The most studied lasers seem to be pulsed dye lasers and fractional lasers (ablative and non-ablative). This study aims to determine the most effective laser for post-operative scar reduction by comparing two laser settings.
Study: We performed a single-blinded, randomized controlled trial involving light-skin surgical patients with closed wounds at least 3 cm in length. Three equal segments of each wound were each randomized into one of following interventions: 585 nm pulsed dye laser at 4 J/cm^2 with a 0.5 ms pulse duration, 585 nm pulsed dye laser with the same parameters followed by the 1064 nm Nd:YAG at 20 J/cm^2 with a 15 ms pulse duration, or no laser treatment (control). One pass of each laser was used with a 10 mm spot size and 10% overlap. Subjects received a total of three laser treatments separated by 4-week intervals. A blinded observer compared scar segments one month after the

last treatment. Two scars were monitored using optical coherence tomography.
Results: Ten patients completed treatment. Both laser treatments were more effective in reducing scar appearance compared to the control. Optical coherence tomography imaging confirmed thicker scar tissue and increased vasculature in the control group. There was no significant difference between the pulsed dye laser and the combination laser in reducing redness or thickness of the scar; however, clinically the combination laser group had more post inflammatory pigmentation changes.
Conclusion: The pulsed dye laser and the combination pulsed dye laser with Nd:YAG are both effective for reducing the appearance of post-surgical scars, but the pulsed dye laser alone produces less adverse effects. Optical coherence tomography is an effective noninvasive imaging device that can be used to monitor laser treatment.

#67

SAFETY OF NON-ABLATIVE FRACTIONAL LASER RESURFACING FOR ACNE SCARS WITHIN 30 DAYS AFTER TREATMENT WITH ORAL ISOTRETINOIN
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Background: It was reported in the 1980s that patients on isotretinoin have a higher risk of scarring and other complications if they undergo dermabrasion or laser procedures. Currently, laser resurfacing for acne scar revision is only recommended 6 to 12-months after the completion of oral isotretinoin treatment. Our aim was to evaluate the safety of non-ablative fractional laser resurfacing for acne scars in patients who have completed oral isotretinoin treatment within the previous 30 days.
Study: This was a randomized split face study involving 10 patients (10 females, ages 18–31 years), Fitzpatrick Skin Types I to III, with mild to moderate facial atrophic acne scars. All patients had completed oral isotretinoin treatment (>120 mg/kg) within the previous 30 days. One side of the face underwent three treatments of erbium-doped 1,550 nm fractional non-ablative laser at 1-month intervals. Fluences ranged from 35 to 40 mJ/microthermal zone. Treatment levels varied from 7 to 10 corresponding to treatment coverage of 20% to 35%. The non-treated side acted as a control. Patients were followed up 7 days after each treatment as well as 6-months after first treatment. Using digital photography, two blinded independent physicians performed evaluations for adverse effects (erythema, edema, blistering, crusting, scarring, and hyperpigmentation) of the laser treatment at each visit and improvement in acne scarring at 6-month follow-up.
Results: All patients showed normal wound healing. The adverse events were minor, and there were no hypertrophic scars or keloids. So far, two patients have completed the 6-month follow up and had a 25% to 50% improvement in acne scarring. Both these patients were satisfied with the results of the laser treatment and will now undergo laser treatment of the non-treated side.
Conclusion: Non-ablative fractional laser treatment for acne scarring seems to be safe in patients who have completed oral isotretinoin treatment within the previous 30 days.

#68

AUTOLOGOUS CELL SUSPENSION GRAFTING FOR DEPIGMENTED SKIN: A RANDOMIZED CONTROLLED TRIAL COMPARING FULL-SURFACE AND FRACTIONAL CO_2 LASER RECIPIENT SITE PREPARATION
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Background: Full surface Carbon Dioxide (CO_2) laser ablation is frequently used to prepare the recipient site before autologous epidermal cell suspension transplantation. However, optimal laser settings and ablation depth are unclear. Fractional CO_2 laser may be another, less invasive, option as pretreatment.
Study: We designed a randomized, observer-blinded, controlled, split lesion trial to compare different recipient site preparations before cell suspension transplantation in depigmented skin lesions. In each patient, we randomly allocated four depigmented skin regions to 1) 209 μm full surface ablation 2) 144 μm full surface ablation 3) fractional ablation and 4) control (no ablation). Directly after the laser procedure we applied the autologous epidermal cell suspension to the skin. After six months we assessed repigmentation and side-effects.
Results: We included 10 patients with depigmentations. Compared to the control site, we found higher repigmentation after 209 μm (median 68.7%, $p = 0.01$) and 144 μm (median 58.3%, $p = 0.007$) full surface ablation, but not after fractional (median 0.0 %, $p = 0.14$) ablation.
Conclusion: Superficial full surface ablation with an estimated depth of 150 μm is effective to prepare recipient sites before cell suspension transplantation while fractional CO_2 laser, using our specific settings, is not.

#69

RESPONSE TO LASER TREATMENT OF CAFÉ-AU-LAIT MACULES BASED ON MORPHOLOGIC FEATURES
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Background: Café-au-lait macules (CALM) are common uniformly pigmented patches that arise in infancy and are characterized by basal layer hyperpigmentation. They respond variably to treatment with Q-switched lasers, and no features have yet been reported to predict clinical outcome.
Study: This was a retrospective chart review of patients who presented to our practice with a clinical diagnosis of CALM treated with Q-switched or picosecond lasers. CALMs with typical rounded, smooth, and well-defined margins were considered "coast of California" subtype while those with jagged, geographic, or poorly defined margins were considered "coast of Maine" subtype. Four physicians were asked independently to categorize each and rank improvement with pre-and post-treatment photographs. Lesions were only included if three of four physicians agreed on subtype.
Results: Forty-five patients were included in the series, 19 with California lesions and 26 with Maine. The two groups had similar mean age at treatment (13 and 14 years old respectively), and California lesions on average received a greater number of treatments (6.7 *vs* 4.8). Assessment revealed excellent response (76–100% improvement) in 80% of Maine

lesions compared with 8% of California lesions. In contrast, poor response (0–25% improvement) was observed in 54% of California lesions compared with 5% of Maine lesions. While 78% of California lesions had less than 50% improvement, 93% of Maine lesions had greater than 50% improvement.
Conclusion: CALM with jagged or ill-defined borders of the "coast of Maine" subtype tend to respond well to laser treatment, whereas those with smooth and well-defined borders of the "coast of California" subtype tend to have poor response. This morphologic distinction provides insight into these often difficult-to-treat lesions. Clinicians using Q-switched or picosecond lasers to treat CALM can use morphology to help predict response and more effectively manage patient expectations.

#70

CLINICAL EVALUATION OF A PICOSECOND LASER FOR THE TREATMENT OF SOLAR LENTIGINES
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Background: Solar lentigines are one of the most commonly found skin lesions in the general population older than 60 years of age, especially in areas of chronic sun exposure such as the face, the upper chest, and the dorsal hands. Lasers can be used to treat such unwanted pigmented lesions on the skin. A 532 nm laser, for example, can be used to target melanin found in pigmented lesions. By producing pulses shorter than the thermal relaxation time of melanosomes, the laser can selectively destroy targeted melanin. Picosecond lasers produce a significantly shorter pulse width (0.5 nanoseconds) compared to Q-switched lasers (50 nanoseconds) and may produce better treatment results. The current study was designed to evaluate the 532 nm picosecond laser as treatment for solar lentigines.
Study: A prospective study to evaluate the efficacy of treating solar lentigines using a picosecond laser was performed. Fifteen patients with solar lentigines on their dorsal hands were enrolled. The treatment parameters were 0.64 J/cm^2, 2 mm spot size, and pulse width of 500–550 picoseconds. Each patient received four treatments to both hands every 4 weeks (+/− 2 weeks), with follow-up evaluations at 1 month and 3 month post last treatment. Digital photographs were taken at each visit. Patient and investigator satisfaction were assessed. Investigators as well as two clinicians independently assessed global aesthetic improvement at 1 month and 3 month post last treatment.
Results: Twelve patients completed the study. Eleven were female. All were Caucasians, with ages ranging from 52–70. Patients were Fitzpatrick skin types I–III. The average pain score on a 0–10 scale was 2. On average, the pain severity was mild and lasted 1 days following treatment, and mild crusting lasted 8 days following treatment; swelling, itching, and blistering were absent. Both patients and physicians were satisfied with the treatment and the physician global aesthetic improvement was evaluated to be very much improved and as having optimal cosmetic result. Patients were extremely likely to recommend the treatment to a friend or family member.
Conclusion: The 532 nm picosecond laser is safe and effective in the treatment of solar lentigines in Fitzpatrick skin type I–III patients.

#71

COMPARISON STUDY OF A 755 nm PICOSOND LASER *vs* A 755 nm NANOSECOND LASER IN THE TREATMENT OF DERMAL MELANOSIS
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Background: Since the introduction of selective photothermolysis, short pulse lasers such as Q-switched lasers (nanosecond lasers) have been used for the treatment of dermal pigmented lesions. Recently, picosecond lasers were investigated. We performed a study comparing a 755 nm picosecond laser versus a 755 nm nanosecond laser, with the purpose of evaluating the clinical efficacy and complications of dermal pigmented lesion removal when using these lasers.
Study: Five Asian patients with pigmented lesions (four nevi of Ota, one acquired dermal melanosis) were enrolled in the study. Each patient was treated with a 755 nm nanosecond laser (Syneron Medical Ltd., Israel) and a 755 nm picosecond laser (Cynosure Westford, MA). The clinical endpoint for fluence choice was immediate whitening of the treated area. The spot size of each laser was 2.5–3 mm. Four treatment sessions were performed. Patients were examined a week and 3–6 months after the laser treatment.
Results: All patients tolerated the treatments well. The number of sites that achieved 50% or more clearing is 3 (60%) with the nanosecond laser and 5 (100%) with the picosecond laser. Mild hyperpigmentation was observed in one patient treated with the nanosecond laser. The hypopigmentation was temporary and resolved in 4 weeks. There was no scarring in any of the patients.
Conclusion: The 755 nm picosecond laser is safe and effective in the treatment of dermal pigmented lesions.

#72

SUCCESSFUL AND SAFE USE OF Q-SWITCHED LASERS IN THE TREATMENT OF NEVUS OF OTA IN CHILDREN WITH PHOTOTYPES IV-VI
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Background: Nevus of Ota represents congenital dermal melanocytosis in a trigeminal distribution, most commonly occurring in Asian individuals and other individuals with skin of color. Patients with nevus of Ota suffer from psychosocial distress and therefore benefit from early treatment. Multiple reports have shown efficacy and safety with Q-switched lasers in adults. Few reports have demonstrated this in children, and fear remains among laser surgeons around treating nevus of Ota in pediatric patients with skin of color. This series was done to demonstrate safe and effective use of Q-switched laser therapy in children.
Study: This was a retrospective chart review of patients under 18 years old who presented to our practice within the last 15 years with a clinical diagnosis of nevus of Ota who were treated with Q-switched lasers (694 nm, 755 nm, or 1064 nm). Percentage of improvement as well as side effects were rated by four physicians independently. Improvement was rated in

quartiles (0–25%, 26–50%, 51–75%, and 76–100% improvement).
Results: Twenty seven patients were identified, 22 of which had completed treatment. The average age at the start of treatment was 3.6 years old (range of 3 months to 12.4 years), and patients were Fitzpatrick types IV through VI. The average number of treatments was 6.7. All patients were treated with topical or no anesthesia, and corneal shields were used for periorbital treatment in appropriate cases. Assessment revealed excellent response (76–100% improvement) in 67% of patients who completed treatment and good to excellent response (51–100% improvement) in 86%. Fourteen of 22 (64%) had complete clearance. Three of 27 patients (11%) had focal post-inflammatory hyperpigmentation.
Conclusion: Treatment of nevus of Ota with Q-switched lasers in children with skin of color is safe and effective. Early treatment is important to prevent psychosocial distress in later childhood and adulthood.

#73

PROSPECTIVE, SPLIT-FACE, EVALUATOR-BLINDED STUDY OF PICOSECOND ALEXANDRITE 755 nm LASER *vs* Q-SWITCHED ALEXANDRITE 755 nm LASER ON FRECKLES IN CHINESE

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Background: Freckle is a common concern in Chinese. Q-switched lasers and intense pulsed light have shown removing freckles effectively. Recently, picosecond lasers of various wavelengths were introduced with proven efficacy in the treatment of freckles. The objective of this study was to compare the efficacy and safety of a picosecond 755 nm alexandrite laser (PAL) and a Q-switched 755 nm alexandrite laser (QSAL) for the treatment of freckles in Chinese.
Study: Using a split-face method, twenty patients of Fitzpatrick skin types III–IV were enrolled in this study. All subjects received one treatment with PAL and QSAL on each side of their faces randomly. The average fluence used was 4.4 J/cm^2 for PAL and 6.9 J/cm^2 for QSAL. All patients were followed up until 8 weeks after treatment. Photographs were taken at baseline and two months follow up after treatment. Images were evaluated independently by three dermatologists. A score of 1–4, representing poor 0–19%, good 20–59%, excellent 60–89%, and complete 90%-100% improvement was given. The Visual Analogue Scale (VAS) and adverse events were also recorded.
Results: Excellent to complete improvement have been achieved in all patients after one treatment. A statistically significant difference of average fluence for the treatments of PAL compared with QSAL ($p < 0.05$; Wilcoxon rank sum test) was observed. There was no significant difference between two types of lasers in the VAS ($P > 0.05$; paired T-test). No significant difference in post-inflammatory hyperpigmentation from both lasers was observed. The pain scale was not significantly different with both lasers. However, shorter downtime was observed in the PAL treated side compared to QSAL.
Conclusion: The 755 nm picosecond alexandrite laser showed significant clearance for the treatment of freckles in Chinese.

#74

SAFETY AND EFFICACY OF THE 755 nm PICOSECOND LASER WITH DIFFRACTIVE LENS FOR THE TREATMENT OF FACIAL MELASMA IN CHINESE

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Background: Due to the recurrent and refractory nature of melasma, management remains a challenge. The use of various lasers to treat melasma including Q-switched Nd: YAG, Q-switched alexandrite, pulsed dye laser and various fractional lasers have all been explored. The objective of this study is to investigate the efficacy of a 755 nm picosecond laser with diffractive lens for the treatment of facial melasma in Chinese.
Study: 13 Chinese subjects with facial melasma were recruited. A total of 6 sessions at 4 week intervals were delivered. Treatment parameters were 0.71 J/cm^2, 6 mm, 10 Hz, total 4 passes and clobetasone 0.05% cream BD for 3 days post-treatment. Standardized photos were taken at baseline, prior to each treatment session and 1, 2 & 3 moths follow up. Two independent physicians evaluated the photos and the operator rated the global aesthetic improvement post-third treatment onwards. Subjective evaluation and pain score were collected.
Results: Total of 49 sessions have been performed and the mean pain score is 4.4/10. At one month post third treatment, 57% had improvement in pigment reported by the operator by means of the global aesthetic improvement. The MASI score will be evaluated by two independent physicians.
Conclusion: Some improvement is observed in the treatment of melasma, by the 755 nm picosecond laser with diffractive lens in Chinese.

#75

CLEARANCE OF PROFESSIONAL MULTICOLOR TATTOOS WITH A NOVEL 785 nm PICOSECOND-DOMAIN LASER

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Background: Green, blue and purple tattoo pigments are often the colors most resistant to laser removal. Recently, the first ever picosecond-domain laser with a 785 nm wavelength was developed to improve the rate of clearance of green, blue and purple tattoo inks.
Study: Twenty-two tattoos from 15 subjects with skin phototypes II–IV were enrolled at in the study. A total of 4 treatments were administered using a single 785 nm picosecond-domain laser wavelength. Blinded assessment of digital, cross-polarized photographs taken approximately 4 weeks following the last treatments was performed using a 10-point clearance scale.
Results: Fourteen subjects with 21 tattoos completed all study visits. The 21 tattoos contained the following pigments: black ($n = 15$), green ($n = 13$), blue ($n = 8$), purple ($n = 4$), red ($n = 3$), and yellow ($n = 5$). Treatments were performed with a 2–4 mm beam diameter and fluences ranging from 0.8 to 3.7 J/cm^2.

Blinded assessment of photographs found 85%, 81%, 74%, 61%, 11% and 5% clearance from baseline photos for purple, blue, green, black, red and yellow pigments, respectively. Treatments were well tolerated with typical erythema, edema and pinpoint bleeding, and no scarring was noted.
Conclusion: This first study of a new 785 nm picosecond-domain laser demonstrates safe and effective removal of multicolor tattoos. Although clearance was shown for a multitude of colors including black, the 785 nm laser wavelength has special affinity to purple, blue and green tattoo pigments.

#76

Q-SWITCHED LASER TREATMENT OF TATTOOS USING A TRANSPARENT PERFLUORODECALIN-INFUSED PATCH: A PIVOTAL TRIAL
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Background: Treatment of tattoos with a Q-switched laser is associated with opaque epidermal whitening that prevents multiple sequential passes during a single treatment session. This epidermal whitening may be prevented by topical application of perfluorodecalin (PFD), which is an optical clearing agent. This pivotal trial assessed the ability of a transparent PFD-infused patch to increase the number of Q-switched laser passes that could be made in a defined, 5-minute treatment session compared with a conventional through-air interface.
Study: Thirty subjects (mean age 37 years; 14 males and 16 females) with predominantly dark blue or black tattoos were enrolled in a split-tattoo trial. One half of each tattoo was treated conventionally through an air-tissue interface, whereas the other half was treated through the PFD-infused patch. Treatments were performed using a Q-switched 755 nm alexandrite laser. The number of treatments performed in a 5-minute time period was quantified for each side of the tattoo.
Results: Using the PFD-infused patch, a mean of 3.7 ± 0.7 passes could be made, compared with 1.4 ± 0.6 passes without the patch. Compared with the side without the patch, the PFD-infused patch enabled a mean of 2.3 additional passes to be made (standard deviation $= 0.7$; sign test $p < 0.0001$). Adverse events were limited to those expected during laser removal of tattoos. The proportions of subjects with transient edema and erythema were lower in the PFD treatment group (36.7 *vs* 63% and 33.3 *vs* 70%, respectively). When surveyed at the 1-month follow-up visit, all subjects (30/30) preferred to continue laser-assisted tattoo removal with the PFD-infused patch.
Conclusion: Significantly more laser passes can be made in a defined 5-minute treatment session with a Q-switched alexandrite laser when using the transparent PFD-infused patch compared with conventional treatment. Treatments using the patch were well tolerated.

#77

EVALUATION OF EFFICACY AND SAFETY OF 500-600 nm INTENSE PULSED LIGHT IN TREATING FACIAL TELANGIECTASIA
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Background: Diffuse facial telangiectasia is clinically manifested as redness of the face, leading to burning sensation and much discomfort. Treatment modality with high efficacy and less side effects is required and narrow-band intense pulsed light (IPL) is a good candidate.
Study: This is a prospective clinical study. To evaluate the efficacy and safety of narrow-band IPL in treating facial telangiectasia, patients with facial telangiectasia underwent 5 sessions of treatment with narrow-band IPL (500nm $\sim$ 600 nm) at 4-week interval. Clinical response was evaluated with an imaging system. The erythema index (EI) and trans-epidermal water loss (TEWL) were measured before each treatment session and at each follow-up.
Results: 25 cases completed treatment and follow-ups. 90% got more than 50% clearance post-treatment and about 25% got more than 75% clearance. The average of the mean EI decreased with the number of treatment, the EI observed after 2 treatment sessions was significantly different from that observed before treatment ($p < 0.05$). The decrease of TEWL post-treatment was statistically significant ($p < 0.05$). There were some cases of recurrence at 6-month follow-up. Burning sensation, erythema and swelling were usually seen during the treatment, no severe side effects were observed during the treatment and follow-ups.
Conclusion: Narrow-band IPL is effective and safe in treating facial telangiectasia.

#78

EVALUATION OF THE SAFETY AND EFFICACY OF MICROFOCUSED ULTRASOUND WITH VISUALIZATION (MFU-V) FOR THE TREATMENT OF SIGNS AND SYMPTOMS OF ERYTHEMATOTELANGIECTATIC ROSACEA- FINAL DATA
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Background: It is hypothesized that creation of focal lesions in the dermis and sub-dermis may affect the symptoms of erythematotelangiectatic rosacea as indicated by results from an initial pilot study. The purpose of this study is to further evaluate the safety and efficacy of MFU-V in improving the signs and symptoms of erythematotelangiectatic rosacea.
Study: 88 subjects were enrolled/randomized. Subjects received up to two dual-depth treatments (4–4.5 mm, 7–3.0 mm, and 10–1.5 mm transducers) two weeks apart. Treatment groups were high (Group C [n = 24] & D [n = 22]) or low density (Group A [n = 20] & B [n = 22]) and one or two treatments. Standardized photographs were taken. A 5-point Clinical Erythema Assessment (CEA) scale, Patient Self-Assessment of Erythema (PSAE), and Colorimeter Assessment were completed at baseline and follow-up visits.
Results: Currently 84 subjects are enrolled. Baseline CEA: 87.5% moderate and 12.5% severe rating. Baseline PSAEs: 4.5% mild, 81.8% moderate, and 13.6% severe. Interim results are provided for the leading group for each endpoint and time point.

CEA improvement (≥1-grade improvement): D90 is Group C (91%, n = 23); D180 is Group A (95%, n = 19); and D365 is both Group B (94%, n = 18) and Group C (94%, n = 18). PSAE Improvement: D90 is Group D (74%, n = 19); D180 is Group D (75%, n = 20); and D365 is both Group B (72%, n = 18) and Group C (72%, n = 18). All groups are showing responders across all endpoints. An analysis across all endpoints will be completed with final data. No serious adverse events have been reported.
Conclusion: Results indicates similar to pilot study data that MFU-V may be effective for the treatment of erythematotelangiectatic rosacea.

#79

NOVEL VERY SHORT PULSE INTENSE PULSED LIGHT DEVICE *vs* PULSED DYE LASER FOR TREATMENT OF FACIAL REDNESS
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Background: To define safe and effective irradiation parameters for facial redness with a new flash lamp device (Ellipse) and compare it with the pulsed dye laser (PDL)
Study: This was a prospective study measuring reduction of rosacea-associated facial redness. In the first part of the study for every patient, safe working parameters were established in a test spot portion of the red face. These test sites will be based on the lowest light dose tolerated by the rosacea area that established transient purpura. For the PDL test spots an earlier optimized fixed pulse duration of 1.5 ms is used. For IPL test spots, the pulse duration will range from 1.5 ms − 2.3 ms. In the second part of the experiment, the entire face was divided into two segments, (a) one segment receiving the light dose at 1.5 ms with PDL, (b) the other with the IPL with optimized pulse duration/fluence combination found by the spot test 1.5–2.3 ms. Two treatments were performed one month apart. All patients returned for a final follow-up visit 2 months after the final treatment. At all follow up visits, standardized photographs were taken as described above (including both a global and close-up view). Also, the spectrophotometer (redness-pigment meter) was applied to objectively assess skin redness and pigmentation. At each follow up evaluation visit, investigators ranked the change of treated lesions or redness, pain tolerance, and other skin reactions using the subjective scale below.
Results: The range of settings that caused flash purpura (a short lived bluish tinge) ranged from 4 J/cm^2- 4.5 J/cm^2 with the PDL and from about 4.7 J/cm^2 − 5 J/cm^2 with the PR (photo rejuvenation) IPL hand piece. Pain was modest for both devices. Patients reported about 2-4/10 pain during the full treatment sessions. Edema and erythema were short lived for both devices, typically the erythema almost completely resolving by the end of the appointment. The purpura threshold, not unexpectedly, varied according the preexisting degree of facial redness. With increasing redness, the PT decreased to about 4.7 J/cm^2 with the PR hand piece, and with a decreased degree of initial redness, the purpura threshold was observed at around 5 J/cm^2. In most cases, there was a sharp cutoff between sub and *supra* purpura threshold fluences for both PDL and PR hand pieces. During the full treat sessions, most patients reported minimal discomfort. Two months after the 2nd treatment, the redness on the PR side was reduced by an average of 60% and 50% and on the PDL sides, respectively, *via* review of the photographs. The spectrophotometer measurements reported a 35% change and 25% decrease in the erythema index, respectively for the PR and PDL hand pieces. The average pulse count for full coverage was about 160 for the PDL and about 42 for the PR hand piece (consistent with the area differences in a single spot with the two hand pieces). The average operative time for the two devices (treating one half of the face) were about 5 minutes for the PDL side and 2 minutes for the PR- IPL.
Conclusion: Both a short-pulsed IPL and PDL can reduce diffuse facial redness.

#80

PATIENT SATISFACTION FOR VASCULAR TREATMENT FOR ROSACEA
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Background: Rosacea patients report self-consciousness and embarrassment from the all-to-visible signs of this common, chronic inflammatory condition. Laser therapy is a promising treatment option, particularly vascular lasers to address erythematotelangiectatic and papulopustular rosacea. This study compared patient side effects and satisfaction following split-face treatment with a 532 nm potassium titanyl phosphate (KTP) laser and an active control 595 nm pulsed-dye laser (PDL) for treatment of erythematotelangiectatic and papulopustular rosacea.
Study: This was a randomized, split-face study of a 532 nm KTP laser (Cutera, Brisbane, CA) versus a 595 nm PDL (Syneron-Candela, Irvine, CA) active control. Twenty-two subjects (18 female, 4 male) average age of 50 years (range 29–70) with erythematotelangiectatic or papulopustular rosacea received 3 laser treatments spaced 4 to 6 weeks apart and were followed for 6 weeks after final treatment. Treatment effect was evaluated through blinded photographic assessment by physician panel, comparison of skin redness using spectrophotometer measurements and subject satisfaction. Pain (0–10 numeric rating scale) and adverse events associated with each laser treatment were recorded.
Results: Subjects reported high satisfaction after 3 laser treatments and all were likely to recommend the laser treatments to other patients suffering from rosacea. Average pain scores during KTP and PDL treatment were 6.1 and 5.3, respectively. As expected with vascular lasers, subjects exhibited post-treatment erythema and edema, which resolved without sequelae. One subject developed purpura on both treatment sides following the first treatment only. Reduction in spectrophotometer values at 6 weeks post-treatment was consistent with blinded physician and subject assessments of improvement in telangiectasia and diffuse redness.
Conclusion: Vascular lasers such as KTP and PDL are a valuable treatment option to offer patients with erythematotelangiectatic and papulopulstlar rosacea. This study demonstrated high patient satisfaction, supported by qualitative improvement in skin redness, and low incidence of adverse effects.

#81

ONE-YEAR FOLLOW UP OF A TRASER CLINICAL TRIAL FOR THE TREATMENT OF NASAL TELANGIECTASIAS
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Background: The TRASER is a novel, highly tunable optical device that safely and effectively clears nasal telangiectasias. In a recent clinical trial, a single TRASER treatment reduced >75% of visible peri-nasal blood vessels in the majority of subjects at the 4-week follow up. Because the hallmark of successfully treated vascular lesions is long lasting results, we evaluated the efficacy of the TRASER for the treatment of nasal telangiectasias at one-year follow up.
Study: Of the 13 subjects included in the TRASER clinical trial efficacy analysis, nine returned for one-year follow up evaluation. Standardized photographs were taken for comparison to baseline. The same evaluator graded vessel clearance using the 5-point Telangiectasia Score: 1 = no clearance or worsening (< 5% clearance), 2 = slightly clear (5%-25% clearance), 3 = moderately clear (25%-50% clearance), 4 = almost clear (50%-75% clearance), 5 = completely clear (75%-100% clearance). Data was compiled and analyzed.
Results: Of the nine subjects with available follow up data, four (44%) maintained a grade 5 score of "completely clear," four (44%) dropped to a grade 4 score of "almost clear," and one (11%) dropped to a grade 3 score of "moderately clear." All showed clinically significant improvement from baseline. There was no apparent correlation between the number of treatments performed to achieve the clinical trial endpoint (grade 5 vessel clearance), and the graded vessel clearance score at one-year follow up.
Conclusion: At one-year follow up the majority of subjects (8/9) had 50% or greater improvement in their nasal telangiectasias, with half of the subjects (4/8) maintaining a "completely clear" grade and the rest dropping one grade to "almost clear." The TRASER effectively treats nasal telangiectasias with minimal recurrence at one year following one or two treatment sessions.

EARLY CAREER AND LUMINARY PEARLS

#82

COMPARISON OF PICOSECOND AND NANOSECOND PULSE DURATIONS IN TREATMENT OF BLACK TATTOOS

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Background: The newest generation of tattoo removal lasers in the marketplace have a pulse duration in the picosecond range. There have been conflicting reports in the literature regarding the optimal pulse duration for tattoo removal. Previous studies have compared a picosecond laser from one manufacturer and a nanosecond laser from another manufacturer using tissue reaction as a treatment endpoint.
Study: Two previously untreated professional tattoos with black ink only were divided in half and each half was treated with the same device using the same settings (1064 nm, 4 mm, 2 J) except that one side was treated with a picosecond pulse width (450 ps) and the other was treated with a Q-switched nanosecond pulse width (6 ns). The tattoos were evaluated six weeks later by a blinded observer.
Results: More fading of the tattoo ink was noted with the picosecond pulse duration than with the nanosecond pulse duration. Healing time and adverse effects were same with both pulse durations.
Conclusion: In our small proof of concept study using the same device to generate both the picosecond and nanosecond pulse durations, the tattoo ink treated with the picosecond pulse width faded better after one treatment compared to the nanosecond pulse duration without increase side effects.

#83

ULTRASONIC MODULATION OF TISSUE OPTICAL PROPERTIES TO INCREASE TRANSDERMAL LIGHT TRANSMISSION

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Background: Applications of light-based energy devices involving optical targets within the dermis frequently experience negative side-effects resultant from surface scattering and excess optical absorption by epidermal melanin. As a broadband optical absorber, melanin decreases the efficacy of light-based treatments throughout the ultraviolet, visible, and near-infrared spectra, while also generating additional heat within the surface tissue that can lead to inflammation or tissue damage. Consequently, many procedures are performed using greater energy densities so as to ensure that the target receives a clinically relevant dose of light; however, doing so tends to exacerbate the detrimental complications of melanin absorption. The technique presented herein represents an alternative method of operation aimed at increasing epidermal energy fluence while mitigating excess absorption by unintended chromophores.
Study: The approach involves the application of continuously pulsed ultrasound to modulate the tissue's optical properties and thereby improve light transmission through the epidermis. To demonstrate the change in optical properties, pulsed light at a wavelength of 532 nm from a Q-switched Nd:YAG laser was transmitted into 4 mm thick samples of pig skin, comprised of both epidermal and dermal tissue. The light was transmitted using an optical waveguide, which allowed for an ultrasonic transducer to be incorporated for simultaneous coaxial pulsation in parallel with laser operation. Light transmitted through the tissue was measured by a photodiode attached to an integrating sphere.
Results: Increasing the driving voltage of ultrasonic pulsation resulted in an increase in mean transmitted optical power of up to 26.23% above the control wherein no ultrasound was applied, after which the optical power increase plateaued.
Conclusion: The increase implies a reduction in light either back-scattered or absorbed within the tissue, which would allow for a greater proportion of incident energy to be delivered to the clinical target, thereby improving procedural efficacy and potentially reducing the severity of detrimental side-effects.

#84

SURGICAL OUTCOMES OF LENTIGO MALIGNA MELANOMA PREVIOUSLY TREATED COSMETICALLY AS BENIGN PIGMENTED LESIONS

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Background: Lentigo maligna (LM) is a type of melanoma *in situ* occurring on chronically sun-damaged skin, often on the head and neck. LM may be diagnostically challenging due to overlapping features with benign pigmented lesions (BPL). Misdiagnosis can have important consequences, as cosmetic treatments to BPLs may be inappropriately performed on LM, obfuscating subsequent detection of malignancy or delaying diagnosis. The aim of this study is to estimate the prevalence of biopsy-proven LM with a history of prior cosmetic treatment, and to evaluate the surgical outcomes.
Study: With IRB approval, a retrospective review was performed of all consecutive cases of biopsy-proven LM presenting for management over a ten-year period (2006–2015). Information was obtained regarding prior cosmetic treatment of their biopsy-proven LM and any prior biopsies. Outside records along with clinical and surgical reports were reviewed for demographic data, lesion characteristics, histological features, and surgical outcomes.
Results: Five hundred three patients met inclusion criteria. Thirty-seven patients (7.4%) reported a history of prior cosmetic therapy. All but two lesions were located on the head and neck. The mean lesion size was 1.9 cm (range 0.3 −5.5 cm). Prior cosmetic treatments included cryotherapy, laser treatment, topical bleaching agents, and electrodessication and curettage. Ten patients (27%) were treated with 2 or more modalities. Eight patients (21.6%) reported a prior benign biopsy. Six patients (16%) had invasive disease (depth 0.2 mm − 1.25 mm); 2 on initial biopsy and 4 detected upon complete excision. Average margin required for clearance was 9.1 mm (range 3–23 mm).
Conclusion: Prior cosmetic treatment of LM presenting for definitive surgical excision is not uncommon, and may delay diagnosis and obscure borders, resulting in wide clinical margins for clearance and higher rates of invasive disease. Clinicians must maintain an awareness of possible alternate diagnoses of BPL, especially for lesions occurring on sun-damaged skin of the head and neck. A biopsy confirming the benign nature of any equivocal lesion should be considered prior to cosmetic treatment.

#85

SUCCESSFUL TREATMENT OF MELASMA USING A MODIFIED KLIGMAN FORMULA COMBINED WITH A LOW FLUENCE QS Nd:YAG LASER
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Background: Melasma is a common chronic disorder of acquired hyperpigmentation that most often affects women of childbearing age. Its pathogenesis involves a complex interplay of genetic predisposition, hormonal influences, and ultraviolet exposure. Dyspigmentation diminishes patients' quality of life, and furthermore, effective treatment is limited due to the refractory and recurrent nature of melasma. This study sought to determine if the combination of a modified Kligman formula followed by low fluence Q-switched (QS) Nd: YAG 1064 nm laser treatment improves mixed epidermal/ dermal melasma.
Study: This was a twelve-month, single center cohort study of patients with skin types II–V (age 25 to 60) with melasma unresponsive to topical therapy and strict sun protection (along the visible and UV range wavelengths). A number of patients noted significant emotional and social distress resulting from melasma. Clinical treatments with the 1064 nm Q-switched Nd:YAG laser over the affected areas with hyperpigmentation were performed in the Stanford Dermatology outpatient clinic. Laser settings included a fluence of 2.0 to 3.5 J/cm^2 with a 6 mm spot size with 2 to 4 passes per treatment (with an endpoint of mild erythema post-treatment). Treatments were spaced 2 to 4 weeks apart. Clinical photographs were used to assess treatment response from baseline.
Results: At 3 months and 6 months, the majority of patients reported excellent treatment tolerability and significant reduction in their melasma, with the ability to maintain response using topical therapy and strict photoprotection. On average, therapeutic response became evident after at least five treatments with the QS Nd:YAG laser in this study.
Conclusion: In patients with refractory melasma, the combination of a modified Kligman formula and a low fluence 1064 nm QS Nd:YAG laser treatment series is a safe, effective, and reproducible treatment modality that improves patients' hyperpigmentation and psychological state. Appropriate maintenance therapy can thereafter facilitate durability of treatment response.

#86

MANAGING MELASMA WITH FRACTIONAL CO_2 LASER
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Background: Melasma is a brown hyperpigmentation of the skin with predominance on the face. It affects mostly women and is related to hormonal alterations. It is a chronic and recurrent disorder found in all racial groups with prevalence in high phototype individuals. There are various treatments available for melasma, from topical to oral medications and the use of technologies, in which fractional CO_2 laser has appeared as a treatment option.
Study: To compare treatments using fractional CO_2 laser in monotherapy with fractional CO_2 laser associated with daily topical depigmentation treatment. Two groups of ten female patients were selected, Fitzpatrick phototypes II to IV, diagnosed with dermal melasma by Wood's lamp examination in the bilateral malar region. Both groups underwent three laser sessions over a period of three months, with monthly intervals between the sessions. Parameters used were 500 μm tip, 60 mJ energy, 75 J/cm2 density, and 30 W power. One group did only the CO_2 laser sessions while the other group underwent laser sessions with 4% hydroquinone topical therapy daily at home during the three proposed months of treatment. Response to treatment was evaluated by photographic comparison prior to the treatment and one month after the last laser session by dermatologists not linked to the study, using a scale that considered 1- absence of improvement, 2- partial improvement, and 3- significant improvement.
Results: In this study, it was observed that the combined treatment displayed better results than those of CO_2 laser used as monotherapy, through photographic evaluation of the lesions classified on a scale as significant improvement in all cases.
Conclusion: Fractional CO_2 laser becomes a treatment option for melasma since treatments currently available do not produce results that are 100% effective in managing this dyschromia.

#87

USE OF ABLATIVE FRACTIONAL CO_2 LASER FOR SCARS IN SKIN TYPE IV-VI

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Background: Fractional 10,600 nm CO_2 laser's use is increasing for scar treatment. Studies analyzing the use of ablative fractional laser in skin type IV–VI is scarce. Our objective is to present the use of fractionated CO_2 laser for scars in skin types IV–VI.
Study: Eight patients with skin types IV–VI were treated at Henry Ford Hospital Scar Clinic for acne scars, surgical scars and traumatic scars. An ablative fractional CO_2 laser – a superficial and a deep setting- was used alone or in combination for different scars. Clinical improvement and adverse effects were monitored with photography and patient assessment.
Results: Three patients were treated for acne scars. For superficial rolling and boxcar scars, a setting of 80 mJ fluence and 3% density was used. For ice pick scars, a deep laser setting was used with 15 mJ fluence & 10–15% density. One patient also received post treatment filler after the laser treatment. Two patients with surgical scars and two patients with traumatic scars were treated with the deep laser setting of 50 mJ fluence & 5% density. One patient received post-laser 5-fluorouracil and triamcinolone 10 mg/mL. One of the traumatic scar patients was treated with both the superficial (225 mJ fluence, 5% density) and deep (15 mJ fluence, 15% density) setting. Minor pinpoint bleeding and erythema was noted in all patients. Moderate to marked improvement was noted in scar appearance or texture. While transient PIH was noted, long term PIH was not evident.
Conclusion: Studies that discuss the use of lasers in dark skin types include pigment specific, vascular and non-ablative fractional lasers, but not fractionated CO_2 laser. This study finds the use of ablative fractional CO_2 laser to be safe in skin types IV – VI with a low risk of PIH. Limitations of the study include small sample size and adjunctive treatments.

#88

PLATELET RICH PLASMA INCREASED CLINICAL EFFICACY OF FRACTIONAL CARBON DIOXIDE LASER FOR ACNE SCAR BY ENHANCEMENT OF TGFβ ASSOCIATED FIBROGENETIC PATHWAY

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Background: Platelet-rich plasma (PRP) which contains large amounts of growth factors has been tried to enhance therapeutic efficacy of laser treatment for acne scar with unknown underlying mechanism. The present study was conducted to investigate the underlying mechanism of PRP injections combined with fractional laser treatment for treating acne scars.
Study: Twenty-five subjects with mild to moderate acne scars were treated with two sessions of fractional CO_2 laser therapy given with and without co-administration of PRP at a four-week interval in a split-face manner. Skin biopsy specimens were obtained at baseline, 1, 3, and 7 days after the first treatment session for investigation of molecular profiles associated with acute skin changes produced by laser plus PRP treatment.
Results: Fractional CO_2 laser treatment produced a significant improvement in acne scars; however, improvement on the PRP-treated side of the patient's face was better than that on the control side. Evaluations based on the Investigators' Global Assessment showed average improvements of 75% and 50% on the PRP-treated side and control side, respectively. Adverse effects such as erythema, swelling and oozing occurred with limited severity on the PRP-treated side. Scores on patient self-assessments of their satisfaction with treatment effectiveness were higher for the PRP plus laser treated side of their face. Patient skin biopsy specimens showed reactions to laser treatment. Compared with specimens of control skin, biopsy specimens of combined laser/PRP treated skin showed more compact and denser depositions of collagen in the papillary dermis. Expressions of TGFβ1 and TGFβ3 proteins as well as transcription of TGFβ1, TGFβ3 and collagen I mRNA were more highly elevated on the PRP-treated side of the face compared to the control side.
Conclusion: Elevated levels of TGFβ1 and TGFβ3 after combined fractional CO_2 laser/PRP therapy may be a mechanism for the improvement in acne scars.

#89

A TOPICAL ANTI-INFLAMMATORY HEALING REGIMEN UTILIZING CONJUGATED LINOLENIC ACID FOR USE POST-ABLATIVE LASER RESURFACING OF THE FACE: A RANDOMIZED CONTROLLED TRIAL

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Background: Fractionated, ablative lasers are usually associated with post-treatment erythema, edema, and crusting which can last from 5–14 days. Conjugated linolenic acid (CLA), an omega-5 fatty acid, has significant antioxidant and anti-inflammatory properties, and has been shown to stimulate keratinocyte proliferation and epidermal regeneration. By modulating the early inflammatory milieu and directly affecting skin structure and function, CLA may therefore shorten downtime following fractionated ablative laser resurfacing of the face. The objective of this study is to evaluate the efficacy and subject satisfaction of a topical regimen containing CLA derived from pomegranate seed extract in accelerating wound healing and improving skin quality following fractionated ablative laser resurfacing of the face.
Study: Thirty-four subjects were enrolled and received fractionated CO_2 laser resurfacing. Subjects were randomized to use the test healing regimen ($n = 24$) or 1% dimethicone ointment ($n = 10$) post-procedure. The primary endpoint was the degree of erythema, edema, crusting, and exudation evaluated by a blinded clinician at post-treatment days 1, 3, 7, 10, 14, and 30. Secondary endpoints included a blinded evaluator assessment of the degree of wrinkling and elastosis using the Fitzpatrick-Goldman Wrinkle and Elastosis Scale, subject-assessed degree of pain, itching, tightness, oozing, and crusting, and subject overall satisfaction.
Results: Subjects who applied the topical CLA healing regimen experienced significantly reduced edema on post-procedure day 3 ($p = 0.04$), and itching on days 1 and 3 ($p = 0.03$ and 0.04). Both regimens produced significant improvements in wrinkling and elastosis at days 14 and 30 post-treatment, with CLA outperforming placebo in wrinkling at day 14. Both regimens were well tolerated with no statistical differences in adverse events or subject satisfaction.

Conclusion: The topical CLA formulation outperformed placebo by decreasing acute pruritus and edema, and enabling a faster positive outcome in wrinkle improvement. Additionally, topical CLA does not raise any safety nor tolerability issues as compared to current standard of care.

#90

THE USE OF CO_2 TO CORRECT MALARPHYMA

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Background: We present a rare manifestation of phymatous change normally confined to the nose and anterior cheeks, which in our case had malar involvement and little in the way of nasal involvement. We have coined the term Malarphyma to describe this condition. Malarphyma is a condition of the skin of the cheeks, which is related to the more commonly presented rhinophyma. It does not have a specific underlying aetiology but is possibly linked to chronic, severe rosacea. Malaraphyma is progressive, with early clinical findings including enlarged pores, thickening of the fibrous tissue and hypertrophy of the sebaceous glands. Both rhinophyma and malarphyma can lead to debilitating functional and psychosocial problems for patients affect by it.
Study: We describe for the first time in the literature the use of the CO_2 laser for the management of malarphyma and review the literature pertaining to the use of laser to treat rhinophyma and the associated malarphyma using a PRISMA 2009 checklist approach to identify eligible studies.
Results: The management of rhinophyma and associated conditions have developed over time. Medical treatment with oral antibiotics or isotretinoin is possible, but the successful treatment of established rhinophyma more commonly requires some form of surgical treatment. CO_2 laser is recognized as the gold standard for soft tissue vaporization, with multiple reported favorable outcomes the treatment of rhinophyma, with excellent cosmetic results and patient satisfaction.
Conclusion: CO_2 laser is an effective method of tissue ablation with an excellent safety profile, as proven throughout the medical literature over a number of years, but no single method that is free of complications and no well-designed studies demonstrate significant benefits of one method over another. We acknowledge that the outcome and complications associated with CO_2 laser depends on the clinician's experience with laser treatment, in the correctly selected patient.

#91

THE ROLE OF THE CARBON DIOXIDE LASER IN THE TREATMENT OF ADVANCED HIDRADENITIS SUPPURATIVA AND IN POST-SURGICAL COMPLICATIONS

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Background: Hidradenitis suppurativa (HS) is characterized by recurrent abscesses, purulent drainage, pain, and scar formation. Intertriginous regions such as the axillae, groin, buttocks, and inframammary region are most commonly affected. Carbon dioxide (CO_2) laser excision is an outpatient surgical procedure used in the treatment of advanced hidradenitis suppurativa. In our follicular disorders clinic, wounds heal by secondary intention and are occasionally complicated by scar contracture, wound dehiscence, and restricted range of motion. Here we present our experience with CO_2 laser excision and deroofing for the primary treatment of HS, and a case series of three patients with post-surgical complications treated with fractional CO_2 laser.
Study: All three subjects were diagnosed with recalcitrant Hurley stage III HS of the axillae resistant to standard medical interventions. Each patient underwent axillary excision with the carbon dioxide laser and was followed for a minimum of 9 months post-operatively. The post-operative courses were complicated by wound dehiscence, and restricted range of motion. Each subject was subsequently treated with 1–4 sessions separated by 5–8 weeks of fractional CO_2 laser with the following parameters: 40–50 J of pulse energy, 5% density, and nominal 120 μm spot size.
Results: The three patients demonstrated good response to fractional CO_2 laser treatment. Carbon dioxide laser excision was well tolerated without adverse events. No evidence of HS recurrence was found in the treated region, a reduction of antibiotic usage was noted, and all patients tolerated fractional CO_2 laser treatment. Improvement in range of motion and healing of chronic ulcerations was reported.
Conclusion: CO_2 laser excision is an effective modality to manage recalcitrant, localized HS lesions. While fractional CO_2 laser has a role in managing scar contracture or chronic non-healing wounds after CO_2 laser excision.

#92

FRACTIONAL LASER-ASSISTED TOPICAL DELIVERY OF THE ANTICANCER AGENT CISPLATIN

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Background: Systemic chemotherapy with the alkylating drug cisplatin (CIS) is approved for advanced non-melanoma skin cancer. CIS's potential for topical use however is unknown. This study investigates the impact of ablative fractional laser (AFXL) at two different laser-channel depths on cutaneous penetration of CIS, elucidating pharmacokinetics and drug biodistribution in skin over 24 hours.
Study: *In vitro* porcine skin underwent AFXL-exposure using a fractional 10,600 nm CO_2 laser, generating microscopic ablation zones (MAZ) reaching the mid- (MAZ-DM) and deep-dermis (MAZ-DD). CIS in AFXL-exposed ($n = 56$) and control ($n=32$) skin was measured in Franz diffusion cells after 30 minutes, 4- and 24 hours. Inductively coupled plasma mass spectrometry (ICP-MS) quantified CIS in full-thickness skin, specific skin depths of 100, 500, and 1500 μm, as well as transcutaneous receiver-compartments.
Results: Compared to unexposed controls, interim results indicate enhanced and accelerated CIS uptake following AFXL, most pronounced in deep skin layers ($p < 0.001$). After 24 hours, median deposition in control skin was thus 86.95, 19.92 and 2.04 ng/cm^2 at 100, 500 and 1500 μm depth respectively. In contrast, CIS in corresponding AFXL-treated samples was 528.83, 545.31 and 230.39 ng/cm^2 after 4 hours, representing a

113-fold enhancement at the most profound skin depth (control *vs* MAZ-DM; $p = 0.004$). Furthermore, suggesting accelerated uptake by 30 minutes, AFXL-assisted CIS delivery at 500 μm (117 ng/cm^2) and 1500 μm (37.97 ng/cm2) skin depth was 6- and 17-fold that of 24-hour controls (control *vs* MAZ-DD; $p = 0.006$).
Conclusion: Preliminary results indicate laser-channel depth-dependent, enhanced and accelerated CIS uptake after AFXL, with increased deposition in deep skin layers. A full result compilation will be presented at ASLMS 2017.

#93

SUCCESSFUL TREATMENT OF STEATOCYSTOMA MULTIPLEX WITH A 1450 nm DIODE LASER
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Background: Steatocystoma multiplex (SM) is a genetic condition, which can be inherited autosomal dominantly, due to a mutation of the keratin 17 gene. It results in the appearance of multiple small yellow cysts during adolescence, typically on the chest, *abdomen* and axillae. Histologic findings include a thin dermal cyst with lobules of sebaceous glands found in the cyst wall. These cysts tend to become easily inflamed which can lead to scarring. We report three patients with SM treated successfully using a 1450 nm diode laser.
Study: Three male patients, Skin Types I–II and ages ranging from 19–22, presented with biopsy-proven SM. The lesions appeared on their chest and abdomen; one patient had cysts additionally on his neck and back. Two patients did not have prior treatment, while one had a trial of oral minocycline and isotretinoin, without response. All the patients had lesions which had become inflamed in the past, resulting in scars. The patients underwent treatment with a 1450 nm diode laser with a 4 mm spot size at a fluence of 20.0 J/cm2 and 250 ms pulse duration. Two blinded observers graded pre- and post-high resolution photographs for therapeutic response.
Results: Both observers correctly chose pre- and post-photographs. There was an average of 80% resolution of treated lesions after 1 −2 treatments (range of 50–100%) . Adverse effects were erythema and mild edema at the site of treatment, which resolved in 1–5 days. No additional pigmentary changes or scarring were caused by the treatment.
Conclusion: SM is a rare inherited condition with typically unsatisfactory treatment options that tends to leave scars. The 1450 nm diode laser targets and shrinks the sebaceous glands that are found in the cyst wall, resulting in improvement of the lesions. We report the successful treatment of steatocystoma multiplex using exclusively a 1450 nm diode laser.

#94

COMPARATIVE STUDY ON BRUISE REDUCTION UTILIZING PULSED DYE LASER VERSUS INTENSE PULSED LIGHT
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Background: Bruising is a common, undesired side effect of various surgical and cosmetic procedures. The pulsed dye laser (PDL) has been studied in treatments to hasten ecchymosis resolution with varying results. The intense pulsed light (IPL) is a competing technology that has also been reported to reduce bruising. However, no comparative, controlled studies have been performed. The purpose of this study is to compare the effectiveness of pulsed dye laser versus intense pulsed light as a bruise reduction method.
Study: 14 consenting adults, 6 male and 8 female, with Fitzpatrick Type II–III skin were enrolled in this Institutional Review Board approved, randomized, controlled study. Bruises were induced on the *abdomen* using a 595 nm PDL (7 mm spot size, 0.45 ms, 6.5 J/cm^2) in three zones of non-overlapping single pulses. Two days later, each zone was randomly treated with 1) control, 2) PDL (7 mm spot size, 6 ms, 7 J/cm^2), 3) IPL (515 nm, 14 J/cm^2, double pulse of 3.5 ms, 10 ms delay, 3.5 ms). Lesions were evaluated 2 and 6 days after treatment, and scored by two blinded raters using a bruising severity scale of 0–10 (0 no bruise; 10 worst bruise).
Results: PDL resulted in significant improvement of bruises 2 days after treatment (Control: $P = 0.001$; IPL: $P = 0.01$). However, PDL-treated bruises were not statistically different compared to IPL-treated ($P = 0.82$) and control ($P = 0.84$) ecchymoses 6 days after treatment. IPL-treated bruises were similar to that of the control group on post-treatment day 2 ($P = 0.77$) and 6 ($P = 0.84$).
Conclusion: When performed 2 days after bruising, PDL may accelerate healing of ecchymoses. However, our study showed no therapeutic benefit compared to observation for PDL- and IPL-treated lesions 6 days after treatment. Future studies are needed to explore different PDL and IPL settings and to determine optimal parameters for bruise reduction.

#95

FRACTIONAL ABLATIVE LASER ACQUISITION: UTILIZING BREAK-EVEN ANALYSIS IN YOUR PRACTICE
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Background: A break-even analysis (BEA) is often used in the business world to determine exactly when the business will be able to cover all of its expenses and generate profit. A BEA can be particularly useful when contemplating expansion and new purchases. Without consulting services, dermatologists can often find the notion of strategic planning and financial considerations overwhelming and not part of their acquired skillsets. However, with the increasingly competitive laser market, it is critical that a practicing dermatologist equip himself/herself with the basic business knowledge to be able to make an informed decision with respect to a major laser purchase. Our study aimed to detail the critical ingredients of a BEA for a major fractional ablative laser device, in order to educate dermatologists on the financial considerations of laser acquisition.
Study: We sought to perform a BEA as an educational tool for laser acquisition financial planning. Only publicly trading companies that generated annual revenues greater than $50 million were considered, and major companies with a fractional ablative CO_2 laser were included. The companies provided their pro forma return on investment (ROI) projections for their fractional ablative CO_2 lasers, which were used to perform a BEA.
Results: Break-even point (BEP) is the point in time in which total costs and total revenue are equal and one is able to generate profit thereafter. Laser revenue (R) is equivalent to the procedure fee (P) for each laser treatment multiplied by unit

sales (X) (number of procedures performed for that particular laser treatment). Total costs include fixed costs (FC) and variable costs (VC). Fixed costs do not change with the volume of patients treated (laser purchase price, warranty, cost of operation such as overhead and cost of staff time, and leasing), while variable costs fluctuate with the number of patients treated and laser activity (cost of consumables/disposables, and occasionally marketing expenses). Variable costs depend on each individual practice, but can be estimated as approximately 10% of total revenue. Another useful concept in a BEA is contribution margin, which is essentially revenue minus variable costs. See Table 1.
Conclusion: BEA can be tremendously useful for dermatologists in determining the number of treatment sessions needed to begin generating profit. Although ROI pro forma templates from companies are helpful in identifying several critical components of a BEA (in particular cost of ownership), each analysis will differ based on cost of operation (overhead and cost of staff time); therefore, fixed and variable costs will differ depending on the clinical context, the device utilized, and the indications being treated. We hope that this laser acquisition example illustrates the feasibility for dermatologists to perform a BEA and make financially sound decisions with respect to purchase of a laser device.

#96

CREATING AN EFFECTIVE LASER PROCEDURAL VIDEO
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Background: Videos are one of the most effective ways to teach surgical and procedural techniques, including those involving novel laser therapies. Further, almost everyone has access to a smart phone capable of creating high definition videos. This abstract seeks to correct common pitfalls when creating a procedural video and outlines best practices.
Study: Best practices for creating procedural videos are reviewed. These include approximating the point of view of the laser provider, creating clips, avoiding redundancy, and narration. Common pitfalls are also reviewed including filming vertical rather than horizontal videos, using digital zoom, altering playback speed, and others.
Results: Multiple examples of best practices and pitfalls will be demonstrated.
Conclusion: With careful application of best practices and avoidance of common pitfalls, anyone with a smart phone can create an effective laser procedural video for publication, presentation, or education.

#97

REFLECTION SPECTRUM COMPARISON *IN VIVO* OF VULVAR LICHEN SCLEROSUS WHEN TREATED WITH CORTICOSTEROID THERAPY, PHOTOBIOMODULATION, OR PHOTODYNAMIC THERAPY
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Background: Reflection spectroscopy is a noninvasive diagnostic method sensitive to small changes in a reflective surface. The area under the reflection spectrum curve transmits information about the intensity of light reflected by the incident wavelength. Lichen sclerosus (LS) is a skin disease and some symptoms are related to changes in the skin, especially whitening. Given that the color white reflects all wavelengths, this study's hypothesis is that the optical reflectance will be changed as the skin disease is treated. The objective of this study was to investigate how the optical reflection of vulvar LS can be changed *via* three different treatments.
Study: Fifteen women from Hospital Pérola Byington's outpatient clinic (São Paulo / Brazil), with histological diagnosis of vulvar LS were treated after approval by the Research Ethics Committee (Protocol 768 168). The patients were randomly divided into three groups of five patients each. The first group was conventionally treated with topical steroids once daily, as recommended by the International Society for the Study of Vulvovaginal Disease. The second group was treated with PDT, once a week, using methylene blue photosensitizer. The last group was treated with PBM, once a week, using the same dosimetric parameters as those of PDT. Reflection measurements were taken before and one month after the start of treatment. The spectrophotometer was used to obtain the *in vivo* reflection spectrum in the 300 nm and 1000 nm range (Ocean Optics USB2000, USA). The areas under the curves were integrated with the aid of Origin Pro software 8. The same software was used for statistical analysis with a significance of $p < 0.05$ for all tests. Upon confirmation of normality with the Kolmogorov-Smirnov test, the homogeneity was checked with the Levene test. Being homogeneous, the areas were compared with two-way ANOVA and post hoc Fisher.
Results: There was a significant difference ($p = 0.0133$) between regions with LS before and after treatment with PBM; a reduction of 50.8% in reflection was detected. After the treatments, the comparison between groups detected that PBM presented the lowest reflection, both in comparison to PDT ($p = 0.0063$) as well as to corticosteroid therapy ($p = 0.0457$).
Conclusion: PBM caused a significant decrease in the optical reflection of the vulvar skin when compared to corticosteroid therapy or PDT. It can be inferred that optical changes in the skin were caused by PBM and parallel studies are being conducted to correlate this finding to the symptomatology and also to the histology after the treatments.

#98

TEMPORAL DECAY OF TOPICAL GLYCOLYSIS MARKER: *IN VIVO* FLUORESCENCE IMAGING OF DEREGULATION OF ENERGY METABOLISM IN ORAL NEOPLASIA
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Background: Imaging that provides molecular specificity could enhance detection of hard to detect precancers and early cancer. A promising candidate is 2-deoxy-2-[(7-nitro-2,1,3-benzoxadiazol-4-yl)amino]-D-glucose (2-NBDG), a marker that 1) provides information on deregulation of glucose metabolism in neoplastic tissue in-vivo, 2) may be assessed with multimodal imaging across scales (macroscopy & microscopy), and 3) may be applied topically, shown in recent results from our lab. Thus, our goals were to determine the temporal response of topically

applied 2-NBDG in normal *vs* neoplastic mucosa by widefield fluorescence imaging and relate differential responses to other metrics determined from in-vivo multiphoton microscopy for development of a multimodal imaging approach.
Study: A combined macroscopy/microscopy approach was used to simultaneously assess 2-NBDG temporal dynamics and microstructure supporting indication of neoplasia in a hamster model for oral cancer. 2-NBDG (1 mg/ml) was topically applied on the buccal pouch and imaged *in vivo* to determine the temporal decay of fluorescence intensity in areas that showed preferential uptake (mostly neoplastic) as well as normal areas. *In vivo* multiphoton microscopy (MPM) provided both depth of penetration of 2-NBDG *via* topical application as well as cellular and extracellular features assessed for indication of neoplasia. Imaged sites were biopsied and H&E stained sections graded by a pathologist.
Results: Results showed decay of 2-NBDG fluorescence ($R2 = 0.98$) over time with higher decay constant in neoplastic (-0.79) tissue than normal (-0.41) indicating faster utilization of glucose in sites confirmed by histology and MPM to be neoplastic. MPM showed 2-NBDG fluorescence from basal epithelium supporting the efficacy of topical application and also revealed previously established cytologic and layer based architectural abnormalities of oral epithelial neoplasia.
Conclusion: This study helps establish the potential pairing of macroscopy with microscopy assessing tissue metabolism and microstructure with the use of a marker for a key cancer hallmark for improved detection of epithelial neoplasia.

#99

VIDEODERMOSCOPY AS A NOVEL TOOL FOR THE VISUALIZATION OF LASER THERAPEUTIC ENDPOINTS
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Background: The safe and effective use of lasers and energy-based technologies requires familiarity with the desired therapeutic endpoints of each treatment modality. Imparting the ability to identify therapeutic endpoints is critical to the training of future laser surgeons. While some therapeutic endpoints are readily visible to the naked eye, it may be difficult for early trainees to discern the endpoints of lasers with small effect sizes. Subtle endpoints from the standpoint of early trainees may include the 1 to 2 millimeters of perifollicular erythema and edema that develop following treatment with hair removal lasers. We propose the use of digital videodermoscopy, which permits the simultaneous dermoscopic examination of skin at magnifications of greater than 200x, as an educational tool to facilitate understanding of therapeutic effects and endpoints.
Study: Videodermatoscopic images were taken immediately post-treatment and 24 hours post treatment of skin following long pulsed 755 nm hair removal laser, long pulsed 1064 nm hair removal laser, Non-ablative fractional 1927 nm laser, and non-ablative fractional 1440 nm laser using a portable video dermatoscope at magnifications ranging from 30x to 200x.
Results: Perifollicular edema is readily seen following laser hair removal on videodermoscopic examination.
Videodermoscopy also permits the visualization and comparison of fractionated lasers, promoting greater understanding of how wavelength, percentage coverage, and pulse energy interact to produce visible differences in the microscopic appearance of skin immediately post-treatment.
Conclusion: High magnification videodermoscopy is a novel educational tool that can be incorporated in the instruction of lasers and energy-based technologies and facilitates trainee understanding of therapeutic effects and endpoints in real time.

#100

LOW-LEVEL LASER (LLL) REDUCES PULMONARY INFLAMMATION IN ASTHMA EXPERIMENTAL MODEL INDUCED BY OVALBUMIN: *VIA* LIPOXYGENASE
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Background: Low-level Laser therapy (LLLT) is a new therapy that shows efficacy in lung diseases to reduce inflammatory parameters, with low cost and without side effects. Studies leukotriene receptor antagonists, such as (montelukast-MK) has contributed at different levels for the treatment of asthma as well as the use of 5-lipoxygenase inhibitors (zileuton-ZIL). Thus, this study aimed to evaluate the effects of LLLT and its combination with MK and ZIL in an experimental model of chronic lung allergic inflammation induced by ovalbumin (OVA).
Study: Balb / C were divided into 10 groups: Basal, LBI, MK, ZIL, OVA, OVA + LBI, OVA + MK, OVA + ZIL, OVA + LLL + MK, OVA + LLL + ZIL. The chronic allergic pulmonary inflammation was induced by ovalbumin. The OVA + LBI group was irradiated (laser diode 660 nm, 30 mW and 3 J), OVA + MK was treated with sodium montelukast (5 mg/kg), OVA + ZIL was treated route (ip) with zileuton (10 mg/kg), the OVA + LLL + MK group was treated with MK and LLL. As the OVA + LLL + ZIL group was treated with ZIL and LLL. 24 hours after the last treatment, the bronchoalveolar lavage was collected and analyzed (total and differential count of the cells and cytokine by ELISA technique).
Results: Both treatments reduced the total number of cells and eosinophils in bronchoalveolar lavage (BAL) ($p < 0.001$). The use LLL reduced IL-4 ($p < 0.05$), however, the concurrent treatments reduction was more significant ($p < 0.01$), there was a decrease of IL-5 ($p < 0.05$) and IL-13 ($p < 0.001$) in all treated groups. The groups, OVA + MK, OVA + ZIL and OVA + LLL + MK increased IL-10 ($p < 0.05$). Regarding leukotrienes, noted decrease of LTB4 ($p < 0.05$) in OVA + LBI and ($p < 0.01$) OVA + LLL + ZIL. CysLT decreased ($p < 0.01$) in all treated groups. Deposition of collagen fibers and mucus in the airways decreased in all treated groups ($p < 0.001$). There was a decrease in the pulmonary mechanics ($p < 0.001$) in all treated groups.
Conclusion: Together, these results indicate that the combination therapy seems to have promising role in treating asthma.

#101

EFFECT OF LOW-LEVEL LASER THERAPY ON CHRONIC LUNG INFLAMMATION IN EXPERIMENTAL

MODEL OF ASTHMA: A COMPARATIVE STUDY OF DOSES

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Background: Asthma is characterized by chronic airway inflammation, affecting approximately 300 million individuals worldwide. The low-level laser therapy (LLLT) is relatively new, no side effects and low cost, as an alternative to use in the treatment of chronic lung diseases. The objective of this study was to evaluate the effect of LLLT with different energies on the chronic lung inflammation in experimental model of asthma induced by House Dust Mite (HDM).
Study: BALB/c mice were divided into 10 groups: control, HDM, LLLT and HDM + LLLT (1 J, 3 J, 5 J and 7.5 J). We used laser diode, power of 100 mW, wavelength 660 nm and different application times (10 s, 30 s, 50 s and 75 s) at 3 different points. For the experimental model, each animal received orotracheal administration of 100 μg of HDM on days 0, 7, following of 3 times a week, during 5 weeks. After 24 hours, we collect the bronchoalveolar lavage (BAL) and the lungs. We evaluated the inflammation by cell counts and cytokines levels. Histological analyzes for quantification of collagen and mucus in the airways. Lung homogenate in flow cytometry for staining CD3+, CD4+, CD11c+, CD19+ and 7AAD. The results were analyzed using One-way ANOVA followed by Newman-Keuls test. Significance adjusted to 5%.
Results: The results for the total and differential counts in the BAL were significantly reduced in HDM + LLLT 1J and 3J groups ($p < 0.01$). For the IL-10 level, the HDM + LLLT 1 J group showed significant increase ($p < 0.001$). LLLT attenuated collagen deposition airways and mucus in the HDM + LLLT 1 J and 3 J groups ($p < 0.001$). In flow cytometry, for CD4+, CD8+, CD19+ and 7AAD we observed significant reduction in HDM + LLLT (3 J) group ($p < 0.01$).
Conclusion: We conclude that LLLT reduced lung inflammation and the effects appear to be mediated by modulation of the LLLT in the secretion of the anti-inflammatory cytokine IL-10 and reduction of mucus in the airway.

#102

ANALYSIS OF PHOTOBIOMODULATION IN THE POPLITEAL VEIN IN PATIENTS WITH SUBACUTE DEEP VEIN THROMBOSIS: PLASMATIC NITRIC OXIDE (NO) GENERATION AND POST-TRANSCRIPTIONAL MOLECULAR ALTERATIONS

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Background: Venous thromboembolism (VTE) is a disease with high morbidity and mortality, which includes deep vein thrombosis (DVT) and pulmonary embolism (PE). It is a common condition characterized by blockade of popliteal vein and unspecific symptoms such as pain, and muscle tenderness. The disease's clinical condition depends upon the affected veins and extension of the thrombus. Photobiomodulation exerts significant anti-inflammatory effects decreasing chemical mediators, cytokines and contribute to vasodilation by release of nitric oxide (NO).
Study: We used two groups of patients with subacute thrombosis in femoropopliteal territory to evaluate the effect of photobiomodulation at 660 nm in relation to the diameter of femoral, popliteal, medial and lateral gastrocnemius, and short saphenous veins using vascular ultrasound (USV). In addition, we quantified plasmatic inducible NO synthase (iNOS) messenger RNA, NO generation and microRNA 221 expression before and after photobiomodulation. The groups were randomized as followed: Group 1 consisted of 15 DVP patients that were driven to first USV and blood collection. Then, they were subjected to photobiomodulation onto the popliteal vein territory. Again, USV was performed and blood was collected. The vessels diameters were recorded and we acquired the delta differences between pre- and post photobiomodulation. Group 2 (placebo) consisted of 15 DVP patients that underwent the same protocol without laser stimulation.
Results: Photobiomodulation resulted in intense vasodilation in the medial gastrocnemius vein of DVP patients ($p < 0.01$), although this effect was not observed in other veins. iNOS mRNA and NO generation were increased only after photobiomodulation (iNOS 23.6 ± 2.5, $p < 0.001$; NO 7.4 ± 1.8, $p < 0.05$). Interestingly, microRNA221, that targets iNOS mRNA was diminished in the Group 1 compared to placebo group (3.1 ± 0.3, $p < 0.001$).
Conclusion: Thus, we suggested that photobiomodulation caused venous vasodilation in DVT patients, mainly in non-obstructed veins, and modulated post transcriptional changes in order to achieve NO-induced relaxation.

#103

PHOTOBIOMODULATION EFFECTS ON GENE AND PROTEIN EXPRESSION OF PROINFLAMMATORY CHEMOKINES AND CYTOKINES BY J774 MACROPHAGES POLARIZED TO M1 PHENOTYPE

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Background: The interactions between tissue and macrophages (M) that migrate into injury area are crucial for wound repair. On the initial steps of acute inflammation, M1 macrophages became the dominant inflammatory cell type and are the main responsible for cytokines and chemokines synthesis, including CCL3, CXCL2 e TNFα, that act as ckemoattractive to immune cells. On the other hand, photobiomodulation (PBM) has been extensively used in the treatment of tissue damage in different clinical and experimental contexts; however, little is known about its effects on macrophages. The aim of this study was to evaluate the effects of PBM (2 dosimetric parameters) on the gene and protein expression of the proinflammatory mediators CCL3, CXCL2 and TNFα of activated/polarized macrophages into M1 phenotype.
Study: J774 macrophages were grown in DMEM medium (5% FSB and 2 mM L-Glutamine). To induce the M1 phenotype, 1×106 J774 cells were treated with 1 μg/mL of LPS and 0.2 μg/mL IFN-γ for 24 hours. After this period, macrophage cultures were washed and irradiated with red laser (660 nm) and

infrared (780 nm) in the same dosimetric parameters (70 mW, 17.5 J/cm^2, 1 J). After 4 hr, cells were collected and total RNA was extracted using specific kits according to manufacturer's instructions. First strand synthesis was performed with 500 ng of total RNA. After 24 hr, culture supernatant of all experimental groups was used to assess protein production. Non-irradiated and non-activated cells served as control. All results were analyzed statistically.
Results: M1 activated macrophages irradiated with 660 nm laser showed significant decrease in CCL3, CXCL2 e TNFα mRNA expression levels when compared to non-irradiated M1 macrophages. At protein level, cells irradiated with 780 nm produced reduced levels of TNFα cytokine in relation to non-irradiated cells.
Conclusion: M1 macrophage treatment with red or infrared laser lead to a decrease in the synthesis and production of important cytokines and chemokines, which could explain the anti-inflammatory effects of low-level light therapy in wound repair.

ESLD CHALLENGING CLINICAL CASES/SERIES

#104

1318 nm LASER TECHNOLOGY IN LUNG SURGERY SEEMS TO BE A UNIQUE THERAPY IN SELECTED METASTATIC PATIENTS

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Background: The use of laser technology in lung surgery is possible. We apply a 1318 nm laser proven to be the optimal wavelength to operate on the lung parenchyma. It has the proper ratio between absorption and scattering in water, which in the operative setting results with excellent cutting and coagulation capabilities. Also it causes tissue shrinkage providing better reinforcement of the coagulation effect as well as sealing of fistulas. These properties allow limited resection of tumors located deep in the lung parenchyma sparing healthy tissue and with minimal deformity to the adjacent tissue.
Study: In 10 years we operated on 415 metastatic patients (196 men, 219 women) with mean age of 62 years (18–83 years). Patients enrolled in this study met the criteria of selection: primary tumor controlled or controllable, no extrathoracic metastases, technical respectability, adequate lung function, clinical condition and no other effective therapy option. We used in our patients a diode laser system with the wavelength 1318 nm and power output of 50 Watt. The resections of metastases were always performed *via* thoracotomies. The tumors were resected with the tip of laser fibre along its margins with a security border of 2 mm. In patients with bilateral metastases two staged operations were necessary.
Results: In 415 patients altogether 3655 metastases (ranged 1-269, mean 9/ patient) were resected without intra- and postoperative mortality. 343 patients (83%) had complete resections with 5 and 10 years survival of 43% and 21% respectively. The 5 year survival for curatively resected patients with solitary metastasis, 2–9 metastases and over 10 metastases was 55%, 37% and 21% respectively.
Conclusion: Patients with multiple lung metastases become the ideal candidates for 1318 nm laser technology. It allows the surgeon the complete resection of multiple tumors which is impossible other techniques. These operations are safe and prolong the life expectancy in selected stage IV tumor patients.

#105

ASSOCIATION OF KHELLIN AND EXCIMER LAMP 308 nm IN THE TREATMENT OF SEVERE ALOPECIA AREATA

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Background: Alopecia areata (AA) is an autoimmune disorder characterized by localized non-scarring hair loss. Because of its resistance to therapy, many options have been suggested for the treatment of AA such as topical or systemic corticosteroids, phototherapy (PUVA, NB-UVB), application of allergic sensitizer or prostaglandin analogs. The excimer lamp (EL) 308 nm is another treatment option of targeted phototherapy and has been recently reported to be effective in the treatment of patchy AA in previous published reports. Khellin is a furanochromone with a chemical structure that closely resembles that of psoralens. Through this case, we tried to evaluate for the first time, the effectiveness of the association of a 308 nm monochromatic EL and topical khelliin, in the treatment of a 5-year old child presenting a severe and resistant AA.
Study: A 5-year child presented with ophiasic and extensive AA of 1 year evolution, that have been resistant to all previous treatment including topical corticosteroïds, minoxidil, antioxydants, oral vitamines and hair loss lotions. The treatment protocol was as follow: EL 308 nm (DEKA), 2 sessions a week, initial dose:150 mJ/cm^2, increase in dose of 50 mJ every two sessions. Khellin was applied on AA lesions 45 mins before UV irradiation.
Results: After 3 months of treatment, a complete hair growth was observed in all the lesions, with no side effects by the parents. The children was re-evaluated 6 months later with no evidence of recurrences of hair loss.
Conclusion: Previous studies of khellin's properties confirm that it has beneficial properties compared with the psoralens (less photo-toxic and carcinogenic) and could be combined with ultraviolet irradiation without risks of photo-toxic side effects. The combination of EL with khellin seems to act synergistically in AA and comparative randomized prospective trials should be conduct in the future to confirm the efficacy of this promising association.

#107

CLINICAL AND HISTOLOGICAL EVALUATION OF THE EFFICACY OF DIFFERENT LASER COMBINATIONS IN THE TREATMENT OF BECKER'S MELANOSIS

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Background: Becker's nevus (BN) remains cosmetically disfiguring and therapeutically challenging, even after the evolution of pigment-specific lasers. Recurrence and lack of uniformity of the obtained color are common obstacles.

Study: This randomized prospective controlled comparison study included 24 BN patients. The nevus was divided into four areas: A, B, C and D. Area A received long pulsed Nd:YAG, area B received either Q-switched Nd:YAG or Q-switched KTP, area C received the three types of laser combined while area D was left untreated as control. Each patient received three bimonthly sessions. Clinical evaluation and photography were done every four weeks until one year after end of sessions. Four mm punch biopsy was taken at baseline and 3 months after the last session from each area and were stained using H&E, Melan-A and smooth muscle actin.
Results: All patients achieved significant hair reduction in area A without color improvement. Significant pigment clearance was achieved in area B in 4 patients (16.7%) who all received KTP and in area C; in 9 patients (37.5%). Reduction in basal pigmentation and melanophages was obtained in area C more than area B but not in area A. Compared to area B, area C showed lower incidence of recurrence of pigmentation. Post-laser hyperpigmentation was observed in 50% of areas that received Q switched KTP and disappeared on topical corticosteroids and hydroquinone leaving lighter skin within intersession period otherwise the following session was delayed.
Conclusion: Combined laser treatment (Q-switched KTP, Q-switched Nd:YAG and long pulsed Nd:YAG) offers an effective therapeutic modality for BN. Laser-assisted hair reduction might not decrease pigmentation but could help minimize its recurrence.

#108

FOCAL LASER ABLATION FOR LOCALIZED PROSTATE CANCER

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Background: To report the techniques and long-term outcome results of a minimally-invasive focal treatment using laser ablation under MRI guidance to treat localized prostate cancer while preserving the rest of the prostate gland.
Study: Fourteen male patients (mean = 62.7 ± 7.4) with 19 foci of localized low- or intermediate-risk prostate cancer underwent 22 MRI-guided focal laser ablation procedures. All procedures were performed within the MRI bore, either *via* a trans-rectal approach (n = 17) on 3T MRI or a trans-gluteal approach (n = 5) on 1.5T MRI. A diode laser fiber (Visualase, TX, USA) was introduced within an internally cooled catheter through a 14 G introducing sheath. Ablations were conducted utilizing 12–27 watts. Simultaneous temperature maps and cumulative damage maps were obtained. Fiber repositioning for additional ablation was conducted as needed. The procedures were concluded when the cumulative damage maps were noted to encompass the entire tumors.
Results: Targeted tumors consisted of 11 low risk (Gleason 6) and 8 intermediate risk (Gleason 7) prostate adenocarcinomas. The mean of the largest diameter of treated tumors was 1.65 ± 0.6 cm (median = 1.6 cm, range = 0.5–3.2 cm). The mean applied laser energy was 7234 ± 3887 Joules with dosage calibrated based on real time feedback of tumor response to ablation. Treatments required 2–4 ablation cycles/laser fiber positionings and resulted in complete tumor necrosis in a single session. Patients tolerated the procedures well and were discharged in 4–6 hours. No immediate or delayed complications were encountered. Follow-up durations ranged between 5.3 and 46.0 months (mean ± SD = 19.6 ± 10.4 months). Significant drop of pretreatment PSA level occurred in all cases. One patient had focal recurrence at his 24-month follow-up and was successfully re-treated with laser ablation. Another patient had new cancer foci remote from the ablation site at his 28-month follow-up time point. No recurrence was noted in the other cases.
Conclusion: This study describes two techniques for MRI-guided and monitored focal laser ablation for minimally-invasive treatment of localized low- and intermediate-grade prostate cancer. The techniques are feasible and well tolerated as outpatient procedures. This small series indicates a promising efficacy for up to 46-month follow-up durations.

#109

NON-ABLATIVE PERIOCULAR REJUVENATION USING LONG PULSE Er:YAG 2940 nm LASER

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Background: Periorbital area is one of the challenging cosmetic units for the laser surgeons. Laser resurfacing has been tried in the old days to correct the periorbital wrinkles and lines. Although effective, the associated downtime has offended many people to go for that option. Recently, the long pulse Er:YAG 2940 nm laser if being offered for patient to improve the structure and function and hence the appearance of the skin in the periorbital region. This is a retrospective study evaluating the safety and efficacy of long pulse Er:YAG 2940 nm laser for the treatment of periorbital static wrinkles and skin laxity.
Study: 30 patients treated for periorbital rejuvenation using long pulse Er:YAG laser over a 3 months period. All patients were assessed according to Fitzpatrick's Classification of periorbital wrinkles to class I, II or III and were treated using a fluence of 3.75 J/cm^2, repetition rate of 1.7 Hz and with the smooth pulse mode (250 msec) of the Er:YAG 2940 nm laser. A full field 7 mm hand piece was used. 3 treatment sessions were performed on each patient four weeks apart. Patient improvement was assessed at follow-up visits up to 12 months after final treatment. Blinded photographic evaluations were performed by three independent physicians using photos unlabeled for before and after and arranged in non-chronological order. Reviewers were asked to determine before and after photos followed by the degree of improvement in Fitzpatrick's Classification of periorbital Wrinkling. Patients were asked to answer a questionnaire measuring the satisfaction after the treatment sessions 4 weeks after each session and to report any adverse reactions.
Results: The blinded evaluators correctly identified the before and after photos in all cases. There was statistically and clinically significant improvements in Fitzpatrick classification of periorbital wrinkles. 25 patients (83.3%) reported excellent improvement, 4 patients (13.3%) reported moderate improvement and only 1 patient (3.3%) reported no improvement. All the patients reported mild edema and erythema which persisted for 1 to 2 days and superficial peeling of the skin for 4 to 6 days after each laser treatment.
Conclusion: The non-ablative long pulse Er:YAG 2940 nm laser seems to be a safe and effective treatment for periocular rejuvenation.

#110

FRACTIONAL CARBON DIOXIDE RESURFACING COMBINED WITH INTRALESIONAL TRIAMCINOLONE

ACETONIDE INJECTIONS FOR KELOIDS AND HYPERTROPHIC SCARS

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Background: Keloids and hypertrophic scars are disorders with an altered dermal matrix deposition as a common sequela to loss of collagen and elastic fibres following inflammatory processes. The resulting disfigurement may negatively affect the quality of life of many patients. Keloids and scars are known to be a therapeutic challenge among laser practitioners. There are few articles discussing fractional CO_2 laser (FxCR) for the treatment of keloids and hypertrophic scars. The advent of ablative fractional photothermolysis in the past decade represents a promising and vastly underused tool in the multidisciplinary treatment of various types of scars in view of the consistent and significant functional improvements as well as the cosmetic benefits. Intralesional triamcinolone acetonide (ILTA) injections have been widely used for the same indications. We hypothesized that combined treatments by FxCR and ILTA could optimize results for hypertrophic scars and keloids and minimize recurrence.

Study: Twelve patients were treated with FxCR at variable settings in 6 sessions at 6–8 week intervals. Gradually increasing dilutions of ILTA were administered each session after FxCR and then at 3 weeks. The ILTA concentrations were progressively reduced from 20 mg/ml to 4 mg/ml. Improvement was reported in each session and at the 6-month follow-up after the last session.

Results: Using the Modified Vancouver Scar Scale (MVSS), in all the cases we observed significant changes in vascularity, height/thickness, pliability, and pigmentation. The most significant side effects were prolonged erythema and temporary hyperpigmentation. No recurrences were reported after the sessions or at the 6-month follow-up.

Conclusion: As well established in the current state-of-the-art, the combination of FxCR and ILTA provides a safe and effective technique for managing keloids and hypertrophic scars. A possible new use of an algorithm based on fractional CO_2 laser, intralesional triamcinolone acetonide injections (with further other substances) could prove to be the most complete approach in the treatment of scars and keloids.

#111

FRACTIONAL PHOTOTHERMOLYSIS FOR DISCOID LUPUS ERYTHEMATOSUS

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Background: Cutaneous Discoid Lupus Erythematosus (CDLE) is a chronic inflammatory disease often resulting in permanent scarring of the affected skin. Fractional Photothermolysis induces a dermal remodeling by wounding of the skin in a fractional pattern. It has been reported to successfully treat atrophic and hypertrophic scars as well as fibrotic autoimmune diseases like morphea.

Study: We report about one young, female patient treated with three sessions of ablative fractional photothermolysis for two stable atrophic scars due to previous CLDE lesions of the upper left and right cheek. Initially one small area of approximately 1×1 cm was tested in order to assure its tolerance to the treatment as well as the absence of a Koebner phenomenon. One month after the test treatment no unexpected side effects were observed. Subsequently the entire surface of both lesions was treated 3 times with a commercially available 10,600 nm CO_2 fractional laser. Parameters were selected conservatively with 60 mJ/MTZ, a pulse-duration of 2 ms, a density of 10%, and concomitant skin cooling by forced cold air.

Results: Three months after the last treatment no side effects were observed. The treated atrophic scars improved in depth and overall cosmetic appearance.

Conclusion: This is the first report of a successful treatment of stable CDLE lesions with fractional photothermolysis. It needs to be emphasized that scientific evidence about the safety and efficacy of this treatment is still lacking and this case report should be followed up with a larger case series or a prospective clinical trial.

#112

CHRONIC RADIATION DERMATITIS AND FIBROSIS – APPROACH TO TREATMENT

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Background: Late-stage or chronic radiation dermatitis typically presents months to years after radiation exposure and is characterized by dermal fibrosis, and poikilodermatous skin changes, including hyper- and hypopigmentation, atrophy, and telangiectasias and affect a significant number of patient undergoing radiotherapy. Radiation dermatitis has a profound impact on the quality of a patient's life, due to pain and discomfort with currently limited treatment options. During our volunteer work in Vietnam, we encountered numerous children with significant scarring and depigmentation of skin from the use of radioactive phosphorus P32 in the treatment of infantile hemangiomas. This outdated practice has left thousands of children with significant chronic radiation dermatitis, showing signs of skin fibrosis, dyspigmentation, and telangiectasias. It is this disfigurement, which prompted our quest in understanding as well as reversing this condition. Currently, the only treatment for chronic radiation injury is laser therapy but focused on vascular lasers only. Here we present our first effort to treat the Vietnamese patients affected by this multifaceted disease using a larger combination of laser treatments, including pulsed dye laser, fractional CO_2 laser, and epidermal grafting to improve the appearance and function of the radiation scars. We will furthermore present a design of a new clinical trial looking at the effectiveness of fractional CO_2 laser for chronic radiation fibrosis in cancer patients, applying our current knowledge of laser therapy on fibrosis and scars.

Study: This is a clinical case series as well as pilot study. The clinical case series involves treatment of radiation fibrosis and dermatitis using a combination of pulsed dye laser, fractional CO_2 laser, as well as epidermal grafting. In this series, 3 patients affected with radiation dermatitis were treated with the pilot study (still in progress) looks at the use of fractional CO_2 laser to treat radiation-induced dermatitis and fibrosis.

Results: In patients treated with all three modalities (pulsed dye, fractional CO_2, and epidermal grafting), we noted

improvement in the softness of the scars as well as the reduction in telangiectasias. Replacing the depigmented and scarred epidermis led to normalization of the skin on the grafted areas. The study on the effect of fibrosis is on-going.
Conclusion: More research is needed in understanding the mechanisms of chronic radiation injury as well as devising treatment options for these patients. We still do not understand if treating the skin alone can modulate the micro-environment of a radiation-induced scar and help improve fibrosis. Potential combination of fractional ablative laser in combination with topical medications may be helpful for these patients who otherwise do not have many options.

#190

C-PDT AND INTENSIFICATION
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Background: The purpose of this presentation is to highlight the results of the pre-treatment of PDT by intensification with sandpaper. 3 patients respectively aged 72, 74, and 86 years, with basal cell carcinomas in various stages and topography, whose physical condition does not undergo surgery, were eligible for treatment Photodynamic therapy intensification with the sandpaper.
Study: 3 patients with basal cell carcinoma, different sizes, different grades, and confirmed by biopsy, were treated by C-PDT with intensification by sandpaper. Then classical protocol is applied: Application of a thin layer of Mal. Incubation 3 hours, 8mn illumination with a red LED lamp, 632 nm 37 J/cm^2. Contrôle visits at W1, M1, M2 and M3
Results: Results obtained are constant in the case 3 with gradual regression of the lesions and healing to 3 months, with clinical and dermatoscopic confirmation. Pain during treatment was increased compared to the single C-PDT but quite tolerable. The side effects such as edema, erythema and crusting were more consistent but without the long-term consequences
Conclusion: The intensification technique by dermaroller, fractional CO_2 laser or sandpaper amplifies the therapeutic response to PDT in our presentation, C-PDT has been intensified by sandpaper; results have been spectacular in the 3 cases surgery could be avoided, which would have been more severe consequence for our elderly patients with comorbidities.

ESLD LASER AND EBD MEDICINE FOR BREAST CANCER PATIENTS

#113

PREVENTION OF ACUTE RADIODERMATITIS BY PHOTOBIOMODULATION: PRELIMINARY RESULTS OF A RANDOMIZED, PLACEBO-CONTROLLED TRIAL IN BREAST CANCER PATIENTS
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Background: The aim is to evaluate the effectiveness of photobiomodulation therapy (PBMT) in the prevention of acute radiodermatitis (RD) in breast cancer patients undergoing radiotherapy (RT).
Study: This randomized, placebo-controlled trial enrolled 66 breast cancer patients that underwent an identical RT regime post-lumpectomy. Patients were randomly assigned to the laser ($n = 34$) or placebo group ($n = 32$). There were no significant differences between the two groups with respect to patient- and treatment-related characteristics. Laser or placebo was applied two days a week, immediately after the RT session, starting at the first day of RT. PBMT was delivered using a device that combines two synchronized laser diodes in the infrared range (808–905 nm) with a fixed energy density (4J/cm2). Clinical scoring of RD (Radiation Therapy Oncology Group (RTOG) grading scale) and biophysical measurements (skin hydration, transepidermal water loss (TEWL), and degree of erythema) were determined at the first day, at fraction 20 and at the end of RT. In the results section, only preliminary results of the RTOG scores are shown.
Results: At fraction 20 of RT, there was no significant difference between the groups in the distribution of RTOG grades ($p = 0.524$), with most of the patients presenting RTOG grade 1. Towards the end of RT, the skin reactions worsened in the placebo group ($p = 0.016$), while they remained stable in the laser group ($p = 0.207$). There was a significant difference in the severity of RD between the two groups ($p = 0.021$) with a larger percentage of patients experiencing RTOG grade 2 or higher (e.g. moist desquamation) in the placebo group (28.1% *vs* 5.9%, for the placebo and laser group, resp.) at the last day of RT.
Conclusion: The preliminary results of this first randomized, placebo-controlled trial show that PBMT can prevent aggravation of acute RD in breast cancer patients.

#114

TREATMENT OF CHRONIC RADIODERMATITIS WITH VASCULAR LASERS
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Background: Related to the improvement of the treatments of breast cancers, including radiotherapy, and the duration of the survival, the frequency of chronic radiodermatitis is growing. This disease includes atrophia of the dermis, dyschromia, and mainly, telangiectasias, located on the presternal area, commonly treated by radiations. The vascular lesions are very visible, reducing the quality of life, and forbidding to forget the previous cancer.
Study: This retrospective open study includes all the patients (176) treated since 2001 with a vascular laser for radiation-induced telangiectasia (vascular chronic radiodermatitis). The 176 women presented a total of 234 different lesions (144 on the presternal area, 90 on the lateral side of the breast). The main criteria of efficacy was the number of needful sessions to obtain a 80% reduction in the number of telangiectasias. The others criteria were the rate of satisfaction and the analysis of the side effects. All the patients, (except 4 treated with a 532 nm 10 millisec laser in 2016) were treated with a pulsed dye laser (595 nm, 7 mm hand piece) using short pulses

durations, from 1.5 to 10 milliseconds, depending on the diameter of the vessels, with a fluence of 9.5 to 13 J/cm^2, related to the pulse duration, with 40/20 msec dynamic cooling device.
Results: On 234 different lesions, the number of sessions of laser to reach a 80% improvement was: one session in 10% of the cases, and respectively 2 sessions in 32%, 3 sessions in 32%, 4 sessions in 16%, and 5 in 10% . The tolerance was very good, with purpura, small crusts (6%), but no scars or any severe side effects. Answering the question: "Was this treatment a significant benefit for you?". 100% of the patients said "Yes".
Conclusion: The treatment of the radiation-induced telangiectasia, after breast cancer, with a vascular laser can be proposed to our patients with a good efficacy and high levels of safety and satisfaction.

#115

EFFECT OF LASER THERAPY ON QUALITY OF LIFE IN PATIENTS WITH RADIATION-INDUCED BREAST TELANGIECTASIAS
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Background: Chronic radiation dermatitis is a common sequela in breast cancer patients treated with adjuvant radiation. The prominent breast telangiectasias associated with this condition may be perceived as disfiguring and cause emotional distress. We measured quality of life (QoL) before and after vascular laser therapy for radiation-induced breast telangiectasias (RIBT) in order to evaluate treatment effect on physical and psychosocial well-being.
Study: Patients presenting for RIBT treatment in the dermatology division of Memorial Sloan Kettering Cancer Center from March 2013–September 2016 were enrolled in this prospective study. Two validated QoL surveys (Skindex-16, Breast-Q Adverse Effects of Radiation) were administered prior to therapy. Patients were treated with a 595 nm pulsed dye laser at 4- to 6-week intervals, with percent telangiectasia clearance and adverse events recorded at each visit. Post-treatment QoL questionnaires were collected after clinician-assessed telangiectasia clearance of >50%.
Results: Twenty-one patients enrolled in this study. A majority (12/21, 57%) exhibited telangiectasias across both the décolletage and axilla in addition to the breast. Eight patients completed follow-up questionnaires, with all 8 (100%) revealing improved composite QoL scores. Patients improved significantly in physical, emotional, and social realms (Skindex-16: median pre-treatment 36.5 *vs* post-treatment 0, $p = 0.019$). Specific physical and cosmetic concerns common to radiated breast skin also bothered patients less (Breast-Q: median pre-treatment 11.5 *vs* post-treatment 7.5, $p = 0.018$). The 13 patients who failed to complete follow-up questionnaires were similar in age (56.6 *vs* 54.4 years, $p = 0.59$), median baseline Skindex-16 (36.5 *vs* 30.0, $p = 0.88$), and median baseline Breast-Q (11 *vs* 11.5, $p = 0.59$) to those who did fill out post-treatment surveys. Common adverse events were transient post-treatment pain and redness.
Conclusion: The psychosocial impact of an illness and its treatment is particularly salient in oncology, as life-saving interventions may have unanticipated and distressing sequelae. We demonstrated that RIBT causes QoL impairment, and that RIBT treatment can yield substantial improvement in multiple QoL spheres.

#116

EPIDEMIOLOGICAL DATA CONCERNING "LASER TREATMENTS FOR BREAST CANCER SURVIVORS" PUBLIC AWARENESS CAMPAIGN
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Background: An increasing number of patients are diagnosed with breast cancer. About 80% is subsequently treated with radiotherapy. Unfortunately, among breast cancer survivors who have been treated with radiotherapy, 30% will develop chronic radiation dermatitis (CRD) ten years after their treatment.
Study: Laser medicine treats effectively and safely CRD. To better understand, if and how patients are treated, the Laser Group of the French Dermatological Society conducted a survey within its member base from 01/2016 to 03/2016.
Results: From 464 sent out questionnaires, 42 (8%) were returned and available for statistical analysis. 76% of the answering physicians report to have treated at least one CRD patient within the last 5 years. This subgroup of treating dermatologists saw an average of 3.3 patients a year affected by CRD. From this data a conservative estimation can be made that a maximum of about 1000 patients are treated for CRD per year in France. Comparing this number with the incidence of CRD within breast cancer survivors in France, far less than 10% of the newly affected patients are treated with laser medicine. The survey finds that most frequently the following regions are treated (multiple answers possible): anterior chest wall (100%), neck (26%), axillary region (23%), face (11%). In contrast to the currently published data, the physicians use different laser systems to treat CRD. Pulsed dye laser remains the primary tool (44 %). However also other vascular lasers are commonly used (KTP = 38%, Nd:YAG = 26%, IPL = 11%). Even though scientific publications describing FP safety or efficacy in this indication are still scarce, fractional photothermolysis is also seen as a valid treatment alternative by 14% of the physicians (non-ablative fractional photothermolysis = 11%, ablative fractional photothermolysis = 3%).
Conclusion: Unfortunately less than 10% of the breast cancer survivors affected with CRD are treated with laser medicine.

#117

TREATMENT OF RADIATION TATTOOS WITH A PLATFORM-BASED QS Nd:YAG 1064 nm LASER
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Background: Radiation tattoos are typically black or sometimes blue ink placed intra-dermally with a needle to mark the margin of a radiation-treatment area in breast cancer patients. They are used as landmarks to improve accuracy with placement in sequential treatment sessions, and are very

resistant to wear and tear. Typically, placement is permanent, and many patients and providers are unaware of existing specific options for removal.
Study: Nine female patients were recruited from radiation/oncology with a history of breast cancer with Skin Types I to IV, with prior placement of radiation tattoos on the chest in cosmetically sensitive areas. The tattoo color was black, and 1–2 mm in average size. A single physician performed up to 5 treatments with a Q-switched (QS) 1064 nm laser (Lumenis, Ltd., Yokneam, Israel) with the endpoint of an ash white reaction. Treatment time was less than 5 minutes.
Results: 3–4 treatments sessions were required achieve complete tattoo removal (>90% reduction by blinded assessment) with a minimal side effect profile. No patients reported hypopigmentation or the appearance of scarring. Patient satisfaction was high, with post-treatment questionnaires showing higher self-esteem.
Conclusion: This study demonstrates the efficacy and safety of a platform-based QS Nd:YAG 1064 nm laser for the treatment of chest radiation tattoos. Awareness of treatment options for this entity (when medically appropriate) amongst patients and radiation/oncology providers can lead to successful treatment and improved quality of life.

LASER DENTAL APPLICATIONS

#118

COMBINING SUPER PULSE DIODE TECHNOLOGY AND SMART TEMPERATURE FEEDBACK FOR FAST AND PRECISE SOFT-TISSUE SURGERY
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Background: Laser diodes (LD) have numerous advantages as laser sources for dental applications, including very high efficiency, reliability, compactness, and low cost. Until recently, LDs have been limited in their ability to deliver high peak power levels, which, in turn, limited their clinical possibilities. Fortunately, recent technological developments made possible advent of "super pulse" LDs. Moreover, advanced means of smart thermal feedback offer means of precisely controlling this power, thus ensuring safe and optimally efficacious application. In this work, we have evaluated a prototype super-pulse diode system in both *ex vivo* and clinical settings.
Study: The prototype super-pulse LD system provided up to 25 W average and up to 150 W pulse power at ~975 nm wavelength. The laser was operated in various modes of control, including Automatic Power Control (APC) and Super Thermal Pulse (STP) modes, where power of the laser was varied automatically as a function of real-time thermal feedback to maintain constant tip temperature. *Ex vivo* evaluation methods were designed to assess the following characteristics of the system performance: 1) Speed and depth of cutting; 2) Degree of charring and dimensions of coagulative margin. Furthermore, the system was evaluated in clinical setting under an IRB-approved protocol for a number of relevant soft-tissue procedures, including troughing and gingivectomy.
Results: In *ex vivo* setting, the super-pulse laser diode system was compared with industry-leading conventional diode and CO_2 devices. The results indicated that the super-pulse diode laser system provided increase in speed of controlled cutting by a factor of 2 in comparison with the conventional diode laser and approaching that of CO_2 device. The produced ratio of the depth of cut to the thermal damage margin was significantly higher than conventional diodes and somewhat lower than that of the CO_2 system, suggesting optimal hemostasis conditions. In clinical setting, the super-pulse laser diode system with temperature feedback allowed fast, well-controlled, char-free surgery favorably comparable with the current industry-leading devices.
Conclusion: Super-pulsed diode laser technology with real-time temperature control has a significant potential for creating a new standard of care in the field of precision soft tissue surgery.

#119

A 980 nm DIODE LASER CLOT FORMATION OF THE RABBIT'S DENTAL SOCKETS AFTER TEETH EXTRACTION
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Background: The aim of this research work is to evaluate the use of 980 nm diode laser in clotting the blood in the bone socket after tooth extraction. The objective is to prevent possible clot dislodgement which is a defect that may lead to possible infection.
Study: A number of rabbits were irradiated using 980 nm CW mode diode laser, 0.86 W power output for 9 s and 15 s exposure time. The irradiated groups were studied histopathologically in comparison with a control group.
Results: Results showed that laser photothermal coagulation was of benefit in minimizing the possibility of the incidence of postoperative complications.
Conclusion: The formation of the clot reduces the possibility of bleeding and infection in addition to the benefit of laser enhancing healing and bone formation in the socket area. The results were based on histopathology of bone specimen was carried on for day 1, 3, 10, 14 and 21 post operatively. the conclusion was using 980 nm wavelength laser stimulate healing and bone formation moreover 15 s laser exposure time shows faster healing than 9 s exposure time.

#120

PERIODONTAL TREATMENT COMBINED TO ANTIMICROBIAL PHOTODYNAMIC THERAPY: EXPERIMENTAL MODEL
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Background: Antimicrobial photodynamic therapy (APDT) has been used as an adjuvant treatment for periodontitis. It combines a photosensitizer (PS) with a light source to induce reactive oxygen species (ROS) and kill microbial cells. PpNetNI is a protoporphyrin derivate, and it has a chemical binding site at biofilm and great affinity to microbial cells. The aim of this study was to investigate the effects of APDT as an adjuvant treatment for periodontitis.
Study: Ten healthy male rats Wistar (Rattus norvegicus) were used in this study (Approved by UNINOVE Ethical committee AN0029/2015). Periodontitis was induced by placing a cotton ligature around the first mandibular molar in a subgingival position. The contralateral mandibular first molar received neither a ligature nor any treatment, and was used as a control. After 7 days, the ligature was removed and all animals received scaling and root planning (SRP) and were divided according to the following treatments: SRP group (received SRP and irrigation with PpNetNI, 10 μM) and PDT group (PpNetNI 10 μM followed by LED irradiation). PDT was performed with a LED (630 nm) with an output power of 400 mW (fluence-rate 200 mW/cm^2; fluence 18 J/cm^2). Rats were euthanized at 7 days postoperatively. The bone loss was measured by Optical Coherence Tomography (OCT, THORLABS LTD., Newton, US). Data were analyzed statistically (Mann-Whitney test, $p<0.05$). in vestibular region of the first molar
Results: The animals treated by APDT showed a bone gain of approximately 30% compared to the SRP group following 7 days from the treatment. OCT was able to detect bone loss in the samples and it was nondestructive method for this experimental model.
Conclusion: In conclusion, within the parameters used in this study, APDT was an effective alternative to held periodontal health after treatment, and it was able to regenerate supportive periodontal tissue.

#121

OCT AND FLUORESCENCE INFLUENCE ON SCREENING DECISIONS FOR ORAL MALIGNANT LESIONS

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Background: Optical instruments for diagnosis are based on the light interaction with tissue. The physical characteristics of light onto tissue can be optimized with regard to several parameters. The chemistry, the morphology, and the structure of the tissue interact with the light revealing for example epithelial thickness, cellular density, nuclear/cytoplasmic ratios blood vessels, and collagen matrix. The aim of the present study was to assess the value of OCT for imaging abnormal changes in tissue architecture and ultraviolet detector system (LED Dental Ltd.) for visualizing the tissue auto-fluorescence of potentially malignant oral lesions and to establish the diagnostic accuracy, sensitivity, and specificity of these methods.
Study: 10 patients were evaluated by conventional oral examination (COE) followed by direct visual fluorescence evaluation (DVFE) using the ultraviolet detector. Areas clinically suspicious detected by COE or with positive DVFE (visual fluorescence loss (VFL)) were further investigated using surgical biopsy. The tissue samples were also investigated with OCT. The association between COE, DVFE and OCT was assessed and compared with histopathology.
Results: Areas of OSCC of the buccal mucosa were identified in the OCT images by the disruption of the basement membrane, an epithelial layer that was highly variable in thickness, with areas of erosion, extensive epithelial down-growth and invasion into the sub-epithelial layers. Eight positive biopsies for malignant lesions were detected by COE and DVFE. Only one positive biopsy for a premalignant lesion was not in accordance with COE and DVFE. One lesion seen on the ultraviolet detector and COE as non-malignant lesion was confirmed by the biopsy. Therefore, the ultraviolet detector system had a sensitivity of 100% and specificity of 50% in discriminating *in situ* normal mucosa from carcinoma or invasive carcinoma, compared with histology. The predictive positive value was 88.89% and the negative predictive value was 100% (95% CI).
Conclusion: OCT seems to be a highly promising imaging modality. DFVE allows for a simple and cost-effective margin determination, for the detection and screening of oral precancerous and early cancerous disorders. It was found that for the moment OCT and the ultraviolet detector system couldn't replace the histopathology procedure. Nonetheless, we determined its usefulness for clinical examination, monitoring oral lesions and guiding the biopsy. Therefore, these methods may add sensitivity to the oral tissue examination and be an effective adjunct for high-risk patients.

#122

EVALUATION OF HARDNESS OF BOVINE DENTAL ENAMEL WITH WHITE SPOT LESIONS FOLLOWING IRRADIATION WITH CARBON DIOXIDE LASER: A PILOT STUDY

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Background: CO_2 lasers have a greater absorption coefficient in enamel than erbium lasers, which makes the interaction more efficient from the energy standpoint and surface changes. However, some issues have not been fully clarified, such as the adequate dose on white spots. The use of laser on tooth enamel promotes changes in its physicochemical properties, solubility and surface characteristics; however, it is important to know whether these effects also occur on white spots. Thus, this study was conducted to evaluate a novel dosimetric protocol for the promotion of the remineralization of white spots on bovine dental enamel with the use of ultra-short pulsed carbon dioxide laser with a wavelength of 10,600 nm. The aim of this study was to evaluate, *in vitro*, the microhardness on artificial carious lesions in bovine dental enamel irradiated with CO_2 laser
Study: Caries-like, lesions were formed in 20 bovine teeth and randomly distributed into two groups ($n = 10$): Control group (with no caries) and Experimental group with dental caries (white spots). Irradiation was performed with a wavelength of 10600 nm, manual scanner with a diode coaxial laser as the guide, a focal distance of 75 mm, pulse interval of 0.99 s, pulse duration of 0.005 s, energy pulse of 5 mJ, pulse repetition of 1 Hz, duty cycle of 6,36%, and average power of 1 W, radiant

exposure of 11,60 J/cm^2 and irradiance of 245 W/cm^2 with constant air-cooling. Specimens were evaluated through Knoop surface microhardness and electron microscopy analysis. Groups were compared by using T-test. The experiment was performed in quadruplicate and temperature and relative humidity were recorded.
Results: The new protocol significantly diminished microhardness of dental caries ($p < 0.0001$) for all comparisons. Laser irradiation led to a significant increase in microhardness on all tests, but was unable to return the samples to their original conditions Laser irradiation did not alter the microhardness of the sound samples ($p>0.05$).
Conclusion: Microhardness of bovine dental enamel with artificial dental caries improved following CO_2 laser irradiation, but did not lead to the return of the original hardness of sound enamel.

#124

DEBONDING OF CERAMICS SELF-LIGATING BRACKETS BY DIODE LASER

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Background: Fractures and cracks have been reported during conventional debonding procedures of ceramics brackets by removing plier. The aim of this study was to develop a method to reduce debonding force and enamel fracture during debonding process of self-ligating ceramic brackets by using laser irradiation with diode laser.
Study: Ninety human premolars and molars extracted for orthodontic reasons were used in this study. Polycrystalline ceramic self-ligating brackets with metal clip were bonded using adhesive and dual cured composite. The samples were thermocycle in 1800 cycles at temperature up to 55 °C during 10 s. Thermocouple for temperature measurement was placed in the hole prepared on the oral tooth side. Tensile force for debonding was measured with custom made machine. All teeth were randomly divided in the three groups: control- plier debonding and laser debonding − 5 seconds, 3 W (group 1) and 4 W (group 2) energy, CW, spot size 2 mm, 2 mm distance
Results: Significantly ($p = 0.023$) lower tensile force for brackets debonding using laser irradiation (15 J and 20 J) in premolar group compared with controls was found. There was no significant difference between two premolar laser groups nor between all three molar groups. There was significantly ($p < 0.001$) pulp temperature increase between all three premolars group. There was significantly ($p < 0.001$) pulp temperature increase between control molar group and molar laser debonding groups
Conclusion: Diode laser is safe clinical tool and significantly reduce tensile force for orthodontic brackets debonding from premolars. During laser debonding temperature increase in pulp chamber is below threshold of 55 °C.

#125

CO_2 LASER FOR DENTAL ALUMINA CERAMIC FRAMEWORK WELDING

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Background: Dental prosthesis with metal framework may be welded if they present a rupture or maladjustment. Recently, due to the advances in ceramic materials, all ceramic prosthesis with no metal framework are being largely employed in dentistry but there is no evidence of the possibility of welding these structures if necessary. The objective of this study was to use CO_2 laser ($\lambda = 10.6\,\mu m$) as a welding agent to fuse dental alumina polycrystalline ceramic.
Study: Ceramic blocks of pre-sintered alumina (AL-20, VITA Zahnfabrik, Bad Säckingen, DE) were sectioned in 14 bars ($1.0 \times 1.5 \times 1.5$ mm) and then sintered to the final cross-section dimension of 1.2×1.2 mm. The bars were adapted to a Laser Heated Pedestal Growth (LHPG) system device were the bars could be fixed in pairs and have their extremity irradiated with CO_2 laser until they fuse. The laser achieved the extremity of the specimens with a ring format (300 μm thickness) and created a cylindrical molten zone (1.0 mm radius, 1.0 mm height). The laser was applied in a continuous mode with 40 W nominal power and with an exposure time of 5 seconds. The seven specimens were then analyzed in stereomicroscope up to 45x magnification and MEV.
Results: The ceramic bars were successfully fused but they showed a little shape distortion in the molten zone. The aspect of the fused alumina differed in color and translucency from the original sintered alumina, suggesting a modification in its crystalline microstructure after laser incidence. MEV showed the presence of porosity and voids in the center of the molten zone.
Conclusion: CO_2 laser was effective in welding polycrystalline alumina bars. A crystalline microstructure change after laser irradiance must be better investigated by diffractometry (XRD). Porosity was observed in the molten zone, similarly to what happens in a metal welding process.

NURSING/ALLIED HEALTH

#126

NURSING CONSIDERATIONS FOR ULTRASOUND TECHNOLOGIES

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Background: An increasing number of patients are seeking non-invasive laser skin tightening and body contouring as an alternative to surgical options. As demand increases, there is a need for consistent nursing protocols to ensure safe and effective clinical delivery of ultrasound energy treatments.
Study: Our practice has developed detailed patient management protocols based on the high volume of non-invasive procedures performed in office. We offer numerous non-invasive procedures with ultrasound technology including both high-intensity focused ultrasound and non-thermal focused ultrasound technologies. Each treatment has specific pre-operative, intra-operative and post-operative considerations to ensure the best outcome. Side effects and complications are rare but require immediate

recognition and management to reduce related adverse reactions. This study will detail our nursing protocols for patient management with both high-intensity focused ultrasound and non-thermal focused ultrasound procedures.
Results: We present a review of ultrasound technologies used within our practice devices, including their primary indications, patient selection criteria, patient preparation, intraoperative and postoperative care considerations. Each ultrasound technology has specific nursing considerations to optimize patient care. These include defining patient expectations, obtaining reproducible pre-treatment and post-treatment measurements, documenting photographic changes and pain management during and after treatment.
Conclusion: Nursing considerations are reviewed to optimize patient outcomes. We present the measures that need to be taken upon, during and after the procedure for optimal outcomes.

#127

ADJUNCTIVE TOPICAL AGENTS IN LASER THERAPY
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Background: Laser therapy can be made all the more powerful with the addition of medical agents that can help target the mechanism of disease or improve the therapeutic effect of the laser. Some methods are based on high quality evidence while others are anecdotal.
Study: This is a review of adjunctive topical agents used in a high volume group laser practice.
Results: Agents include topical perfluorodecalin to delay epidermal whitening during Q-switched and picosecond tattoo treatment, bimatoprost solution after fractional non-ablative resurfacing to improve hypopigmentation, topical sirolimus with laser destruction of angiofibromas (especially in the context of tuberous sclerosis), and timolol solution for synergistic improvement of infantile hemangioma.
Conclusion: Laser is a powerful modality with many applications. In some cases, topical medical therapy can be added to optimize therapy.

#128

EVALUATION OF EFFECTIVENESS OF LASER ACUPUNCTURE ON OSTEOARTHRITIS KNEE PAIN – RANDOMISED, DOUBLE-BLINDED, PLACEBO-CONTROLLED TRIAL
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Background: Worldwide, osteo-arthritis is the major cause of musculoskeletal pain and mobility disability in elderly people. The objective of this randomised, double blind, placebo-controlled trial was to evaluate the effectiveness of laser acupuncture on osteo-arthritis knee (OAK) pain. The study integrated traditional acupuncture philosophy, treatment principles and techniques with modern laser technology for the treatment of OAK pain.
Study: 40 participants were recruited and screened against inclusion/exclusion criteria and randomized into 2 groups – intervention and placebo. Intervention or placebo was administered 3 times per week for 4 weeks (12 treatments). Class 3B Low intensity laser equipment with an output power of 100 mW was used for the treatment of osteoarthritis knee pain. Outcome measures including VAS, WOMAC, McGill Pain Questionnaire, Credibility Expectancy, Working Alliance Inventory and multi-dimensional Health Locus of Control measure effects on pain, stiffness, physical functions and practitioner and patient relationships, etc.
Results: Findings on two outcome measures – VAS and WOMAC indicated that the active laser acupuncture group was statistically significant different from the sham laser group with a P value < 0.05. This showed laser parameters and acupuncture treatment principles and techniques were favorable to the positive outcome of the treatment. Symptoms of pain, stiffness and function all improved.
Conclusion: This randomized, double-blind, placebo-controlled clinical trial provided a robust design demonstrating that TCM-based laser acupuncture was beneficial for the treatment of osteoarthritis knee in reducing pain and improving stiffness and physical function.

#129

NURSING CONSIDERATIONS FOR PHOTOGRAPHY
Katherine Corradini, Anne Chapas, Jennifer MacGregor
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Background: Laser based cosmetic treatments can have subtle effects that are best captured in before and after photographs. It is important for nurses to take consistent before and after pictures so that patients can appreciate their results.
Study: Our office has specific protocols to keep photographs consistent and comparable. Photographs are used to capture baseline appearance, evaluate progress and the result of treatments. Photographs are also essential for documentation when complications arise.
Results: Great photographs are of vital importance when treating cosmetic patients. They serve as useful visual aids during consults with patients, help set realistic expectations for treatment outcomes, and allow us to monitor progress of treatments. Patients can appreciate subtle results when there is consistent photographic documentation with appropriate lighting and positioning. Nursing considerations for taking great photographs include consistent lighting, patient position and backdrop. The patient should have their hair off of their face, and make up and jewelry should be removed.
Conclusion: Photographs are the best way to track progress of laser based cosmetic treatments. Detailed nursing protocols are necessary to standardize photography so that before and after photographs are easily comparable.

#130

SCAR TREATMENTS UTILIZING LASERS AND RELATED TECHNOLOGIES
Tracy Ovtcharov, Iwona Drazila, Tamara Ammon, Clare McGrath, Daniel Belkin, Hana Jeon, Roy Geronemus
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Background: With the advancement of laser technology, various lasers are being employed to augment or replace traditional treatments for scars. It has become a common practice at our large laser center to provide multiple treatment options utilizing lasers and related technologies for patients seeking scar correction.
Study: This is a review of various modalities used in scar treatments at a large laser center.
Results: For many of the scar treatment visits, our center uses multiple treatment modalities, including intralesional kenalog with 5-fluorouracil, pulsed dye laser, ablative and non-ablative fractional lasers, Q-switched 1064 nm laser, picosescond laser, microneedling with radiofrequency and the non-fractional Er:YAG laser. Various types of lasers can be used to address the specific characteristics of each scar and skin phototype of the patient.
Conclusion: A customized approach utilizing the latest laser and related technologies can optimize scar treatments.

#131

ADVANCED ANESTHESIA TECHNIQUES FOR LASER PROCEDURES
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Background: Patient comfort is an important priority in elective cosmetic treatments. Painful procedures such as fractional ablative resurfacing, tattoo removal, and microneedling with radiofrequency require effective anesthesia to allow for a pleasant patient experience.
Study: This is a review of advanced anesthesia techniques for laser and related treatments.
Results: For painful treatments, our center uses a combination of topical anesthesia, local anesthesia, and facial nerve blocks. Local anesthesia techniques include the use of mesotherapy multi-injectors to reduce the amount of medication and the time needed to achieve numbing.
Conclusion: A combination of advanced anesthesia techniques for laser and related treatments can achieve rapid and effective numbing and improve patient experience.

#132

THE USE OF NAIL SURGERY AND LOW-LEVEL LASER FOR THE TREATMENT OF STUBBORN FUNGAL NAIL INFECTION – CASE STUDY
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Background: Onychomycosis (OM) is a mycotic (fungal) infection caused by the invasion of fungi into the structure of the nail (Bessinger, 2012). OM represents half of all nail abnormalities (Szepietowski and Salomon, 2007). Immuno-suppressant populations are known to be susceptible to OM. Healthy population may acquire OM through a portal of entry from such events as trauma or poor foot care (Gupta et al, 1998). Conventional treatment includes topical medication that has poor clinical outcome and oral medications that are known for risk of liver damage. In the last 7 years, laser therapies have offered an alternative for the treatment of OM. Clinical outcome for laser have shown to be 60%-70% cure rate in mild case of OM. Surgical intervention is advocated as a treatment when conventional treatment fails but it has a poor clinical outcome with a high dropout rate (Grover et al, 2007). This case study examines the outcome of the use of low-level laser therapy and total nail avulsion in the treatment of OM.
Analysis: A 58 years old Caucasian male with an 18-year history of suffering from onychomycosis. He is in good health with no past medical issue or allergies. As a banker, his work did not pose increase risk of contracting fungal nail infections. The patient suspected he acquired his infection from a contaminated swimming pool in 1999. On clinical examination, the appearance of the nail was yellow and thickened, a clinical diagnosis of distal onychomycosis was made. To confirm the diagnosis, a nail sample was taken for mycology. Fungus was present on initial microscopy and after 4 weeks of culture the fungus Trichophyton rubrum was grown.
Discussion: Initial treatment was given to patient for 9 months of low-level laser and oral Terbinafine and topical Amorolfine. He was to follow a strict foot health protocol of new shoes and socks was also required. Although there was initial improvement with clear nail growth of up to approximately 3 mm this was clearly a disappointing outcome after 9 months of treatment. As conventional treatment with the addition of low-level laser therapy had provided a poor clinical outcome, nail surgery was recommended as a final management plan. The concept of total nail avulsion was to remove the fungal nail infection complete from the nail matrix and nail bed and allow low-level laser to treat the fungal infection
Conclusion: Nail surgery was performed under local anesthetic and 3 nails were removed from the nail matrix and nail bed. A sterilized dressing was placed on the foot and once the wound had heal, 8 rounds of low-level laser therapy was applied 2 to 4 weeks apart. A strict foot health protocol of new shoes and socks was also required. After 6 months, the nail grew out completely with 100% resolution (which indicated an accelerated nail growth compared to the previous treatment). Subsequent mycology indicated that there was no fungus present. Further follow up for 9 months post-surgery demonstrated no evidence of fungal growth or reinfection indicating complete clinical cure. Combination of surgery and laser therapy may be considered for severe and chronic fungal nail infection when all conventional treatment has failed. Compliance to attend laser treatment may be important to increase the chance of mycological and clinical cure. Wound must be healed to allow laser to be used as it is not recommended to use on wounds. Foot Health education is also important to prevent re-infection. Future studies with larger study population are required to fully evaluate these methods for the treatment of onychomycosis.

PAPDT PDT

#133

ANTIMICROBIAL EFFECT ON CANDIDA ALBICANS BIOFILMS WITH DIFFERENT WAVELENGTHS AND DYES WITH SYNTHETIC KILLER DECAPEPTIDE
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Background: The aim of this study is to test the application in photodynamic therapy protocols of different laser wavelengths in combination or not with different photosensitizing dies on Candida albicans biofilms with or without a synthetic killer decapeptide (KP).

Study: For this study, C. albicans SC5314 was grown on Sabouraud dextrose agar plates at 30 °C for 24 h. Cells were added to RPMI 1640 buffered with MOPS and cultured on resin discs of polymethyl methacrylate. A previously described synthetic killer decapeptide (KP) was used in this study. The fungicidal activity of KP, associated or not with PDT protocol applications, on C. albicans biofilms adhered to acrylic discs was evaluated *in vitro* by the XTT assay. For scanning electron microscopy (SEM), 5 ml of yeast cell suspension were put onto resin discs within each well. Protocols were realized with three different wavelengths and colors: red diode and toluidine blue, blue-violet diode and curcumin and green diode and erythrosine. Laser irradiation has been performed in continuous mode at a fluency of 10 J/cm^2.

Results: The most effective dye, when used without laser, was curcumin that showed a significant effect on C. albicans biofilm in comparison with the untreated control ($p < 0.0001$), but also in comparison with toluidine blue and erythrosine ($p < 0.0001$). In the comparison with the untreated control, the application of red diode laser with or without toluidine in combination with KP treatment showed a statistically significant result ($p < 0.0001$), but the combination of dye and KP defined the same significant result without laser application ($p < 0.0001$). In the comparison with the untreated control, the application of blue diode laser with curcumin in combination with KP treatment showed a statistically significant result ($p = 0.0006$), but the combination of dye and KP defined the same significant result without laser application ($p = 0.0001$). In the comparison with the untreated control, only the application of green diode laser without erythrosine in combination with KP treatment showed a statistically significant result ($p = 0.0002$).

Conclusion: The combination of laser light and right color for the used wavelength, together to the use of a synthetic killer decapeptide (KP) may change dramatically the results in terms of antimicrobial effect.

#134

APPLICATION OF PHOTODYNAMIC THERAPY WITH LED AND METHYLENE BLUE IN STREPTOCOCCUS MUTANS IN THE PRESENCE OF GLUCOSE- *IN VITRO* STUDY

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Background: Streptococcus mutans is a microorganism associated with tooth decay; many genes that express adhesion, biofilm formation, extracellular polysaccharide, carbohydrate uptake and acid tolerance regulate its cariogenic properties. S. mutans inhabits a complex biofilm and it produces a large amount of exopolysaccharides to promote adhesion and enabling transport pumps. Photodynamic therapy involves the use of a photosensitizer (PS), which is absorbed by specific cells followed by irradiation with visible light, resulting in cell death. The aim of this study was to investigate antimicrobial photodynamic therapy on Streptococcus mutans in the presence of glucose.

Study: Streptococcus mutans was grown in brain heart infusion (BHI) at 37 °C for 48 h. Inocula were prepared with pure colonies, which were suspended in phosphate buffered saline (PBS) with and without 50 mM glucose. One-hundred micromolar methylene blue was used as photosensitizer and the experiments were performed with groups (control, irradiated with LED, FS without irradiation, and PDT 30, 60, and 120 s). Colony form units were counted and statistically analyzed (one-way ANOVA and Tukey 5%).

Results: The irradiation as well as the photosensitizer in the dark did not cause cell death. In contrast, in experiments without glucose, PDT caused cell death proportional the amount of light used. The more light, the higher the inactivation of S. mutans and after 2 min a reduction of 7 orders of magnitude (100%) was observed. In experiments with glucose cell death was observed even increasing the radiant exposure.

Conclusion: We concluded that PDT is a viable solution for inactivation of S. mutans in suspension, and that the presence of glucose activates efflux pumps in the bacterial cell wall, and it drastically reduces the effect of PDT.

#135

SINGLET OXYGEN IS MORE EFFECTIVE THAN RADICALS TO KILL C. ALBICANS BY aPDT

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Background: Antimicrobial photodynamic therapy (aPDT) is based on the combination of a photosensitizer, light and oxygen. In Brazil, methylene blue (MB) is a well-known photosensitizer due to its low cost and effectiveness. However, MB has its photochemical action mechanism modulated by its aggregation state, i.e., depending on the vehicle in which MB is used, it has a tendency to occur as monomers or dimers. Is was already shown that while monomers generates Type II reactions (singlet oxygen) dimers triggers Type I reactions (radicals).

Study: In order to evaluate if one of the photochemical mechanisms is more effective to kill Candida albicans, methylene blue in different states of aggregation was evaluated in planktonic culture. Besides the photobiological analysis assessed by counting CFU/mL, in which MB concentrations (0–100 μg/ml), incubation interval (1–20 min) and irradiation interval (0–30 min) were tested, the dimer-monomer ratio was determined by absorption spectroscopy.

Results: The results showed no statistically significant differences between the irradiation intervals used (0–30 min) and between the incubation intervals (1–20 min). The MB lowest concentrations (10 and 20 μg/ml) were the most effective for Candida albicans inactivation. This result breaks the paradigm that the highest MB concentrations are related to greater effectiveness. This observation is associated with MB physicochemical properties in aqueous medium and the photochemical mechanism. At the concentrations of 10 and 20 μg/ml the dimer/monomer ratio is approximately 0.40, while at higher concentrations, 50 and 100 μg/ml, the ratio increases to 0.50 and 0.64, respectively.

Conclusion: Thus, at the most effective concentrations,, i.e., the lowest ones, the amount of monomers is greater than dimers and consequently, the singlet oxygen generation is bigger than

radicals, which implies that singlet oxygen seems to be more effective on damaging the fungi than the radicals.

#136

SYNERGISTIC EFFECT OF SIMULTANEOUS CHEMOTHERAPY AND PHOTODYNAMIC THERAPY

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Background: Photodynamic Therapy (PDT) has a long clinical track record of tumor ablation. In general PDT has been employed alone as salvage after failure of surgery, radiation therapy and chemotherapy. We examined the outcome of PDT with simultaneous chemotherapy in advanced stage breast cancer patients.
Study: An FDA approved clinical trial for patients with cutaneous metastatic breast cancer (CMBC) was undertaken with the photosensitzer SNET2 (Adgero Pharma). Patients were randomized to cutaneous lesion ablation with control lesions not illuminated. As part of this trial some patients were on chemotherapy and/or hormonal therapy, while others were not. Lesion control as defined by complete response, partial response or no response was independently recorded.
Results: All patients underwent outpatient PDT as prescribed. Lesion control (CR and PR) was over 90% in patients undergoing chemotherapy/hormonal therapy as compared to 75% in patients not undergoing chemotherapy/hormonal therapy during PDT. In particular, complete response with full healing was more than doubled (56% *vs* 22%) in the chemo/hormonal therapy cohort. This was statistically significant: $p < 0.05$. PDT morbidity was minimal both in the chemo and non-chemo group mostly related to pain during PDT illumination. No difference in wound healing rates were noted on follow up.
Conclusion: The combination of PDT and chemotherapy was safe and significantly enhances lesion control rates for CMBC patients. It appears that chemotherapy and PDT offers synergistic effect for these patients and should be considered a clinical treatment option.

#137

SPLIT CHEST STUDY OF REJUVENATION USING A LOW ENERGY THULIUM 1927 nm LASER PRIOR TO APPLICATION OF AMINOLEVULINIC ACID (ALA) AND PHOTODYNAMIC THERAPY (PDT) *vs* ALA-PDT ALONE

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Background: Photoaging of the chest is a common problem resulting from ultraviolet damage and aging. While ALA-PDT has been shown to improve photodamage on the face, there is limited evidence evaluating it for chest rejuvenation. Here, we evaluated pretreatment with a fractionated 1927 nm thulium laser prior to topical ALA application and PDT compared to ALA-PDT alone for rejuvenation in a split chest study.
Study: Eleven female subjects aged 53–72 years with skin types I–III and class I–IV chest rhytides were treated with 3 monthly sessions with a 1927 nm thulium laser at 10 mJ/cm^2 and 10% coverage on a randomized side of the chest. Subsequently, both sides of the chest were incubated with ALA under occlusion and a heating pad for 30 minutes, followed by illumination with blue light (417 nm) for 10 J/cm^2 at 1000 seconds, Standardized photographs and blinded physician assessments were performed at baseline, treatment visits, and 4 and 12-week follow-up visits after the last treatment. Three non-treating physicians scored photographs independently for rhytides, pigmentation, and erythema.
Results: Immediate post-treatment side effects included erythema, edema, and burning/stinging, which were significantly worse with laser pretreatment. Blinded, in person assessment at the 12 week follow-up showed improvement in wrinkles (100%) and skin texture (91%) with no significant difference between treatments. Scoring of photographs at the 12 week follow-up compared to baseline showed improvement ($p < 0.05$) in rhytides, pigmentation, and erythema with no significant difference between the two treatments. One subject experienced substantial post-inflammatory hyperpigmentation which appeared worse on the pretreatment side.
Conclusion: ALA-PDT is a safe and effective treatment for chest rejuvenation, resulting in mild to moderate improvement in pigmentation, erythema, rhytides and skin texture. Laser pretreatment did not have added benefits compared to ALA-PDT alone, and was associated with worsened immediate post-treatment side effects and post-inflammatory hyperpigmentation.

#138

DAYLIGHT PDT: SOUTHERN CALIFORNIA EXPERIENCE

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Background: Photodynamic therapy (PDT) is an effective treatment for actinic keratosis, but traditional in-office treatment is often painful for patients. Discomfort during activation of the photosensitive agent is a considerable obstacle to therapy, and natural sunlight has been shown in several other studies to be a more comfortable method of treatment. Most prior daylight PDT studies have been performed in northern Europe, and in the geographic area of sunny southern California clinicians have been hesitant to use daylight PDT for fear of patients burning in the ample sunlight.
Study: We present a prospective study of 31 patients treated with daylight photodynamic therapy. Facial maps were created to count and monitor actinic keratosis, followed by application of aminolevulinic acid and 2 hours outdoors in the indirect sunlight. Patients then adhered to 48 hours of complete photoprotection. All participants used luxometers to measure the intensity of daylight during the 2 hour treatment period, and recorded pain on a 1–10 scale. Patients were seen in follow up at 3 and 6 months to assess change in number of actinic keratosis as well as subjective improvement.
Results: Our study is currently closed to new participants, and all 6 month follow up visits will be completed by December 2016. To date the 6-month reduction in actinic keratosis has been 74%, but there are several participants who have not had their final study visit. The treatment was well tolerated, with the highest pain score recorded as a 4/10. Additionally, all study participants have stated that they would repeat the treatment in the future if necessary.
Conclusion: Daylight PDT is a well-tolerated and effective treatment for actinic keratosis. It should be considered as a standard therapy in the setting of patients with field

cancerization, and is safe even in traditionally "sunny" geographic locations.

#139

PHOS-ISTOS: A NEW SOLUTION FOR PHOTODYNAMIC TREATMENT OF ACTINIC KERATOSIS

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Background: Actinic keratosis (AK) are common pre-cancerous skin lesions which mainly affect the elderly population. The lesions are usually present on the scalp of the patients and thus are easily reachable by light, making PDT one of the first line treatment. The European PHOSISTOS project (CIP project 621103) aims to develop a light emitting helmet.
Study: This helmet consists of a 3D printed frame and a patented flexible structure composed of knitted optical fibers. Besides its original design, the project aims to demonstrate that an illumination performed 30 minutes after 5-ALA application, with a low irradiance (4 mW/cm^2), a reduced fluence (12 J/cm^2) is as efficient as the conventional protocol: illumination 3 hours after 5-ALA application, 75 mW/cm^2, 36/cm^2. The evaluation of this device is currently in a Phase II study that takes place in France and in Germany. The main objective is to show the non-inferiority of the PHOSISTOS protocol compared to the conventional protocol. The secondary objective is to show the benefit in terms of pain. 42 patients with at least 10 actinic keratosis of the scalp and forehead are being included. After randomization, each patient is treated with PHOSISTOS on one side and with a conventional LED panel (Aktilite) on the other side.
Results: The clinical evaluation is still in progress. Preliminary results show that PHOSISTOS is effective in the treatment of AK of the scalp with pain scores much lower than the conventional protocol. Updated data concerning this protocol will be presented.
Conclusion: PHOSISTOS ® could offer an effective and well tolerated alternative to LEDs for the treatment of AK by PDT. An ambulatory version of the PHOSISTOS device can be easily developed.

#140

A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED CLINICAL TRIAL EVALUATING THE ROLE OF SYSTEMIC ANTIHISTAMINE THERAPY FOR THE REDUCTION OF ADVERSE EFFECTS ASSOCIATED WITH TOPICAL 5-AMINOLEVULINIC ACID PHOTODYNAMIC THERAPY

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Background: Following photodynamic therapy (PDT) with topical 5-aminolevulinic acid (ALA), patients often experience a bothersome spectrum of acute inflammatory effects such as erythema, edema, crusting, superficial erosion, and rarely ulceration. The pathophysiology of this acute inflammatory response has been suggested to be secondary to the activation of H1 receptors *via* an immediate and time-dependent release of histamine. This biochemical response peaks at 30 minutes post-PDT, remains stably elevated for another 4 hours, and returns to baseline by 24 hours post-procedure. The objective of this study was to evaluate the benefit and subject satisfaction resulting from use of antihistamines during ALA-PDT.
Study: Twenty adult subjects with 5 to 20 actinic keratosis on the face were enrolled. Subjects were randomized to ALA-PDT plus cetirizine 10 mg daily for 3 days pre-treatment, on the day of treatment and 3 days post-treatment for a total of 7 days ($n = 10$), or ALA-PDT plus placebo for the same time period ($n = 10$). The primary endpoint was Localized Skin Response consisting of erythema, edema, crusting, exudation, vesiculation/pustulation and erosion/ulceration on post-treatment days 1, 2, 3, 7, 30, 90 and 180. Secondary endpoints were AK count, investigator-rated Global Assessment Improvement Score (GAIS), healing, tolerability and subject satisfaction.
Results: Actinic keratosis counts 6 months following ALA-PDT were significantly reduced in both the antihistamine and placebo groups ($p = 0.002$ and $p = 0.000$, respectively), but not different between the groups. The Localized Skin Response following treatment was also not significantly different between the antihistamine and placebo groups, though crusting on post-procedure day 7 was less in the antihistamine group ($p = 0.027$). Investigator-rated GAIS, subject satisfaction, healing and tolerability were similar between subjects randomized to antihistamines and placebo.
Conclusion: This study suggests that while prophylactic and therapeutic systemic antihistamines do not impair the efficacy of ALA-PDT, they also do not relieve post-treatment inflammation and discomfort.

#141

A CASE OF REFRACTORY ELASTOSIS PERFORANS SERPIGINOSA SUCCESSFULLY TREATED WITH ALA-PDT

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Background: A 56-year-old woman with a history of cystinuria on penicillamine therapy for forty years developed numerous erythematous polycyclic and annular plaques with atrophic centers and serpiginous, raised borders on the anterior neck and axilla. A punch biopsy revealed transepidermal elimination of abnormal thick elastic fibers with perpendicular buds. Movat stain outlined coarse tortuous elastic fibers throughout the dermis in a "bramble bush" configuration. She was diagnosed with penicillamine-induced elastosis perforans serpignosa (EPS). EPS is a rare condition often seen in the setting of underlying conditions, such as Down's syndrome or Ehlers-Danlos, but also following penicillamine therapy. Penicillamine, a heavy metal chelator, is used to treat various diseases including cystinuria, Wilson's disease, and systemic sclerosis. Long-term administration has been associated with cutaneous adverse events in 20–50% of patients. Penicillamine-induced dermatoses include EPS, cutis laxa, or pseudo-pseudoxanthoma elasticum. Treatment of EPS is difficult and consists of intralesional corticosteroids, retinoids, destruction, and isolated cases of photodynamic therapy (PDT). The patient failed numerous intralesional corticosteroids injections and topical retinoids. She developed significant neck strictures and wrinkling causing physical discomfort and social anxiety.

Study: The patient was treated with aminolevulinic acid PDT (ALA-PDT) once weekly for 4 treatments. 1.5 ml of 20% ALA was applied to the neck and occluded with plastic wrap for two hours. The patient was then irradiated with a narrow band LED at 630 nm 15 cm away from her neck. The first treatment exposure dose was 99 J/cm^2 and the remaining three treatments doses were 130 J/cm^2. Pain was assessed during and post-procedure on a numerical scale. Clinical images were taken before and after each treatment session.
Results: Clinical images revealed a significant improvement in disease activity and patient satisfaction
Conclusion: ALA-PDT is a viable option in treatment-resistant EPS.

#142

CHARACTERIZATION OF A NOVEL DEVICE FOR INTRAOPERATIVE PHOTODYNAMIC THERAPY IN NEUROSURGERY

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Background: For several years, Photodynamic Therapy (PDT) has been developed in neurosurgery for the management of brain tumors. Recently, special attention has been paid to High-Grade Glioma, with focus on Glioblastoma a malignant primary brain tumor. Despite the current standard of care including surgery, radiation oncology and chemotherapy, this condition has a dismal prognosis with median overall survival below 16 months. Indeed, local relapse is a universal occurrence and, in this context, PDT delivered intraoperatively is a relevant adjuvant treatment to improve local control.
Study: A specific light applicator was designed to fit into the surgical cavity during neurosurgical procedures. Several experimentations (temperature and impermeability tests) were conducted to insure the safety of the device. Dosimetry characterization with *ex vivo* experimentations was achieved to calibrate the device and to estimate irradiance in tissues according to shape and size of the surgical cavity. A methodology was designed and applied to translate power measurements (W) into irradiance values (W/cm^2). Photosensitizer concentration impact on optical properties was also investigated.
Results: Neither thermal elevation nor liquid leak was observed during the safety tests. A prescription *abacus* was created from different irradiance measurements according to different surgical cavity volumes (40 mL to 500 mL). This *abacus* allows determining an illumination time as function to the surgical cavity in order to deposit a therapeutic fluence value close to 25 J/cm^2 at 5 mm inside brain tissues. Conversion from power into irradiance measurements induces a standard deviation of 17 seconds on the total illumination duration, that remains acceptable in comparison with the mean illumination duration (30 minutes).
Conclusion: In this study, we present the assessment and the calibration of novel device dedicated to intraoperative PDT for brain tumor treatment. Average lighting duration, ranging from 20 to 40 minutes, was assessed by neurosurgeon experts as an acceptable additional time. A "first in man" clinical trial, INDYGO, is planned in 2017 to assess feasibility and safety of the procedure.

#143

SYNTHESIS OF COUMARIN/BENZYLIDENE CYCLOPENTANONE PHOTOSENSITIZERS FOR TWO PHOTON EXCITATION PHOTODYNAMIC THERAPY

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Background: Photodynamic therapy (PDT) has been clinically applied in oncology, ophthalmology and dermatology. Compared with one-photon excitation PDT, two-photon excitation PDT (TPE-PDT) offers the advantages of deeper tissue penetration and better spatial selectivity. However, very limited number of photosensitizers (PSs) for mediating TPE-PDT are now of good water-solubility and high two-photon absorption.
Study: Coumarin derivatives conjugating a benzylidene cyclopentanone substituent at 3- or 4-position of the coumarin ring without (T3, T4) or with water-soluble polyethylene glycol (PEG) (T3-PEG, T4-PEG) were synthesized as the PSs. The water solubility, octanol-water partition coefficient (Log P), singlet oxygen *quantum* yield, two-photon absorption cross section and *in vitro* photo-cytotoxicity of these PSs were studied.
Results: Compared with T3 and T4, T3-PEG and T4-PEG achieved sufficient water solubility (2.4 and 2.8 mg/mL respectively) and more suitable Log P (2.2 and 1.7 respectively). In dimethylformamide, the singlet oxygen *quantum* yields of T3 and T3-PEG (0.04) were higher than those of T4 and T4-PEG (0.01). Furthermore, T3 and T3-PEG exhibited much larger two photon absorption cross section (670 GM) than T4 and T4-PEG (140 GM) at 820 nm wavelength. In one-photon excitation PDT, after irradiation with a 532 nm laser (50 mW/cm^2, 10 min), the concentrations of T3-PEG and T4-PEG required to photo-inactivate 50% of cancer cell HepG2 (IC50-light) were 5.5 and 9.5 μM, respectively, while the IC50-light of clinically used PSD-007 was 3.5 μM ($P < 0.05$). In TPE-PDT (800 nm laser, 1.64 W/cm^2, 1 kHz, 130 fs, 10 min), the post-PDT survival of HepG2 cells using T3-PEG (20 μM) as the *PS* (~40 %) was much lower than those using T4-PEG (20 μM) (~92%) or PSD–007 (20 μM) (~99%) ($p < 0.05$).
Conclusion: Coumarin/benzylidene cyclopentanone PSs T3-PEG and T4-PEG are promising agents of PDT. T3-PEG is more effective than T4-PEG and PSD 007 for two-photon excitation photodynamic therapy.

#144

NOVEL BITE BLOCKS FOR PRECISION AND ERGONOMIC INTRAORAL PDT LIGHT DOSIMETRY AND DELIVERY WITH A PORTABLE, LOW-COST LED SYSTEM FOR GLOBAL HEALTH APPLICATIONS

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Background: Photodynamic therapy (PDT) has been used for various cancer treatments and can be well adapted to the global health settings due to its photochemistry mechanism.

Previously, we demonstrated a battery-powered portable LED system that proves to be a functional and reliable source for ALA-PDT with consideration of clinical translation under resource-limited setting. We discuss here the development of intraoral ergonomic light delivery bite-blocks, which improves the light dosimetry precision and eases the operation for clinical professionals.
Study: By using a commercially available smart-phone dental endoscope which has the similar size and geometry of the optical fiber used in our LED system, we designed and tested various fiber-adapted light delivery bite-blocks for posterior buccal, anterior buccal and retromolar area in the oral cavity. They are designed for lesions up to 1.5 cm in diameter. We calibrated the optical power, stability, light intensity distribution after those light delivery pieces from our LED system. Silicon pads were added around the bite blocks to enable stable and comfortable bite-on for total of 30 min treatment with patients' mouths closed. The development was in close dialog with clinical professionals to make it readily adaptable in practice.
Results: A set of novel bite blocks that are adaptable with fiber optic light delivery in the oral cavity were developed, calibrated and tested. They can be operated hands-free and are comfortable to stay inside the oral cavity during the treatment without additional anesthetic. Personalized fitting and designing of those bite blocks are available if needed.
Conclusion: We developed a set of ergonomic fiber adaptable bite blocks for light delivery in three areas of the oral cavity. Together with the battery-powered portable LED light source we developed, the whole system is a great candidate for the ALA-PDT treatment of oral cancer in both the global health and standard setting.

#145

AN INTRODUCTION TO INDYGO: SET-UP AND PRELIMINARY RESULTS OF THE FIRST PILOT CLINICAL TRIAL ON INTRAOPERATIVE 5-ALA PDT FOR THE TREATMENT OF NEWLY DIAGNOSED GLIOBLASTOMA

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Background: Glioblastoma (GBM) is a rare neoplastic disease and still remains an incurable brain tumor with a median overall survival of approximately 16 months. Despite of its low prevalence (0.3/10,000 persons), it is the most frequent primary malignant brain tumor in adults and no existing therapeutic agent is able to stop GBM progression. Complete tumor resection is rarely feasible, since tumor cells usually infiltrate brain surrounding tumor core. Adjuvant therapies to improve local control are thus highly expected. Management of newly diagnosed GBM includes surgery for maximal tumor resection followed by radiation therapy and concomitant and adjuvant chemotherapy. Recently, 5-ALA interstitial photodynamic therapies (PDT) have been reported with promising results. However, if one consider the absence of controlled clinical trial, efficacy of 5-ALA PDT is not still evidenced and thus not included in the standard protocol. We present here the set-up of clinical trial to evaluate 5-ALA PDT to treat newly diagnosed GBM.
Study: Our group has recently developed a specific light applicator to deliver PDT in the surgical cavity early after maximal resection to demonstrate 5-ALA-PDT efficacy on newly diagnosed GBM. Treatment of the infiltrating cells by a PDT effect is expected in the first millimeters of the cavity borders. Intraoperative PDT is a seamless strategy easily embeddable into the standard surgical protocol, which is more ethically acceptable and more efficient to assess PDT efficacy. Ten patients will be enrolled and will undergo to intraoperative PDT in addition to the standard of care. PDT will be delivered early after maximal resection with 25 J/cm^2 delivered at 5 mm of the surgical cavity borders. Total light dose will be delivered with 5 fractions of 5 J/cm^2 each (off-period of 2 minutes between each fraction). A first early post-operative MRI will be acquired and, then, MRI will be acquired quarterly for monitoring.
Results: Primary endpoint is the feasibility of intraoperative PDT, estimated by the proportion of patients who undergone intraoperative PDT without unacceptable toxicity. The objective is 70% that is 7 of 10 patients without unacceptable toxicity in relation to PDT. Secondary endpoints are progression-free survival, overall survival, and evaluation at 3 months, 6 months and 12 months of radiation treatment response and patients' quality of life.
Conclusion: Finally, after the feasibility and the absence of adverse effects, multicentric, parallel-group, randomized controlled trial (RCT) will be set-up to evaluate the efficacy of 5-ALA PDT for the treatment of newly diagnosed GBM. This multicenter clinical trial will be set-up and performed with the support of the European network Synaps.

#146

MAGNETIC RESONANCE IMAGING TO ASSESS PHOTODYNAMIC THERAPY EFFECTS ON A PRECLINICAL MODEL: PRELIMINARY RESULTS ON DIFFUSION/PERFUSION MRI TO EVALUATE PDT RESPONSE

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Background: Glioblastoma (GBM) is a malignant brain tumor with a particularly dismal prognosis (overall median survival lower than 16 months). Despite of GBM is a rare neoplastic disease with low prevalence (0.3/10,000 persons), it remains the most frequent malignant primary brain tumor in adults. Today, 5-ALA PDT, either delivered interstitially or intraoperatively, has recently been reported to have potential effective outcomes in patients harboring GBM. Recent studies reported the outcomes of PDT delivered to GBM using preclinical immunohistological data. Our study aims to evaluate the role of MRI imaging, including diffusion and perfusion, for monitoring PDT effects early after treatment and for different illumination regimen.
Study: "Nude" rats were grafted with human U87 cells into the right putamen. After 5-ALA intake, an optic fiber was introduced into the tumor. The rats were randomized in three groups: without illumination, with two-fraction lighting or five-fraction lighting for a total dose of 25 J at 30 mW/cm^2. Treatment effects were assessed with early MRI including diffusion and perfusion sequences and compared to immunohistology.
Results: Images acquired on a 7 Tesla MRI revealed an elevated diffusion values in the center of the tumor and a

decreased perfusion around the treatment site among treated animals, especially in 5-fraction group. These observations were in agreement with histology. Indeed, diffusion was a relevant marker of necrosis and apoptosis and perfusion well described the level of necrosis. Additionally, T2 signal was correlated with inflammation/edema observed on histology.
Conclusion: We observed that diffusion and perfusion MRI were able to assess PDT effects. Diffusion and perfusion MRI were good biomarkers of the histological lesions. Indeed, interstitial PDT induced specific tumor lesions observed with MRI were confirmed from histopathology study. Finally, MRI might provide a non-invasive and reliable tool to assess treatment outcomes early after PDT.

#147

ULTRA FAST THERMAL PDT FOR FACIAL AKs: PROOF OF CONCEPT STUDY
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Background: The temperature dependence of porphyrin production is well established in murine and keratinocyte models. The clinical application of warming skin during cutaneous Photodynamic therapy (PDT) is just beginning to be appreciated. Recent studies have demonstrated warming skin during one hour incubation of ALA is well tolerated and increases efficacy of AK clearance on extremities. A subsequent long term follow up study demonstrated similar clearance rates were sustained for one year. The potential of further reducing incubation times while increasing efficacy of PDT for facial AKs has not been formally investigated.
Study: Ten subjects with at least ten facial AKs were enrolled in this prospective single center proof of concept study. 5% ALA was applied to facial skin followed by a warming mask for 20 minutes prior to exposure to 10 J/cm2 blue light. The warming mask is comprised of a sodium acetate liquid emits heat upon crystallization that consistently heats skin to approximately 40 °C for 20 minutes. Lesion counts were performed at baseline and 2 months follow up. Standardized photographs were taken and porphyrin production quantified at baseline, after incubation, light exposure, and at 1 day, 1 week, and 2 months after treatment.
Results: Final lesion counts and porphyrin analysis will be presented pending the completion of the 2 month follow up period for all ten patients (final results will be complete prior to the meeting). Preliminary results demonstrate facial skin temperatures of 39–42 °C dramatically increase porphyrin production during a 20-minute incubation period. Typical PDT reactions are observed with erythema, diffuse scaling and mild edema throughout the treated field. The treatment is well tolerated during light exposure followed by mild sunburn like reactions. Clinical and porphyrin images of traditional one hour PDT will be shown for comparison.
Conclusion: Warming facial skin during incubation of ALA dramatically increases porphyrin production during a 20-minute incubation time and appears to be effective and well tolerated by patients.

PHOTOBIOMODULATION

#148

THE USE OF PHOTOBIOMODULATION THERAPY FOR THE MANAGEMENT OF ORAL MUCOSITIS IN CANCER PATIENTS OTHER THAN HEAD AND NECK CANCER: TWO RETROSPECTIVE ANALYSES
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Background: Photobiomodulation therapy (PBMT) is a standard therapy for oral mucositis (OM) in head and neck cancer, but for other cancer types the research is limited. The aim is to evaluate the effectiveness of PBMT in the management of OM in cancer patients other than head and neck cancer in a single center cancer unit.
Study: Two retrospective studies were conducted with cancer patients other than head and neck cancer who underwent PBMT for the treatment of OM. PBMT was delivered using an AsGA diode laser ($\gamma = 665$ nm; output power: 100 mW) combined with an infrared laser (continuous emission, output power: 500 mW, fluence: 4 J/application point). PBMT was applied to the anatomical areas of the oral mucosa (tongue, palate, tonsil, cheek, lips, floor of the mouth). Patients were treated two times a week until healing of the lesions. Trained nurses evaluated the severity of OM by using the WHO grading scale at the start and the end of PBMT. The WHO grades of all treated areas were summed to become an OM score for each patient.
Results: In a first study, data of 245 cancer patients undergoing treatment for malignancies of various origins were analyzed. In a second analysis, data of 93 breast cancer patients who underwent chemotherapy were included. The average duration of PBMT was 2 to 3 weeks. In both studies, there was a significant improvement in OM severity at the end of PBMT ($p < 0.0001$), with an increased proportion in WHO grade 1 and a decrease in $\geq$ grade 2. Additionally, the OM score significantly decreased ($p < 0.0001$). In general, the OM score improved of 71.4% of the patients with cancer of various origins and of 80.6% of the breast cancer patients.
Conclusion: These two retrospective analyses demonstrated that PBMT significantly reduced the severity of OM in patients with various cancer types.

#149

INHIBITION OF CHEMORESISTANCE TO 5FU BY 635 nm LED IRRADIATION IN CANCER-STEM LIKE CELLS
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Background: Consistent with the cancer stem cell model, a small population of cancer cells, described as cancer stem cells (CSCs), are thought to predict tumor recurrence and multiple

anti-cancer drug resistance. Therefore, much effort has been devoted to the development of CSCs targeting therapy for overcoming drug resistance. In this study, we tried to examine the effect of multiple treatments of LED irradiation and conventional anti-cancer drug in CSC-like head and neck cancer cells which acquired stemness and chemoresistance by ectopic overexpression of CD133 for CSCs targeting combination therapy.
Study: For the evaluation of LED irradiation and anti-cancer drug combining effects, we investigated the chmosensitizing effects of 635 nm irradiation in 5-fluorouracil (5FU) treated KBCD133 + and KBVec cells and interrogated the underlying molecular mechanisms responsible for tis chemopreventive activity.
Results: 635 nm LED irradiation led the inhibition of CSC like properties consistent with decrease of ALDHA1, OCT4, NANOG protein expression, ALDH activities and colony forming abilities. Also, LED irradiation enhanced the 5FU-induced cytotoxicity and inhibited proliferation in both of KB CD133+ and KBVec cells *via* enhancement of apoptosis. Especially, 635 nm irradiation improved the 5FU chemoresistance in KB CD133+ through the cell cycle progression. These findings were validated *in vivo*, wherein LED irradiation combining 5FU treatment resulted in inhibited tumor growth in KB CD133 + −innoculated xenograft model.
Conclusion: Collectively our results provide novel and previously unrecognized evidence for 635 nm irradiation-induced 5FU chemosensitization targeting of CSC in head and neck cancer. In addition, our results highlight that 635 nm LED irradiation may serve as an adjunctive treatment to conventional chemotherapeutic drugs in head and neck cancer patients.

#150

PHOTOBIOMODULATION INHIBITS TUMOR GROWTH *IN VIVO* BY STIMULATING IMMUNE SURVEILLANCE
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Background: Photobiomodulation is emerging as a recommended supportive therapy for oral mucositis induced by cancer therapies. However, its mechanisms of action and, more significantly, its safety in oncological patients, have never carefully investigated so far.
Study: We assessed the metabolism and the proliferation of cancer cells *in vitro* and *in vivo* after exposure to different laser protocols. We employed two different animal models, both ectopic melanoma and a more physiological oral carcinogenesis, followed by molecular, histological and immunohistochemical analysis.
Results: Photobiomodulation slightly increased cell metabolism and proliferation *in vitro*, albeit each laser protocol exerted a difference response. Interestingly, *in vivo* laser therapy reduced tumor growth and invasiveness, indicating a beneficial influence on tumor microenvironment. Laser-treated tumors were delimited and infiltrated by immune cells, in particular by lymphocytes and dendritic cells. A paralleled effect was the enhanced secretion of type I interferons. In contrast, the number of pro-angiogenic macrophages was reduced in response to photobiomodulation, with consequent normalization of the tumor vasculature. Based on these obtained findings, we have also started exploring the effect of photobiomodulation on lymphocyte response in a mouse model of vaccination. Preliminary data indicate that laser light stimulated antigen-specific CD8+ and CD4+ T-cell responses.
Conclusion: From both *in vitro* and *in vivo* analysis we can state that photobiomodulation is effective in stimulating cell metabolism and in boosting a potent immune response *in vivo* in both cancer and vaccination experimental models. We can therefore foresee that the laser therapy can be safely performed even in oncological patients, thus opening the way to innovative therapeutic opportunities.

#151

PHASE I SAFETY STUDY OF HIGH FLUENCE LIGHT EMITTING DIODE-RED LIGHT (HF-LED-RL) ON HUMAN SKIN: A SINGLE-BLIND, DOSE ESCALATION, RANDOMIZED CONTROLLED TRIAL
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Background: The goal of this study was to establish the maximally tolerated dose (MTD) and the safety of high fluences (160 J/cm^2 up to 640 J/cm^2) of light emitting diode-red light (HF-LED-RL) on human skin.
Study: This was a phase I, single-blind, dose escalation, randomized controlled trial in healthy subjects to evaluate safety of HF-LED-RL on normal forearm skin. This study was approved by the Sacramento VA IRB. The maximum recommended starting dose of 160 J/cm^2 was based upon published clinical studies that demonstrated clinical safety with no adverse events. The dose ceiling of 640 J/cm^2 was chosen due to feasibility and pre-clinical anti-fibrotic properties demonstrated *in vitro* compared to lower doses of LED-RL. A hand-held LED-RL phototherapy unit was used (Photo Therapeutics, Carlsbad, CA). Subjects received doses of LED-RL phototherapy or temperature-matched mock treatments based upon randomization (using a custom device that only generated heat but no LED-RL), three times per week for three consecutive weeks (nine total sessions) on the non-dominant forearm to define the MTD.
Results: 60 subjects were enrolled and 57 subjects completed the study. One subject experienced an adverse event (a 0.5 cm blister) after the first 480 J/cm^2 HF-LED-RL session. This adverse event led to determination of 320 J/cm^2 as the MTD of LED-RL in human skin. Fifty subjects (30 LED-RL and 20 mock) received 320 J/cm^2 LED-RL. Within this cohort, there was one adverse event of erythema lasting >24 hours that resolved by 48 hours. Ten subjects (21%) had post-inflammatory hyperpigmentation (PIH). No subjects experienced pain, ulceration, sensory changes, muscle weakness, or systemic effects.
Conclusion: These results establish the MTD and safety profile for HF-LED-RL (160 J/cm^2 up to 320 J/cm^2) use on unaffected human skin, and will serve as the foundation for future clinical trials.

#152

PHOTOBIOMODULATION OF NO BIOACTIVITY AND RELEASE IN THE SKIN

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Background: Nitric oxide (NO) is a very important signaling molecule for the cardiovascular system and impacts a series of other functions. NO is present in most living organism and tissues including human skin. It has been shown that UVA-mediated photolysis of cutaneous nitrite and/or nitrate can release NO from human skin. PBM may also release NO by photodissociation of NO from cytochrome c oxidase and from intracellular stores like nitrosylated forms of myoglobin and hemoglobin with less risk than UVA. The aim of the study was to determine if PBM can mobilize NO in the skin.
Study: Human skin samples were collected fresh from a face lift procedure and flash frozen on site and later mounted on microscope slides. The sections were then incubated in 4,5-Diaminofluorescein diacetate (DAF-2DA), a Nitric Oxide detecting fluorophore. Following this, half of these sections were irradiated with continuous wavelength light of 660 nm (10 mW/cm^2, 4 J/cm^2) and the other half were not irradiated. The slides from both groups were then treated with the NO Synthase inhibitor, L-NMMA, the NO scavenger, c-PTIO, or left untreated with these chemicals. The sections were examined using confocal microscopy to detect fluorescence.
Results: Confocal fluorescence microscopy studies of human skin pre-labeled with the NO-imaging probe DAF-2DA revealed that PBM-induced NO release occurs with the majority of the light-sensitive NO pool in the upper skin strata. Interestingly, in all samples, most of the fluorescence was observed in the epidermis as compared to the dermis.
Conclusion: Further studies are needed to measure the likely systemic rise in circulating nitrite and concurrent fall in plasma nitrate. This is consistent with the presence of NO storage forms mobilized by PBM in the epidermis reported in this study and the probable liberation of NO from these pools.

#153

UNDERSTANDING PHOTOBIOMODULATION FOR HUMAN WOUND HEALING

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Background: Visual and non-visual opsins (OPNs) and cryptochromes (CRYs), the putative transcription factors and circadian clock regulators have previously been suggested as mediators of photobiomodulation in human skin. Therefore, we have sought to localize their expression in human skin, in primary cells and in *ex vivo* wounds after 2 days in culture and determine changes in cell migration, metabolism and mRNA and protein expression in response to blue and red light.
Study: Expression of OPNs and CRYs in human female skin (n = 3) and *ex vivo* wounds was detected by immunohistochemistry. mRNA and protein expression in primary human dermal fibroblasts, DF, (n = 8) and epidermal keratinocytes, EK, (n = 3) was confirmed by qRT-PCR and immunocytochemistry. Different parameters of low-level red and blue light were used to modulate keratinocyte metabolism and migration (scratch assay). Knockdown of OPN3 was achieved using siRNA.
Results: CRY1 was expressed in the epidermis and dermis, OPN1-SW was expressed in the epidermal suprabasal layer and dermis, and OPN3 and OPN5 − in the epidermal basal layer. OPN3, but not OPN5 was expressed in the dermis. Expression mirrored in primary cultures of keratinocytes and fibroblasts. Photoreceptors were also expressed in the epithelial tongue of *ex vivo* wounds. Low doses of blue, red and IR light stimulated keratinocyte metabolism. High doses of IR inhibited keratinocyte metabolism, while medium doses of blue light had no effect on metabolism, but delayed migration. Silencing a blue light receptor (OPN3) with 98% efficiency increased cell migration. Furthermore, silencing OPN3 up regulated CRY1 and CRY2 in mechanically wounded keratinocytes.
Conclusion: The presence of different photoreceptors in human skin and *ex vivo* wounds suggests that light therapy may have diverse roles in wound healing. Different light parameters modulate keratinocyte metabolism and migration, which may be regulated by the blue light receptor OPN3. Further studies using light in combination of photoreceptor silencing will provide a better understanding of the molecular mechanisms of light therapy in wound healing for the development of reliable and efficient light-based treatments.

#154

A REVIEW OF FDA-CLEARED HOME-USE PHOTOBIOMODULATION DEVICES FOR TREATMENT OF ANDROGENETIC ALOPECIA

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Background: The market for home-use devices to treat androgenetic alopecia (AGA) has rapidly expanded, and the FDA has recently cleared many new photobiomodulation therapy devices for this indication. Photobiomodulation therapy has far-reaching biochemical effects that are thought to accelerate hair growth, induce and prolong anagen, and inhibit transition to catagen. The purpose of this review was to evaluate FDA-cleared commercially available home-use photobiomodulation devices for the treatment of AGA.
Study: A search of the FDA 510(k) Premarket Notification database was conducted to identify all home-use photobiomodulation therapy devices that have been FDA-cleared for the treatment of AGA.
Results: Thirteen devices were identified and compared. These devices emit visible red light with wavelengths ranging from 650 nm to 678 nm and have power classification of no more than five milliwatts (mW) per diode. The number of diode lasers or LEDs contained in the devices ranges from 7 to 272. The majority of these devices contain only diode lasers; however, two devices also incorporate pulsed emission LEDs. Device design varies and includes combs, headbands, caps, and helmets. Most home-use devices are available directly to consumers, but some must be obtained from an authorized physician. Retail cost of these devices

varies significantly from $295 to $3000. There are no head-to-head studies comparing the efficacy of these devices to date.
Conclusion: Commercially available FDA-cleared photobiomodulation therapy devices are similar with respect to light source, wavelength, and treatment regimens but vary significantly in terms of shape/design, technical features, price, and total power output. Despite an excellent safety profile and mounting evidence supporting their efficacy, there is a lack of long-term, high-quality studies comparing these devices in diverse populations.

#155

PHOTOBIOMODULATION EFFECT ON CHILDRENS' SCARS

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Background: The management of burn scars has become one of the major clinical challenges in the developing countries which involve enormous treatment cost, this need new methods for better cost benefit relationship
Study: To analyze the effectiveness of low-level laser therapy on post-burn scar tissue in children. Patients and methods: A randomized controlled study included 15 children, ranging from 2–10 years of age, presenting with burn scars. They received diode laser and topical treatment. Each scar was divided into two halves. One half was treated with laser therapy and topical treatment (study area), and the other half was treated with topical treatment only (control area). The children were evaluated before and after 3 months of the study by Vancouver scar scale (VSS), ultrasonography (U/S) and laser Doppler perfusion imaging.
Results: Significant improvement was reported in the studied area compared to the control area for patients with p values ($p = 0.005$) and ($p = 0.0001$) for VSS and U/S scores, respectively. No difference was detected for blood perfusion to the scar between both areas ($p = 0.18$). In addition, no adverse effect was reported.
Conclusion: Photobiomodulation is an efficient and safe therapeutic modality for post-burn

#156

CLINICAL EVALUATION OF A DIODE LASER 1210 nm ON POST-SURGICAL SCAR: RESULTS OF THE "SLASH" RCT (LASER AFTER SCAR LASER ASSISTED SKIN HEALING)

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Background: These last decades, laser therapy has been used as a prophylaxis for excessive scar formation; their early application to surgical incisions should lead to a shorter acute inflammation phase and faster scar maturation; among them, the LASH (Laser Assisted Skin Healing) using a laser diode 810 nm. This device induces a heat stress which activates tissue regeneration through the HSP70 over-expression. A first RCT has reported that the LASH improved the appearance of the surgical scar. This device has recently been improved with a laser diode 1210 nm and made more safe, enabling its use on I to VI patient's phototype (Fitzpatrick Classification).
Study: A double-blind RCT was then conducted in a University Plastic and Reconstructive Surgery Unit. Breast reduction was performed using a standardized operating procedure (McKissock, Thorek). This portable compact device was applied in the operating room, on one of the horizontal sutured incisions. The primary objective was to assess the performance, at six months with a follow-up to one year, based on the Modified OSAS Score, from a Blind Review performed by two experts external physicians, in association with a 3D iconography analysis, which leads to objective measurements of the scar characteristics.
Results: For the 40 patients who participated this trial, the volume of the treated scar was improved by 36% in the laser group ($p = 0.038$) at six months and remains significant at 12 months (volume, $p = 0.003$ and surface, $p = 0.017$). The M. OSAS Score shows a very strong tendency for the laser group at six months, with a significant overall scar appearance score in the early postoperative phase. In addition, patients reported a better overall assessment in the treated group.
Conclusion: The concordance of the objective data from the 3D pictures and the subjective assessments from both patients and physicians contribute to the relevance of these results observed in the laser group.

#157

NANO SIZED PHOTOSENSITIZERS (PS) AND IPL FOR P. ACNES TREATMENT

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Background: The Photodynamic Antimicrobial Chemotherapy (PACT) which uses a combination of a photosensitizing (PS) drug and visible light has been recently used for P. acnes treatment. Many attempts are being made to prepare nano-sized *PS* that would penetrate easily the skin barrier and the bacteria. Moreover, lowering the size of a substance has an additional advantage because when the particle size decreases, its surface area increases, leading to a greater biological activity per given mass compared to larger particles.
Study: The size of nano *PS* was characterized using environmental scanning electron microscopy (ESEM) analysis. The antibacterial properties of the nano *PS* relatively to intact *PS* was examined using Electron Spin Resonance spectroscopy (ESR). In order to evaluate the penetration depth into skin of the nano PS, a new noninvasive method known as an optic iterative technique based on the Gerchberg-Saxton (G-S) algorithm was used. 20 female patients with facial severe acne for at least one year were enrolled, 10 served as control. The nano *PS* cream was applied on the whole face 5 min before irradiation with IPL at 590nm-1100 nm, 40 J. The treatment was repeated 6 times. The control group was treated with topic antibiotics.
Results: The skin penetration depth of the nano-sized *PS* was found to be greater than that of the intact *PS*. The photosensitization capability of the *PS* nano particle was found significantly greater than that of intact *PS* which makes it a

better antibacterial drug. Results were noticed after six sessions, and its remained after 6 months.
Conclusion: We believe that the use of nano-sized *PS* with IPL irradiation should be an effective treatment for P. acnes in acute and subacute phase without any side effect.

#158

LASER THERAPY AND GRIMALDI'S MUSCLE SHORTENING MANOVEUR IN THE TREATMENT OF TRAUMATIC SPINAL CORD INJURIES
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Background: Since 2015 we use physical therapy (Grimaldi's Muscle Shortening Maneuver – MSM). in association with Non-Surgical Laser Therapy (NSLT) in patients with Traumatic Spinal Cord Injuries (TSCI). The goal is to increase muscle strength and to further explore new emerging synergies. This technique is based on the most current knowledge about the motor control and it could allow the operator to work on certain muscles selectively.
Study: In 2015–2016, 20 patients with TSCI, occurred at least one year before laser treatment and documented by NMR, ESSP, and ESMP, were enrolled. All patients have total or subtotal sensory and motor paralysis under the level of lesion, evaluated through ASIA Impairment Scale. Lasers used were 808 nm, 915 nm, 10600 nm, and 1064 nm, applied with a first cycle of 20 sessions, four a day. Patients were involved in MSM two times a day, eight sessions at all, working selectively on certain joints, muscles and limbs. Before treatment under the level of lesion, muscles' activity and force were tested with EMG system of surface (sEMG), electronic dynamometers and goniometers. Every cycle of both treatment was replicated in average each month.
Results: Results were regarded as positive if sEMG showed modifications in CNS-muscle conduction spikes, under the level of lesion. Objective assessment of force displayed encouraging results in the majority of patients, overall in those who had a subtotal TSCI. After each cycle, patients showed improvements in motor function and voluntary command shown by the graphic features. Follow-up was positive after 12 months.
Conclusion: The association between laser treatment and Grimaldi's Muscle Shortening Maneuver (MSM) seems to be effective and synergic on muscle strength and motor control of patients affected by SCI and it could become a subject for future studies.

#159

PHOTOBIOMODULATION IN NEURO-ISCHEMIC ULCERS- NOVEL METHOD FOR LIMB SALVAGE IN DIABETIC FOOT-PRELIMINARY REPORT
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Background: Diabetic foot with diabetic neuropathy and arteriopathy of the lower limbs compromise the foot function. Diabetic foot with an open ulcer is often the real cause that leads to amputation. The low-level laser therapy promotes accelerated healing of diabetic foot ulcers, thereby preventing the risk of future amputation. Therefore, objective of the study was to determine the effect of low-level laser therapy on diabetic foot ulcers at regular intervals on 7th day, 14th day till complete healing
Study: Participants: A total of 17 participants were referred by the physician from the Kastuba Hospital Manipal to Diabetic Foot Clinic. All were diagnosed with diabetic peripheral neuropathy and presented with chronic diabetic foot ulcer. The mean age was 67 ± 8, with mean duration of diabetes mellitus of 14 ± 5 years. After obtaining informed consent, type 2 diabetes mellitus with chronic neuro-ischemic foot ulcer were treated with low-level laser therapy both with scanning and non-contact method. The ulcer was clinically observed and area was measured on different interval. The laser therapy was administered till the complete closure of the ulcer. Descriptive statistics was used for demographic data and to compare the mean changes in pre-post laser therapy.
Results: The mean duration of the ulcer was 120 ± 7 months. The result analysis showed that with mean 26 days, we observed complete closure of the ulcers. We observed mean increase in rate of healing of 2 cm square per day following laser irradiation. In addition, we observed mean reduction of the semi-quantitative Vibration Pressure Threshold from 49 ± 2 to 20 ± 4 in all participants.
Conclusion: The low-level laser therapy can be effectively used as an adjunct modality for treatment of neuro-ischemic foot ulcers in type 2 diabetes mellitus. The foot complications and amputation in diabetes mellitus could be prevented with focused physiotherapy care.

#160

NEW TREATMENT OF CHRONIC PROLIFERATIVE AND OBSTRUCTIVE OTITIS EXTERNA IN DOGS WITH COMBINATION OF HARD, PHOTODYNAMIC AND LOW-LEVEL LASERS
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Background: Otitis externa, inflammation of the external ear canal is one of the most commonly diagnosed diseases in dogs. There are numbers of predisposing factors which render individual pets susceptible to chronic and recurrent otitis. The aim of this case study is to explore how a combination of different lasers can be applied to resolve these difficulties. Materials and Methods Chronic proliferative otitis externa is often a bilateral and very painful disease and develops over few weeks or months. The entrance to the ear canal is difficult to find because of the proliferation. Symptoms include shaking of the head, grey to yellow cerumen, pus and odor. With classic surgery (in most cases) the only solution is the removal of the ear canal and the base of the auricle.
Study:
1.1. Photodynamic Antibacterial Treatment
The photosensitising agent was given locally and then PDT diode laser (wavelength 810 nm) light was applied. The sensitizer was based on Phenothiazine (Methylene blue). Light reacts with the drug, breaking it down and releasing a single

oxygen atom. The oxygen destroys microbial cells from the inside out. Treatment was given one day before the surgery.
1.2. Removing the Proliferative Tissue from the Entrance of the Ear Canal
Our technique for cutting and vaporizing the inflamed tissue is performed using a CO_2 laser (Lasram) 6–10 W, CW. Opening the stenotic ear canal with a laser is a clean, easy, fast and highly effective procedure. No preparation of the surgical area is required; sutures are neither required nor recommended.
1.3. Removing the Proliferative Tissue from the Inner Ear Canal
This is a difficult area to reach with normal surgery but is easy to reach with a thin flexible diode laser optical fibre. A 980 nm wavelength surgical diode laser (Biolitec) was used, CW with 400 micrometer optical fibre. We inserted the diode laser fibre into the canal. We set the laser on 4 or 8 watts depending on the amount of the tissue. The laser beam coagulates the proliferative tissue.
1.4 Low-Level Laser Therapy
LLLTh was applied twice in the first 2 weeks, then once a week for the wound treatment. The dogs received 6–10 treatments of infra diode laser. LLLTh dose depends on the wound conditions; 6 to 3 J/cm^2 was used in this case and the dose was gradually decreased week by week.
Results/Conclusion: It was found that a combination of four different lasers could eliminate this serious and painful disease in dogs. The PD therapy reduced bacterial infection and improved conditions for surgery. Laser cut surfaces regenerated quickly without scarring or complications. Wound regeneration with LLLT was excellent in all cases. Functional and anatomical integrity was preserved, and patients were able to continue their routine life. In each case, proliferative tissue was eliminated completely.

#161

THE IMPORTANCE OF THE SELECTION OF OPTICAL PARAMETERS, CELL CULTURE CONDITIONS AND TREATMENT PROTOCOLS IN PHOTOBIOMODULATION *IN VITRO*: A MULTI-FACTORIAL ANALYSIS OF THE RESPONSE OF PRIMARY HUMAN DERMAL FIBROBLASTS TO VISIBLE AND NIR LIGHT

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Background: The outcomes of *in vitro* and *ex vivo* studies on photobiomodulation are highly inconsistent, due to a great variability in applied light parameters and other misunderstood factors, impeding progress in the field. This study aimed to disentangle the experimental factors affecting the response of human dermal fibroblasts (DF) to light, including optical parameters, serum concentration, cell confluency, oxygen concentration, light treatment regime and protocol.
Study: Primary DF were isolated from human facial skin. Optical parameters were varied in wavelength (450nm-850 nm), irradiance (0–80 mW/cm^2) and dose (0–250 J/cm^2). Our standard conditions were 2% FBS, 60% confluency and 21% oxygen; they were varied within 2–10% (FBS), 20–80% (confluency) and 2–21% (oxygen). DF were treated daily during 1 to 3 days. Indirect light effects were tested by treatment with irradiated cell-free media. The impact of the treatments was evaluated on cellular metabolic activity.
Results: The dose response at short wavelengths ($<=530$ nm) showed two phases, a progressive inhibition ($<=30$ J/cm^2) and cytotoxicity (>30 J/cm^2). At 450 nm, the inhibitory effect at 30 J/cm^2 was neutralized by the increase of the cell confluency (90%); the increase in FBS to 10% reduced the inhibitory effect at 30 J/cm^2, and prevented cytotoxicity at 60 J/cm2; a single light treatment stimulated DF, however, subsequent treatments cumulatively inhibited DF (30 J/cm^2); the treatment by irradiated cell-free media also resulted in inhibitory effects, albeit less pronounced. The reduction of the oxygen concentration to a physiological level (2% 02) accentuated the light treatment: increased inhibition at 450 nm (30 J/cm^2) and stimulatory effect at 850 nm (20 J/cm^2), while no significant stimulation was observed at long wavelengths ($>=590$ nm) over 0–250 J/cm^2 at 21% oxygen.
Conclusion: Our study demonstrated that experimental outcomes in photobiomodulation not only depends on the optical parameters but also on the cell culture conditions and experimental protocols, which partially explains inconsistencies between previously reported *in vitro* results. We recommend not only the reporting but also the careful selection of all experimental conditions, which will help to reach *consensus* in the field.

#162

PRELIMINARY STUDIES OF A NOVEL RED-EMITTING *QUANTUM* DOT LED SOURCE FOR PHOTOBIOMODULATION APPLICATIONS

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Background: The ability to easily apply Photobiomodulation (PBM) paradigms experimentally and clinically is limited by the lack of stable, efficient light sources with low power consumption and heat production. This study investigated using an ultrabright QLED source for PBM *in vitro*.
Study: HEp-2, L929 and 3T3 cells were cultured in 24 well trays in complete DMEM media supplemented with 10% FBS, SPF, glutamine and pyruvate, without phenol red. Photoradiation was performed using a 4 pixel (4×4 mm ea.) inverted QLED array emitting at 626 ± 23 nm (max output $\sim$ 20,000 nits @ 6V DC; ≈ 10 mW/cm^2) delivering 4.0 J/cm^2 /10 min treatment @ 8 mW/cm^2 to the culture wells. A specialized platform and cradle was built to stabilize the QLEDs allowing proper tray positioning for photoradiation. Control cell cultures received no light treatment. Cell metabolism was assessed by MTT assay (Chemicon International Inc., Temecula, CA) 24 hrs posttreatment. Parallel studies were performed at 670nm $\pm$ 20 nm using an LED device (Quantum Devices, Barneveld, WI) delivering 4.0 J/cm^2 / 10 min treatment.
Results: Mean 24 hours MTT assay results were as follows: QLED+ v. QLED-: HEp-2: 0.697 ± 0.082 ($n = 14$) v. 0.545 ± 0.066 ($n = 14$) $p = 0.0004$; L929: 0.574 ± 0.062 ($n = 14$) v. 0.510 ± 0.062 ($n = 14$); 3T3: 0.443 ± 0.182 ($n = 12$) v. 0.351 ± 0.090 ($n = 12$); and LED+ v. LED-: HEp-2:

0.789 ± 0.032 (n = 4) v. 0.668 ± 0.033 (n = 4) p = 0.002; L929: 0.647 ± 0.021 (n = 4) v. 0.499 ± 0.033 (n = 4) p = 0.0003; 3T3: 0.346 ± 0.036 (n = 4) v. 0.273 ± 0.050 (n = 4) p = 0.05. This *in vitro* study is the first to demonstrate PBM using a QLED device. The device surpasses state-of-the-art OLED peak luminance and electroluminescence efficiencies at high current densities, and low power consumption. QLED PBM increased cell metabolism in multiple cell lines and in a similar fashion to an LED source.
Conclusion: Further studies investigating QLED devices for PBM applications are warranted.

#163

EFFECTS OF LOW-LEVEL LASER THERAPY ON ADHESION AND PROFILERATION OF A549 EPITHELIAL CELLS IN DECELLULARIZED LUNG

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Background: Currently lung bioengineering has been show a potential alternative therapeutic for lung transplantation of patients with end-stage lung disease. This promising alternative therapeutic strategy consists in recellularization of lung Scaffold. It is well known the ability of low-level laser therapy (LLLT) in modulate and differentiate cell types. Therefore, the aim of this study was investigated the recellularization in lung scaffolds submitted to treatment with LLLT in order to enhance adhesion and proliferation of the reseeded cells.
Study: Decellularized slices lung obtained from male C57/BL6 were cultured with lung epithelial cells A549 and treated for 7 days with LLLT 660 nm twice per day. At the end of protocol the scaffold from the lung was analyzed for your ability to support growth and differentiation of cells treated with LLT. Analyzes of histological, qPCR and MTT assay were performed.
Results: In mRNA expression of some markers related to epithelial cell-adhesion the treatment with LLLT shown to be a stimulator of proliferation and cell adhesion when compared to control group in the following molecules: ICAM-1, ICAM-2, VCAM, MCP-1. In the MTT assay, where we can observe the effect of LLLT on cell proliferation and death of lung epithelial cells, we observed that LLLT group increased the number of viable epithelial cells compared to the untreated control group. In addition, we observed that the group treated with LLLT reduces cell death compared to control, showing that LLLT can be a facilitator on the cell adhesion process in decellularized organs
Conclusion: The low-level laser therapy was effective in enhance the proliferation and adhesion of lung epithelial cells in scaffold lung. Therefore, the LLLT proves to be an important tool in lung recellularization process increased the feasibility of future lung transplantation

#164

REGULATION OF THE CAMP/PKA PATHWAY BY RED LIGHT (640 nm) IN PC12 AND C2C12 CELLS IS INVOLVED IN ANTIOXYGENATION OF PHOTOBIOMODULATION

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Background: Oxidative stress is involved in the occurrence and development of aging and several neurodegenerative diseases such as Alzheimer's and Parkinson's diseases. The present study investigated the antioxidant effects of red light at 640 ± 15 nm from light emitting diode array (RLED) against hydrogen peroxide (H_2O_2)-induced oxidative stress in neural-like rat differentiated pheochromocytoma cells (dPC12) and C2C12 myoblasts.
Study: The dPC12 and C2C12 cells were subjected to H_2O_2 at 150 μmol/L or/and RLED at 0.06 mW/cm^2 for 20 min, respectively. After the irradiation 12 or 24 h, the samples were collected for detection. The level of extracellular lactate dehydrogenase (LDH) was assessed by enzyme linked immunosorbent assay (ELISA). The cellular apoptosis was evaluated by TdT-mediated dUTP Nick-End Labeling (TUNEL) staining. The intracellular level of adenosine-5'-triphosphate (ATP), cyclic adenosine monophosphate (cAMP) and caspase-3 were assessed with Chemical luminescence Assay Systems. The expression of protein kinase A system (PKA) was assessed by Western Blotting. The significance was assessed by both SPSS and quantitative difference.
Results: After treatment of H_2O_2, ATP activity of dPC12 cells significantly decreased. In addition, levels of LDH, cAMP, PKAIIβ, caspase-3 and apoptosis were significantly increased. The LDH levels of C2C12 cells were significantly increased with H_2O_2 treatment, while the levels of cAMP and PKAIα was significantly reduced. And RLED significantly attenuate H_2O_2-induced all these changes.
Conclusion: RLED may inhibit H_2O_2-induced oxidative stress of dPC12 and C2C12 cells through cAMP/PKA signaling pathway.

#165

LOW-LEVEL LASER THERAPY IN RESOLUTION OF FIBROTIC PROCESS AND SIGNALLING: NEW TOLL TO TISSUE REPAIR

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Background: Low-level laser therapy (LLLT) is a modulator of kidney fibrosis without evidences of side-effects. Herein we investigated the LLLT effect on chronic kidney disease from mice submitted to obstruction ureteral unilateral (UUO).
Study: Methods: Male C57/BL6 mice (22 g) were divided in 3 groups (n = 5) being them: basal, UUO, UUO + LASER. On day 0. Following UUO mice were treated with LLLT for 7 days and sacrificed in day 7 after UUO.
Results: LLLT shown to be effective to decrease M1 macrophages with reduction of mRNA expression IL-1β, iNOS, CD86 compared to UUO group. In contrast, LLLT can increase the expression of Arg-1, FIZZ-1, YM-1 compared to UUO group and basal group. When we verified fibrotic process, we observed that LLLT reduced the mRNA

expression of Col I, Col 4, TGF-β and MMP9 compared to UUO group. The values of protein/creatinine ratio were (0.96 ± 0.08) in LLLT group and (2.99 ± 0.32) in UUO, showing a preserved effect in renal function. This result is observed in total cell count with Sirius Red (LLLT 0.93 ± 0.16) to (UUO 5.39 ± 0.84).
Conclusion: In the fibrotic process, macrophages are recognized for their central role. Thus, the study of non-pharmacological and non-invasive tools that can modify the natural history of the development of fibrosis after renal initial insult is justified. In our study LLLT operates in different areas, so that there is a reduction in M1 profile, a control of production of M2 phenotype, reduced renal fibrotic process, and improved renal function frame with a non-invasive treatment without side effects, and low cost, we believe that LLLT act by modulating TGF beta pathways.

#166

EFFECTS OF LOW-LEVEL LASER THERAPY ON KNEE REPAIR IN AN EXPERIMENTAL MODEL OF INDUCED GOUTY ARTHRITIS

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Background: Low-level laser has the ability to improve cell division, its effects are also related with analgesic, and anti-inflammatory benefits, thus laser appear like an important treatment for gouty arthritis. The aim of this study was ti evaluate the effects of low-level laser therapy on knee repair in an experimental model of induced gouty arthritis.
Study: Forty-eight Wistar rats were assigned into four groups A (Control; n = 12), B (Sham − induced arthritis; n = 12), C (Induced arthritis + laser 830 nm; n = 12), D (Induced arthritis + laser 670 nm; n = 12). Animals of B, C and D were anesthetized with Ketamin-Xilazin-Tramal (10, 0, 9 and 5 mg/Kg, respectively) and submitted to two intraarticular injection of calcium pyrophosphate (2 mg/50μL) in right knee with interval of 24 hours. After 48 hours of the induction, animals from C and D groups were submitted, respectively, to low-level laser therapy with a Gallium-Arsenide (GaAs) laser device with λ = 830 nm, energy density = 18 J/cm^2, power = 40 mW, total energy = 0.36 J, beam area = 0.02 cm^2 for 9 seconds and a Indium-Gallium-Aluminum-Phosphorus (InGaAlP) λ = 670 nm, energy density = 13.5 J/cm^2, power = 30 mW, total energy = 0.27 J, beam area = 0.02 cm^2 for 12 seconds, both by contact method, point application in patellar region of right knee once a day. After 7 and 21 days of laser treatment animals were euthanized by overdose, knees samples were collected, processed and submitted to histological analysis. The cartilage thickness, number of chondrocytes (number in 104 μm2) and collagen fibers birefringence area (% in 104 μm2) were quantified using a 40x objective in five fields of each of three sections obtained from the cartilages of each animal at each experimental time. Quantitative data were analyzed by ANOVA and Tukey post-test ($p < 0.05$).
Results: After 7 days it was observed in B, C and D reduction of basophily, loss of articular alignment surface and increased cartilage thickness and inflammatory cells compared to A. However, in 21 days C and D showed higher basophily, although articular cartilage thickness, matrix acidophilia, collagen fibers and morphological aspects showed no differences. About inflammatory cells, C and D showed decrease compared to B, although all data showed no significant differences $p > 0.05$.
Conclusion: Low-level laser therapy recovered the joint region, especially at anti-inflammatory aspect of treated animal's knees with both wavelength, although further studies are necessary for laser parameters in gouty arthritis.

#167

LOW-LEVEL LASER ASSOCIATED WITH CARBON BIOMATERIAL MAY IMPROVE THE BONE HEALING PROCESS

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Background: Bone diseases such as fractures and bone defects may result from several reasons, where the repair process is normally long and painful. The most used therapies are based either on the implantation of a biocompatible prosthesis or through the insertion of a biomaterial in the local injury. However, those treatments involve extended and costly surgical intervention. Thus, the association of two low cost techniques such as the use of activated carbon fiber (ACF) as bone biosubstitute and the application of the low-level laser therapy in order to assist the bone repair can be an alternative to overcome those problems.
Study: The study was performed by induction of a bone defect in rat tibias and their subsequent treatment with ACF and laser therapy. Five different groups of rats were studied: control (CTL), untreated Injury (NT), Injured treated with activated carbon fiber felt (ACF), Injured treated with laser therapy (L6J) and Injured treated with association of ACFF and laser therapy (ACF + L). All groups were evaluated by gene repair expression (IL-6, TNF-a, BMF4, BMF7, OPG, OCN) histological and biomechanical properties of bone after the healing process and by phosphatase alkaline level (ALP).
Results: The NT group presented decrease in gene repair expression and the lowest values of stress at break, besides histological changes related to disorganization of the tissue. Gradually, the groups L6J, ACF and ACF + L showed to improve their mechanical properties in comparison to CTL group and low changes in gene repair expression. The group ACF + L presented the highest value of stress at break, organized histological aspects and increasing the levels of ALP and gene repair expression similar to the control.
Conclusion: Thus, the association of low-level laser and activate carbon fiber seemed to assist the process of bone healing in experimental model in rats' tibia.

#168

PRESENCE OF OSTEOCALCIN PROTEIN AND GENE EXPRESSION IN BONE TISSUE AFTER LOW-LEVEL LASER IRRADIATION

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Background: Low-level laser irradiation has the ability to increase bone formation through osteoblasts mitosis and higher protein deposition and consequently promoting new bone formation. The aim of this study was to evaluate the presence of osteocalcin *in vitro* and in an *in vivo* model of ostectomy.

Study: Twenty Wistar rats were assigned into two groups A ($n = 10$, laser) and B ($n = 10$, placebo). Ostectomy was performed with an oscillatory saw in the femur diaphysis; twenty fragments were removed and composed *in vitro* groups named as *in vivo* (A and B). For *in vitro* mechanical and enzymatic digestion was performed and the cells were cultivated in CO_2 atmosphere for thirteen days. Low-level laser irradiation was realized in groups A of *in vivo* and *in vitro* by an Arsenide-Gallium Aluminum device with $\lambda = 808$ nm, nominal dose of 2 J/cm^2, power density of 0,2 W/cm^2, total energy of 1.25 J, spot diameter of 0.02 mm, for 5 seconds, at one point, daily. *In vivo* group received laser irradiation by contact technique. After thirteen days, A and B of *in vivo* groups were euthanized by ketamine overdose and femurs were histological processed. For immunocytochemistry assays, in summary, the tissues and cells were incubated overnight with primary antibody, anti-osteocalcin, they were incubated with secondary antibody (rabbit IgG) for 30 minutes, treated with streptavidin-biotin peroxidase and stained with DAB for 5 minutes. Cells of *in vitro* groups were submitted to RNA extraction, cDNA synthesis and osteocalcin gene expression by real-time PCR and evaluate by 2-ΔΔCt technique. Statistical analysis were realized with one-way ANOVA and unpaired T-test ($p < 0.05$).

Results: Immunocytochemistry scores of *in vivo* groups A (median 2.0 ± 0.67) and B (2.5 ± 0.89) ($p = 1$) and *in vitro* A (1.6 ± 1.51) and B (0.3 ± 0.82) ($p = 0.100$) showed no statistical differences. As well as immunohistochemistry, gene expression of A (3.876 ± 0.78) and B (3.099 ± 1.34) has no statistical differences $p = 0.3122$.

Conclusion: Low-level laser irradiation did not alter osteocalcin protein and gene expression *in vivo* and *in vitro* in the studied period, which may have been expressed in a period earlier.

#169

IS SINGLE APPLICATION OF 810 nm LASER EFFECTIVE IN FASTER BONE FORMATION?: A RABBIT HISTOMORPHOMETRIC STUDY

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Background: In last decade, low-level laser therapy has been evaluated for stimulation and acceleration of bone formation. In spite of promising results, biphasic 'dose' response remains. Moreover, the use of single session of low-level laser on healing of bone is not explored thoroughly. The aim of this study was to determine the optimal 'dosage' for formation of bone using diode laser of 810 nm under single irradiation.

Study: The study was carried out adhering to guidelines of the CPCSEA and institutional ethical committee. Six New Zealand male rabbits were used weighing 1.5–2 Kgs and 10 months old for the study. Femur was chosen as site of surgery. The center of the femur was drilled using implant osteotomy drills to the size of 2.8 mm in width and 6 mm in depth. A 810 nm diode laser was used in this study. Laser parameters were, wavelength of 810 nm, power of 90 mW, time of 30 seconds (energy of 2.7J) in continuous mode using the disposable fibre of 300 μmm diameter in punctual contact. *Contra* lateral femur was used as a control and the laser was sham treated. At the end of 2 weeks, samples were collected from the surgical area and slides were prepared. The density of osteocyte, osteoblast and amount of bone formation evaluated using Histomorphometry analysis.

Results: Data were analyzed using Microsoft SPSS 11.0 for Windows (SPSS Inc., Chicago, IL, USA). The differences between the groups were analyzed with the Wilcoxon Mann–Whitney test. The level of statistical significance was set at 5% ($p \leq 0.05$). At the end of 2 weeks, there was increase in the osteoblasts and amount of bone formation in the laser treated compared to control group. The results were significant at $p < 0.05$.

Conclusion: Single application of diode laser of 810 nm at 2.7 J energy effectively showed faster deposition of bone in osteotomy site in 2 weeks.

#170

EFFECT OF PHOTOBIOMODULATION ON THE LEUKOCYTE RECRUITMENT INDUCED BY BOTHROPS JARARACA VENOM IN THE MICROCIRCULATION OF THE CREMASTER MUSCLE OF MICE

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Background: The majority of snake bites in Brazil are caused by Bothrops snakes. This envenomation causes signs and symptoms such as hemostatic disturbances, local pain, necrosis, and intense inflammatory reactions. The specific serum therapy can neutralize toxins present in these venoms, reversing the systemic symptoms. Nevertheless, due to the rapid action of these toxins and to the participation of endogenous mediators, antivenom does not present the same efficacy in reversing local lesions of this envenomation. Experimental studies have demonstrated that Low-level Laser Therapy (LLLT) shows analgesia, wound healing, and anti-inflammatory effects, and reduces local symptoms of the Bothrops envenomation, but its mechanism of action is unknown. The aim of this study is to evaluate the effect of the LLLT on the inflammatory reaction induced by Bothrops jararaca venom (Bjv) on the microcirculation of cremaster muscle of mice.

Study: In anesthetized animals, the cremaster muscle was surgically exposed. Leukocyte-endothelium interactions induced by Bjv were evaluated in groups of animals irradiated with LLLT (685 nm, 4.6 J/cm^2, 13 s) before the topical application of the venom and compared to the respective control group. The cells in rolling and adhered were counted in post-capillary vessels 10, 20 and 30 min after the venom application.

Results: Our results showed that per se, the LLLT did not induce changes in the leukocyte-endothelial interactions when

compared to control non-envenomed group. The group in which the venom was topically applied, the microcirculation presented a significant increase of rolling and adhered cells, 10 and 30 min after the venom application, respectively. In animals irradiated with LLLT immediately before the venom application, these parameters were similar to the control non-envenomed group.
Conclusion: These data suggest that LLLT reduces the leukocyte interaction with endothelial cells, possibly affecting the expression of adhesion molecules.

#171

EFFECTS OF PHOTOBIOMODULATION THERAPY AND DICLOFENAC ON MORPHOMETRIC ASPECTS IN AN EXPERIMENTAL MODEL OF SKELETAL MUSCLE TRAUMA IN DIABETIC RATS

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Background: Diabetes mellitus (DM) is associated with delay in tissue repair. Exercise has been prescribed for treatment of patients with DM due to the improvement in glucose control and reduction in other risk factors. Traumatic muscle injuries are directly related to exercise. Both pharmacological and non-pharmacological approaches have been used in the treatment of musculoskeletal injuries, such as anti-inflammatory drugs and photobiomodulation therapy (PBMT); however the process of muscle regeneration in a diabetic organism remains unknown. The aim of this work was to investigate the effects of PBMT on morphometrical aspects of skeletal muscle, 28 days after trauma induction in diabetic Wistar rats, comparing PBMT, diclofenac, and both treatments applied together.
Study: This study was approved by the Ethics Committee of Sagrado Coração University (n° 34/13). Male Wistar rats were randomized into 6 groups (n = 7). Diabetes was induced by administration of streptozotocin (50 mg/kg). Trauma was performed using a 200 g block weight that dropped from 20 cm onto the right posterior limb. One hour after the injury protocol, groups received treatment of topical diclofenac (11.6 mg/g-1), PBMT irradiation (3 J, 810 nm, 100 mW, 30 s), or both treatments applied together. For the morphometric analyses, 220 muscle fibers per animal were measured. The morphometric variables were area and minimum diameter of the muscle fiber. Analyzes were performed 28 days after the injury protocol.
Results: For the minimum diameter, the laser and laser + diclofenac groups (10.70 ± 1.11 and 12.10 ± 0.89) demonstrated statistical differences when compared to the diclofenac group (5.18 ± 0.82), $p < 0.001$ and untreated group (2.64 ± 1.64), $p < 0.001$; For the area analysis, the laser and laser + diclofenac groups (105.9 ± 5.16 and 105.1 ± 7.02) demonstrated statistical differences when compared to the diclofenac group (90.77 ± 9.85), $p < 0.001$ and untreated group (34.04 ± 2.95), $p < 0.001$.
Conclusion: PBMT associated with diclofenac or applied in isolation significantly improved morphometric aspects in diabetic animals 28 days after a muscle injury protocol.

#172

PHOTOBIOMODULATION IN EXPERIMENTAL MODEL OF ISCHEMIA AND REPERFUSION IN TRAM FLAP IN RATS

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Background: Skin flaps are widely used in surgical procedures to the reconstruction of an injured area. This flap keeps their own vascularization and fill the wound. This project compared the rectus abdominis muscle flap (TRAM) viability in three groups of five rats (Rattus norvegicus Albinus, Wistar). One group was subjected to ischemia and reperfusion without further application of the low-level laser therapy (LLLT) and the other group was treated with the application of the LLLT. The third group was the control one. The assessment was performed by calculating and comparing the area of necrosis in each group. The results proved that LLLT can be used instead of the pre-conditioning method of ischemia and reperfusion. In addition, the use of LLLT doesn't cause the collateral effects and risks of using long and repeated cycles of ischemia and reperfusion.
Study: This project compared the viability of the rectus abdominis muscle flap (TRAM) in 15 rats Rattus norvegicus Albinus Wistar into three groups of five rats in each group. One group was subjected to ischemia and reperfusion (pre-conditioning method), without further application of the low power laser therapy (photobiomodulation), and one with the application of the LLLT. These two were compared to the control group. The pre-conditioning method used in this study: 3 cycles of 10 minutes of ischemia and 5 minutes of reperfusion. The effects were evaluated by calculating and comparing the area of necrosis the animals presented at seven days post-op.
Results: The necrosis area of groups LLLT and IR (ischemia-reperfusion) groups were reduced in comparison to the control group. The necrosis area of LLLT and IR groups were similar. The use of LLLT doesn't have the risks of the ischemia and repercussion method.
Conclusion: In this study, the use of photobiomodulation had similar effects on necrosis prevention as the pre-conditioning ischemia and reperfusion method. The pre-conditioning method of ischemia and perfusion can be substituted by the use of LLLT.

WOMEN'S HEALTH

#173

THE EFFECT OF RF EXCITED FRACTIONAL CO_2 LASER FOR THE TREATMENT OF STRESS URINARY INCONTINENCE

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Background: Stress Urinary Incontinence (SUI) affects an estimated 15 million American women every day. The causes of SUI include pregnancy, childbirth, obesity, menopause and chronic coughing. The current treatment options include Kegel exercises, bio-feedback electrical stimulation, bulking agents,

pessary and surgical correction often with the use of a mesh. Recently laser and light based treatments have been reported as a treatment option.
Study: Women suffering from SUI as determined by questionnaire, pelvic exam and urodynamic studies showing maximal urethral closure pressure (UCP) of less than 40 cm H_2O, were enrolled in a study. Subjects received three fractional CO_2 laser treatments at four-week interval. CO_2 laser energy in deep mode at 50 mJ at 5% fractional density was delivered in the vaginal canal in a circumferential pattern. The second pass of the laser was done at 1 o'clock and 11 o'clock where the pubo-vesical fascia would be. Subjects were then reevaluated at one month and three months post treatment, subjectively using a questionnaire for incontinence and a urodynamic evaluation to determine max UCP and compare it to baseline.
Results: Twenty women between the ages of 31 and 69 who were enrolled in the study tolerated the treatments well. The subjects reported minimal to no treatment discomfort and no post treatment adverse events. At one month post treatment of the series, reported in 100% correction of SUI subjectively based on the survey administered. The subset of subjects who thus far completed three months post treatment underwent urodynamic reevaluation showed an increase in maximal UCP from 19 to 33 cm H_2O pre-treatment to 45–73 cm H_2O post treatment.
Conclusion: This study shows that fractional CO_2 laser is a safe and effective treatment and may be an alternative option for the improvement of SUI which would affect the quality of life in women.

#174

PIXELATED VAGINAL CO_2 LASER TREATMENT FOR STRESS URINARY INCONTINENCE
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Background: Stress urinary incontinence (SUI) in women leads to significant impact on quality of life and emotional burden. While pelvic floor exercises have been advocated as initial treatment, surgical interventions have demonstrated better efficacy and durable results. However, the possible morbidity of surgical interventions, made many patients reluctant to undergo surgery. Recently, vaginal CO_2 laser treatments have been introduced as a conservative option to treat SUI. The objective of this study was to assess the effect of vaginal CO_2 laser on bladder and vaginal symptoms in patients with SUI.
Study: Retrospective evaluation of patients that were contacted 3–12 months following completion of treatments.134 patients were treated in 3 clinics, of whom 126 were successfully contacted to complete the evaluation following 2 or 3 laser treatments.
Results: Urinary incontinence symptoms improved significantly (VAS>= 7) in 89 patients (71.2%) and pad use declined significantly following treatment (no pad use: 47.8% to 80.6% ($p < 0.0001$). Significant reduction in urinary urgency and frequency were found (21% to 17.5% and 23.9% to 17.7%; $p < 0.05$). Dyspareunia and vaginal dryness improved significantly following treatments (19.3% to 8.6%; 21.4% to 6.5% accordingly). 63.8% reported generally better situation compared to pre-treatment condition. Patients who had 3 treatments (n = 44) reported significant better improvement in incontinence symptoms compared to those who had only 2 treatments (n = 82)(90.1% *vs* 60.5%, $p < 0.05$). No adverse events were reported.
Conclusion: Vaginal CO_2 laser treatment demonstrated promising initial results for treatment of stress urinary incontinence symptoms and vaginal symptoms. Three treatments achieved significantly better results compared to two treatments. Further studies are needed to assess prospectively the long-term efficacy of vaginal CO_2 laser treatment on SUI.

#175

COMPARISON OF Er:YAG LASER TREATMENT WITH TVT AND TOT IN ASIAN WOMEN WITH STRESS URINARY INCONTINENCE
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Background: In this paper we are reporting about assessment of efficacy and safety of erbium laser photothermal therapy in a group of Asian women with SUI in comparison to TVT and TOT.
Study: This was a prospective, single center study, based on Asian women with mild-to-severe SUI, intervened with non-ablative Er:YAG laser, open surgery TVT, or TOT between 2013 and 2016, in Yokosuka, Japan. Laser therapy was executed with a 2940 nm Er:YAG laser, operating in a special SMOOTH mode designed to increase temperature of the vaginal mucosa up to $60 - 65^{\circ}C$ without ablation. Laser treatment was done under local anesthesia with 9% Lidocaine ointment. TVT and TOT surgeries were done under lumbar anesthesia. Efficacy was evaluated with 1 hour pad test and ICIQ-SF.
Results: 130 patients diagnosed with mild to severe SUI were included in this study. 40 of them received laser therapy, 45 TVT and 45 TOT. Results of laser group: ICIQ-SF median was 11.5 before and 2.5 at 3 months FU. At follow-up 78% reported improvement and 37% a complete healing of SUI. In pad test, the average changed from 33.7 g to 2.0 g. Of 21 sexually active women, 18 (85.7%) reported improvement of sexual gratification. Only mild pain during the procedure was reported as AE. TVT results: ICIQ-SF went from 12.6 to 2.2 and pad test from 37.6 to 2.2. 61.1% improved sexual gratification. AE: 2 infections, 1 severe pain, 2 bleedings over 400 ml. TOT results: ICIQ-SF went from 12.8 to 2.5 and pad test from 37.2 to 2.9. 59.0% improved sexual gratification. AE: 1 infection, 1 severe pain, 1 bleeding over 100 ml.
Conclusion: Non-ablative Er:YAG laser procedure seems to be a safe and efficacious alternative for patients with SUI with comparable short-term efficacy to TVT and TOT and with much less adverse effects.

#176

EFFECT OF HYBRID 2940 nm AND 1470 nm INTRAVAGINAL LASER TREATMENT ON STRESS URINARY INCONTINENCE
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Background: Energy-based female genital rejuvenation is an emerging trend that offers a noninvasive therapeutic option. Current device options include fractional non-ablative and ablative laser and radiofrequency. In addition to the cosmetic

benefit that can be provided with these devices, such as vaginal tightening and labial shrinkage, improvements have also been seen in urinary incontinence and sexual satisfaction. We present the first case series evaluating a novel hybrid technology using 2940 nm and 1470 nm laser for vaginal rejuvenation and improvement in urinary incontinence and sexual function.
Study: 6 female patients that were at least primiparous and had resultant stress urinary incontinence were recruited. Subjects received a series of three monthly treatments with a hybrid 2940 nm and 1470 nm laser. Thirty minutes prior to each treatment 6% lidocaine/6% tetracaine gel was inserted intravaginally. Initial treatment settings were as follows: first 180 degree pass of 1470 nm only at 400–500 μm depth, with 9–12% density followed by a 360-degree treatment with 1470 nm at 400–500 μm depth at 4–6% density combined with 2940 nm at 200–300 μm depth and 7% density. Final follow-up visit was at 4 months. Validated questionnaires including Questionnaire for Urinary Incontinence Diagnosis, Incontinence Impact Questionnaire, Urogenital Distress Inventory and Female Sexual Function Index were administered at baseline and at each follow-up visit in addition to intraoperative assessments of tolerance and post treatment diaries for monitoring adverse events.
Results: Ages ranged from 31 to 51 years of age. Subjects had 1 to 4 pregnancies with 1–3 live births and 5 had at least one vaginal delivery. Significant improvement in both stress urinary incontinence and sexual function were noted as early as one month after the first treatment. All patients tolerated the procedure well with topical anesthesia. No significant adverse events were noted.
Conclusion: In conclusion, Hybrid 1470 nm/2940 nm laser treatment offers a safe and effective novel noninvasive approach for improving stress urinary incontinence and sexual function. Further investigation is warranted to determine optimal treatment settings.

#177

INTRAURETHRAL Er:YAG LASER FOR THE MANAGEMENT OF URINARY SYMPTOMS OF GENITOURINARY SYNDROME OF MENOPAUSE (GSM)
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Background: The objective of this study was to assess the efficacy and safety of intraurethral erbium laser treatment of urinary symptoms of genitourinary syndrome of menopause.
Study: Patients with diagnosed GSM (having less than 5% of superficial cells, vaginal pH higher than 5 and at least one moderate or severe symptom of vaginal atrophy) received two sessions of intraurethral erbium laser with 3 weeks interval in between the sessions. Laser energy was delivered in non-ablative way using Smooth mode technology and thinly 3 mm cannula. Local anesthesia (topical lidocaine) was applied to urethra prior to laser intervention. Therapy efficacy on urinary symptoms of GSM was measured using ICIQ-SF, 1 hour pad test and VAS scores for atrophy symptoms. Adverse effects were observed at every visit. Follow-ups were at 3 and 6 months.
Results: 29 female patients fulfilling the inclusion criteria were included in this pilot study and received two sessions of the intraurethral non-ablative Smooth mode Er:YAG laser therapy. Significant improvement was observed in all measured parameters at both follow-ups. ICIQ-SF improved in average for 13 points at 3 months FU and for 10 points at 6 months. 1 hour pad test showed reduction of the quantity of leaked urine for 63% at 3M FU and 46% at 6M FU. All urinary symptoms of GSM improved. Dysuria dropped to 12% of base value, urinary urgency to 22%, SUI to 18%, UUI to 20% and Polaquiuria to 21%. Adverse effects were mild and transient.
Conclusion: Our findings suggest that intraurethral Er:YAG laser is efficacious and safe for treatment of urinary symptoms of GSM, however there is a need for prospective, randomized and controlled trials, with a large number of patients, to better address the long-term effect of this novel procedure.

#178

3 YEARS FOLLOW-UP OF PELVIC ORGAN PROLAPSES TREATED WITH Er:YAG LASER
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Background: This paper reports about assessment of long term efficacy of new Er:YAG laser therapy used for treatment of pelvic organ prolapses.
Study: Female patients older than 18 years and having cystoceles of grades II–IV were included in this study. All patients were clinically inspected, and classified by grades using Baden-Walker scale. Patients received two to seven laser treatment sessions with intervals in between the sessions of 2 months. At each visit photographs of prolapses under straining were obtained and graded by two physicians. Treatment discomfort was measured with 10 grade VAS scale and at every follow-up patients were interviewed about their satisfaction with the therapy. Follow-ups were performed at 2, 6, 12, 24 and 36 months after the first laser session.
Results: 83 patients having cystoceles of grades II–IV were treated with erbium laser in period of past four years. 67 of them were followed-up for longer period and included in this study. Patient's average age was 54.9 yrs, parous status 2.2 and BMI of 25.5. The average POP grade before the treatment was 2.36 ± 0.62 and was significantly ($p < 0.001$) reduced already after the first session (to 1.5 ± 0.79). The POP continued to improve with sessions, getting reduced to 0.94 ± 0.78 after 6 months and 0.86 ± 0.78 after 12 months. Average grade at 24 months was 1.13 ± 1.02 and at 36 months 0.89 ± 0.79. Treatment discomfort was very low (average score of 0.4) and patient satisfaction high (median level of 4 on scale 1–5). There were no adverse effects of this treatment reported.
Conclusion: Erbium laser treatment for higher-grade cystoceles demonstrated good efficacy in the improvement of cystoceles and minimal patient discomfort during the treatment, with no adverse effects. The improvement was lasting at least 12 months and for many patients even longer up to 36 months.

#179

LASER TREATMENT OF LICHEN SCLEROSUS ET ATROPHICUS: PRELIMINARY RESULTS OF RANDOMIZED CONTROL TRIAL
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Background: In this paper we are reporting about preliminary results of laser treatment of lichen sclerosus and are giving the first assessment of efficacy and safety of this new laser therapy.
Study: This is randomized control trial performed in two medical centers in Slovenia. Included were female patients older than 18 years and with histologically proven lichen. Patients were randomized into two groups. Study group received three laser treatments every 14 days, while the control group was receiving topical corticosteroids for 3 months. Laser treatment consisted of combination of non-ablative Nd:YAG using Piano (5 sec) pulses and of fractional ablative Er:YAG. The improvement was assessed with: biopsies; pictures grading on 4 grade scale and VAS (1–10) for dyspareunia and itching. Follow-ups were scheduled at 1, 3, 6 and 12 months.
Results: 40 patients were randomized into study (laser) group and control (corticosteroid) group with 20 patients each. So far 18 patients from laser and 12 patients from control group were completed the treatments and were followed up for at least 3 months. Laser patients reduced pain during the intercourse from 10 to 5 and itching from 9 to 1. Control group had dyspareunia reduced from 10 to 5.5, but after the discontinuation of therapy, at 3M FU it raised back to 9. Similarly itching reduced during the treatment from 10 to 2 and at 3M FU raised to 6. Treatment discomfort was very low (average score of 1.5). The adverse effects were all mild and transient.
Conclusion: Preliminary results of laser therapy for lichen sclerosus demonstrated good efficacy and minimal patient discomfort during the treatment, with no adverse effects. In comparison with control group laser showed equally good but longer lasting improvement. However, we have to wait until the final results to see if they will confirm the promising findings of this preliminary study stage.

#180

EFFICACY OF A FRACTIONAL CO_2 LASER IN ADDRESSING WOMEN'S HEALTH ISSUES

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Background: Non-surgical rejuvenation of the vaginal area is an emerging field of interest. A variety of laser and radiofrequency devices have recently become available for this treatment but scientific studies of these technologies are scarce.
Study: 12 female subjects were asked to fill out an extensive survey of the efficacy of a fractional CO_2 laser for vaginal rejuvenation at baseline and at 6 months follow up. Detailed information about vaginal laxity, atrophy, lubrication, pain with intercourse and stress urinary incontinence was elicited and compared to post treatment. Adverse events were recorded.
Results: Benefits of the laser on vaginal laxity, atrophy, improved lubrication, painful intercourse and stress incontinence were statistically significant at 6 months follow up compared to baseline.
Conclusion: A fractional CO_2 laser was found to be safe and effective for vaginal rejuvenation.

#181

FRACTIONAL CO_2 LASER TREATMENT OF THE VAGINAL CANAL AND EXTERNAL LABIA FOR SYMPTOMS OF VULVO-VAGINAL ATROPHY IN POSTMENOPAUSAL WOMEN

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Background: Vulvovaginal atrophy (VVA) is a common and underreported condition that can affect the sexual health of women. Here we present a nonsurgical approach for treatment by resurfacing and coagulation of vaginal tissue with a fractional CO_2 laser.
Study: Postmenopausal women with symptoms of VVA were recruited to undergo three internal and external CO_2 laser treatments. The Vaginal Health Index (VHI) was used by the investigator to assess changes in vaginal elasticity, fluid volume, vaginal pH level, epithelial integrity and moisture. Subjects self-reported symptoms of dryness, dyspareunia, burning, itchiness and dysuria, using a numerical scale from 0 (no symptoms) to 10.
Results: Currently, 38 females (mean age 56 ± 8 years) have undergone three internal and external CO_2 laser treatments. There was no to mild discomfort during and after treatments reported, and no significant adverse events. Vaginal health improved with successive treatments with 90% and 97% of subjects showing highly significant improvement in the VHI scale after the first and second treatments, respectively ($p < 0.001$). At one month following the third treatment, all patients showed a statistically significant improvement in the VHI scale ($p < 0.001$), with an average improvement of 9.8 ± 3.1 points compared to baseline. Improvement remained significant ($p < 0.001$) at the 3-month ($n = 34$ subjects) and 6-month ($n = 16$ subjects) follow-ups, with a mean VHI score of $20.1 + -2.9$ and $21.9 + -2.3$, respectively. Vaginal symptoms also improved significantly with treatment with 86% improvement in dryness ($p < 0.001$), 78% in dyspareunia ($p < 0.001$) and 64% in burning ($p < 0.001$) at follow-up. Histological findings at the 3-month follow-up showed increased collagen and elastin staining, as well as a thicker epithelium with an increased number of cell layers and a better degree of surface maturation.
Conclusion: In this study, fractional CO_2 laser treatment was well tolerated and associated with improvement of vaginal health and amelioration of symptoms of VVA.

#182

CO_2 LASER AS A TREATMENT OPTION FOR GENITOURINARY SYNDROME OF MENOPAUSE (GSM) IN ONCOLOGICAL PATIENTS: PRELIMINARY RESULTS

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Background: To evaluate the impact of fractionated CO_2 laser therapy on GSM (Genitourinary Syndrome of Menopause) symptoms in oncological patients with surgically or pharmacologically induced menopause.

Study: Twenty surgical-induced menopause patients after gynecological cancer treatments and twenty pharmacologically-induced menopause after breast cancer treatments presenting with vaginal atrophy, underwent three vaginal CO_2 laser treatment sessions, performed at one-month intervals. Vaginal symptoms were evaluated using the Vaginal Health Index Score (VHIS) and Visual Analogue Score (VAS) for dyspareunia and VAS for subjective satisfaction. The impact of urinary incontinence on patient quality of life was also evaluated using the International Consultation on Incontinence Questionnaire (ICIQ). Symptoms were evaluated before treatment, at every subsequent treatment session, and at 3 months following the last treatment session.
Results: Significant improvement in both subjective symptoms (dryness, burning, dyspareunia) and clinical signs (VHI score) ($p < 0.01$) is demonstrated. In addition, a significant trend in reduction of stress urinary incontinence (SUI) is noted during the treatment period, and was maintained during this relatively short course of follow-up. The vast majority of patients (90%) were satisfied with the procedure, and reported a significant improvement in their quality of life. No adverse events were recorded throughout the study period.
Conclusion: Fractionated CO_2 laser might be a safe and effective treatment modality for GSM in oncological patients. Treatment protocol and detailed outcome will be discussed.

#183

A NOVEL PROCEDURE FOR VAGINAL REJUVENATION USING A CO_2 LASER WITH A NEW NON-ABLATIVE MODALITY

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Background: CO_2 laser and radiofrequency have been used for facial neocollagenesis rejuvenation. Most recently it has been used in the vagina for the same purpose. Previously, CO_2 has been used in the ablative mode. In this study for the first time we are using a CO_2 laser in a non-ablative mode for neocollagenesis and vaginal rejuvenation.
Study: 15 patients with atrophic vaginitis and pelvic organ prolapses were recruited for the study. Vaginal mucosa was harvested prior to treatments. Three CO_2 laser treatments were done one month apart and then a month later a second biopsy was obtained for histologic studies.
Results: On histologic studies it was noted that post-treated patients had thickening of the submucosal collagen and elastin layer. Clinically there is more lubrication, and less dyspareunia and decrease in stress urinary incontinence and symptoms of overactive bladder.
Conclusion: CO_2 in a non-ablative mode is as effective as CO_2 in an ablative mode and radiofrequency in the stimulation of new collagen and elastin producing more vaginal elasticity and lubrication in patients with atrophic vaginitis and pelvic organ prolapse. The thicker more elastic lubricated tissue decreases dyspareunia and more sexual gratification and in cases of pelvic organ prolapse reconstruction with mesh it reduces mesh complications.

#184

EXPERIENCE OF VAGINAL TIGHTENING BY 2940 nm Er:YAG LASER IN JAPAN

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Background: Vaginal Relaxation Syndrome (VRS) is a laxity of the vaginal wall and is usually associated with vaginal child delivery and natural aging. Loss of vaginal tightness is causing the reduction of friction during the intercourse and thus a decrease or loss of sexual gratification. Classical treatment of this indication is with surgery, but recently also non-surgical methods using energy based devices become popular for the treatment of VRS. In this paper we are presenting our experience with a special Smooth mode Er:YAG laser for treatment of VRS in Japanese women.
Study: Japanese women complaining of VRS were included in this single center retrospective study. All patients were subjected to non-ablative Er:YAG laser treatment and received two to three sessions with the interval of one month. Approximately 240 J of laser energy was delivered per each pass and during one session we were delivering 3 to 5 passes depending on patient vaginal canal relaxation. Only local anesthesia was used for this laser treatment. The results were assessed by subjective evaluation of patient's satisfaction and by taking before and after pictures of the opening of vaginal canal. Follow-ups were made at 12 weeks after the laser treatment.
Results: From February, 2015 to September, 2016 50 patients between 26 and 65 years of age were treated with non-ablative Smooth mode Er:YAG laser. Average number of treatments was 2.5. All the patients expressed satisfaction with the treatment results. There were no adverse effects aside of short lasting edema and increased vaginal discharge for a few days. Improvement of VRS was confirmed also by the before and after pictures of vaginal opening.
Conclusion: This study showed that this laser is efficient and safe for the treatment of VRS. We plan to collect data of larger number of patients with longer follow-up to get better assessment of this new therapy.

#185

Er:YAG LASER VAGINAL TIGHTENING USING ROBOTIC PROBE

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Background: Objective of our study was to evaluate the efficacy and safety of erbium laser treatment for vaginal tightening when laser energy is delivered with robotic probe.
Study: Patients with a complaint of vaginal relaxation syndrome and without other genitourinary symptoms were included in this trial. All patients received 3 sessions of non-ablative Smooth mode Er:YAG (2940 nm) laser treatment with one month interval. Laser energy was delivered to vaginal tissue with a new robotic probe. No anesthesia was used. The efficacy was assessed with tonometry and VAS (0–10) questionnaires about sexual and lubrication enhancement. Measurements were executed at every visit and 6 months after the first session. In all measurement points the adverse effects were also observed.
Results: 45 patients with average age of 38.7 years were included in this study and received 3 monthly sessions of erbium laser treatment with robotic probe. Tonometry showed increase at every follow-up going from 9 ± 5 to 15 ± 10

cmH_2O (basal) and 37 ± 12 to 48 ± 21 cmH_2O (Valsalva). Improvement of sexual gratification was graded 8.13 ± 1.36 and of lubrication 8.73 ± 1.48 at 3 months FU. At 6 months 80% of all patients claim to have same or better sexual enhancement as after 3 months and 70% claim the same for lubrication. There were no adverse effects reported aside of mild discomfort at introitus area during the treatment.
Conclusion: According to our results the new robotic probe for non-ablative erbium laser vaginal tightening seems to be efficacious and safe. Further studies with larger number of patients and longer follow-up are needed for better assessment of this novel equipment.

#186

364 CASES OF LASER TREATMENT OF VAGINAL RELAXATION SYNDROME WITH NON-ABLATIVE Er: YAG LASER

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Background: The purpose of this study is to present our experience with non-ablative Er:YAG laser for treatment of vaginal relaxation syndrome in Asian women.
Study: Our paper presents a retrospective study in which larger number of Asian women were treated with non-ablative Er:YAG laser in the period from October 2013 until February 2016. Patients received 2 or 3 laser sessions with interval of 1 month. All treatments were done under topical (lidocaine cream) anesthesia. At every visit standardized photographs of closed and open introitus were taken for evaluation of the treatment efficacy. Two independent observers evaluated the improvement visible on photographs using 4 grade Likert scale (0 = no change, 1 = mild, 2 = moderate, 3 = excellent). Patients were also interviewed about satisfaction with treatment results. Follow-ups were made at 3 and 12 months after the last laser treatment.
Results: 364 patients with average age of 43.0 years (range 20–75) complaining of vaginal relaxation syndrome were treated with non-ablative Smooth mode Er:YAG laser. Majority of the patients (76.1%) were younger than 50 years and 21.4% were postmenopausal. At 3 months FU the average improvement scores for open and closed intriotus were 2.3 and 2.8 and all the patients were satisfied with the treatment. At 1 year FU large majority of patients claim to still have treatment effect maintained. Adverse effects (AE) observed were edema (all patients), stronger vaginal discharge (40%) and temporary urge incontinence (3%) – all AE were mild and transient.
Conclusion: According to the results of our study non-ablative Er:YAG laser procedure showed to be safe and efficacious treatment for vaginal relaxation syndrome whose effects last at least one year and which are producing just mild and transient adverse effects.

#187

EXPERIENCE IN SURGERY LOW AND MEDIUM COMPLEXITY (VULVAR, VAGINAL, AND ANAL PATHOLOGY) WITH LASER SYSTEMS

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Background: To explain the usefulness of CO_2 and diode laser surgery in vulvar, vaginal and anal. Specific objectives: To demonstrate the advantages of laser hemorrhoidectomy. To determine the advantages of laser surgery in pelvic floor, specific to reconstruction, site, vulvar pathology (hypertrophy of labia) and labioplasty (labia majora). To identify trans and postoperative complications of patients treated with laser.
Study: A prospective longitudinal study was conducted. All patients were gathered from the private practice during the period of January 2012 to August 2015 for surgical correction of vulvar, vaginal and anal pathology; of the 126 patients, the procedures done included labia plasty (labia minora) (56), clitoroplasty (36) hemorrhoidectomies (26), anterior and posterior compartment correction of technical site specified (118). Labioplasty of labia (18).
Results: Surgical time for labiaplasty (labia minora) was 60–80 minutes. Surgical correction time for anterior and posterior compartment was 120 minutes. The combined techniques did not exceed 120 minutes. There was better hemostasis concomitantly in hemorrhoidectomy surgeries, as well as healing time. The postoperative recovery time was 21 days for each of the procedures. 50 percent of patients were reinstated to their daily routine activities before seven days. No patient required use of antibiotics or postoperative analgesic after 6 days. There were no surgical wound dehiscences, hematoma, or other complications, post or intra operative. 99% Patients were pleased with the postoperative results from the functional and aesthetic point of view, as reported in the satisfaction survey.
Conclusion: Laser systems area tool that provides multiple benefits over other cutting surgical instruments in pelvic floor reconstruction amongst which are anti-inflammatory, regenerative and coagulative power, resulting to be as good as conventional techniques.

#188

EFFECTIVENESS OF LASER SYSTEMS IN INFERIOR GENITAL TRACT CAUSED BY HPV IN FERTILE AGE WOMEN

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Background: Currently the use of laser systems to treat gynecological pathologies has risen due to its analgesic, repairing, anti-inflammatory and immunologically stimulating effects; in 1984, reported a number of cases with the use of combined technique of excisional and vaporizing laser for cervical conization to destroy NIC; by 2011 successfully reported the use of 980 nm diode laser for the treatment of female genital tract pathologies. The objective of the present investigation is to prove the effectiveness and benefits of the use of laser tools in the treatment of female inferior genital tract pathologies caused by HPV in women within fertile age, compared to traditional methods.
Study: A hundred women were studied within the 17 and 56 years old age group, with a 34 average and a 4-year follow-up, inclusion criteria was used which included a positive cytological and histological report for HPV, who were then

divided into two groups: A included those who received conventional treatment (asaleep, ata, cryotherapy) and B which included those treated with laser technology, photovaporization of low-grade lesions with CO_2 10,600 nm 15 W and conization with diode 980 nm 30 W for high-grade lesions.
Results: Results: (13%) of patients of group A had relapses with a positive biopsy and cytology, with a post-treatment sintomathology rate of 97%, where vaginal discharge was the most frequent, (98%) of group B did not have relapses with a 4-year follow-up that included colposcopy, cytology and cervical and canal biopsy which all reported negative, they did not show any post-treatment complications or sintomathology. (7%) were able to get pregnant after the laser treatment.
Conclusion: Cure rates for both conventional therapies such as laser group were significantly higher than the rate of spontaneous regression ($p < 0.001$) being slightly higher in the treated laser systems, suggesting that treatment with handle LEEP, tie or laser vaporization systems significantly changes the natural history of HPV genital infections, also laser treatment allows faster recovery after treatment with almost no symptoms and does not interfere with fertility of women.

#189

PROCICEPT-L 4% LIDOCAINE ANESTHETIC GEL FOR INTRA-VAGINAL FRACTIONAL LASER TREATMENTS: A COMPARATIVE PILOT STUDY *vs* XYLOCAINE 2% GEL
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Background: The use of fractional lasers for intra-vaginal treatment has become increasingly more common. As this treatment is intended to be performed in office with no systemic anesthesia adequate topical anesthesia with a high safety margin is of paramount importance. Procicept-L (Ampersand, Thousand Oaks, CA) is a novel topical 4% lidocaine utilizing a trademarked process that improves topical drug delivery. The composition solubilizes and hosts guest drugs into a flexible micelle delivery vehicle entering skin through paracellular transport. This could have a distinct advantage in IVL treatments providing adequate depth and density of anesthesia with a lower percentage anesthetic medication, potentially improving comfort and safety. The purpose of this study was to compare pain scores with typical intra-vaginal topical anesthesia using 2% Xylocaine gel and Procicept-L 4% lidocaine during fractional vaginal laser treatments.
Study: Retrospective, comparative pilot series. 25 women intra-vaginally treated with a Hybrid Fractional Er:YAG laser for standard indications with a total of 39 treatments. 2% Xylocaine gel or Procicept-L 4% lidocaine gel were applied copiously to the vagina 20–25 minutes prior to treatment. Procedural pain scores were recorded on a standard 10-point numeric pain scale (0–10). Potential safety issues and complications were monitored.
Results: 14 women received 2% Xylocaine gel for pain control on initial treatment and received Procicept-L 4% Lidocaine gel on second treatment. 11 women received Procicept-L 4% Lidocaine gel for single treatment. Median pain score with 2% Xylocaine gel ($n = 14$) was 5.5 (2–8). Median pain score with Procicept-L 4% Lidocaine gel ($n = 25$, initial and second treatments combined) was 2 (0–5). In the 14 subjects receiving both pain control options reported a median pain score of 1.5 (0–3) on treatment with Procicept-L compared to 5.5 (2–8) with 2% Xylocaine. All 14 subjects who received both anesthetic options subjectively reported improved pain control with Procicept-L. No complications or safety issues were recorded during procedure and no adverse events were reported after the procedure.
Conclusion: Procicept-L 4% Lidocaine gel appears to offer superior pain control over standard anesthetic options for intra-vaginal fractional laser treatments. Procicept-L 4% lidocaine gel appears safe for intra-vaginal use. Further studies are warranted.

Author-Abstract Index*

*Numbers represent the abstract number, not the page number.