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ABSTRACTS

BASIC SCIENCE AND TRANSLATIONAL RESEARCH

#1

MALIGNANT CHANGE AND MARGINS: NOVEL MINIATURIZED PROBES IN THE QUEST FOR MARKERS OF MALIGNANCY

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Background: The majority of oral premalignant lesions (OPL) are present in the oral cavity over years, and predictors of risk and timing of malignant change remain elusive. Moreover, field cancerization effects allow for multiple lesions in the oral cavity, many of which are not visible to the naked eye. Intra-operative delineation of lesion margins remains a clinical challenge. The latest advances in technology permit the development of miniaturized probes for *in vivo* evaluation and mapping of potential biomarkers for these purposes. Goal of this study was to use prototype multimodality probes to image and map the expression of specific biomarkers known to play a role in vascular and extracellular matrix (ECM) changes during oral carcinogenesis.
Study: Non-invasive multi-wavelength Non-Linear Optical Microscopy (NLOM) including Multi-Photon Microscopy (MPM) and Second Harmonic Generated (SHG) Fluorescence, Stimulated Raman Scattering (SRS) and Coherent Raman Scattering Microscopy (CARS) techniques were used to image hamster cheek pouches throughout carcinogenesis in 28 hamsters. Surface and subsurface fluorescence was imaged prior to and after the injection of biomarkers including: Vascular Endothelial Growth Factor (VEGF); Epidermal Growth Factor (EGFR); Urinase Type Plasminogen Activator (uPA) and Inhibitor (PAI); and Matrix Metalloproteinases (MMPs). Two animals were sacrificed at weekly intervals, and tissues underwent routine sectioning for histopathological and IHC staining. Areas of change were evaluated on a standard scale of 0–6 and mapped for comparison with imaging-based determinations of biomarker localization.
Results: Beginning at 3 weeks of carcinogenesis, (early dysplasia), biomarker changes could be detected using our imaging approach. Optically mapped biomarkers co-localized well with histopathological and IHC data.
Conclusion: Biomarkers of events such as neoplastic vascular and ECM change can be imaged using novel multi-modality microprobes, providing an excellent research tool for future studies on mechanisms of dysplastic and malignant change.
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#2

PILOT STUDY ON *IN VIVO* MULTIPHOTON MICROSCOPY IMAGING OF BASAL CELL CARCINOMA

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Background: Recent translation of multiphoton microscopy (MPM) to clinical practice raises the possibility of *in vivo* imaging of basal cell carcinomas (BCCs), a non-invasive process that would reduce the time from consultation to treatment. MPM is a nonlinear laser scanning microscopy technique that features high three-dimensional resolution and label-free molecular contrast. Several endogenous tissue components can be visualized, including collagen (through second-harmonic generation), NADH, FAD, keratin, melanin and elastin fibers (through two-photon excited fluorescence). The purpose of this study was to demonstrate the ability of MPM to image *in vivo* BCC lesions in human skin and to find out if the histopathology criteria can be identified in MPM images.
Study: Imaging was performed with a clinical MPM-based tomograph (MPTflex, JenLab, Germany). Ten BCC lesions were imaged *in vivo* in nine patients before biopsy. The MPM images were compared to histopathology to evaluate if traditional histopathology criteria can be identified in MPM images.
Results: We identified three parameters associated with morphological features of BCC: 1) nests of basaloid cells present in the papillary and reticular dermis, some of which showed palisading in the peripheral layer. This feature was imaged in all lesions and correlated well with histopathology; 2) collagen and elastin arranged in parallel bundles surrounding the tumors. This feature was imaged in 5 out 10 lesions and was not correlated to histopathology; 3) elongated tumor cells in the epidermis aligned in one direction. This feature was imaged in 4 out 10 lesions and was not correlated to histopathology.
Conclusion: This study proves the MPM ability to image *in vivo* and non-invasively BCC lesions. The three parameters identified in the MPM images of the BCC lesions may provide criteria for non-invasive diagnosis. Further investigations are planned with larger number of patients.

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#3

BIOCHEMICAL CHANGES IN NORMAL SKIN CAUSED BY SQUAMOUS CELL CARCINOMA USING FTIR SPECTROSCOPY

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Background: Squamous cell carcinoma is the second most common skin cancer. The diagnosis requires biopsy followed by histopathological analysis, which is the gold standard diagnosis. The histopathology has some subjectivity and an auxiliary cancer detection method is necessary to accurately determine the presence of cancer cells still in early stages. Due to its molecular-level information, the FTIR technique has great potential to differentiate neoplastic from normal cells, making it a possible and powerful diagnostic tool.

Study: We used the FTIR spectroscopy and histopathological technique to analyse the biochemical and morphological changes in normal skin during the evolution of squamous cell carcinoma in 50 Swiss mice submitted to chemical carcinogenesis. Infrared spectra data of FFPP (Formalin-fixed paraffin-processed) sections of normal and tumoral skin were obtained with a Thermo Nicolet 6700 Fourier transform infrared spectrometer equipped with an attenuated total reflection (ATR) accessory. Hierarchical Cluster analysis (HCA) was used as an unsupervised classification technique in order to evaluate the similarity level between spectral data.

Results: Neoplastic lesions shown an intense proliferation of keratinocytes in an exophytic pattern. The basal layer epithelium displays a moderate dysplasia and hyperchromatism. Hyperkeratosis and papillary projections were frequently observed and some of lesions exhibited invasion of the neoplastic cells into the dermis, which showed intense collagen deposition and numerous blood vessels, which clearly indicates SCC. FTIR spectroscopy shown an increase in vibrational modes associated with RNA, suggesting an increased amount of this nucleic acid, that is consistent with increased protein bands intensity (Amide I and II).The decrease in intensity of collagen bands were observed and it is associated to potentially malignant carcinomas.

Conclusion: We have shown that FTIR spectroscopy was able to distinguish normal skin from cutaneous SCC and it is a promising auxiliary method during the diagnosis process.

#4

NON-INVASIVE DIAGNOSIS OF HEMANGIOMAS USING DOPPLER OCT IMAGING

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Background: Hemangiomas are vascular tumors of the dermis capillaries that often involve the head, neck and oral cavity, with light to severe disfigurement. Early diagnosis and recognition of the lesion is essential to provide appropriate treatment and decrease harmful cosmetic and psychological effects. Critical parameters for diagnosis are the presence of caverns, the density and diameter of blood vessels as well as the intensity of their blood flow. Excisional biopsies are the gold-standard but may cause severe bleedings and side-effects, so that a non-invasive imaging technique should be preferred.

Study: We propose to use Optical Coherence Tomography (OCT), a morphological *in vivo* optical imaging technique, coupled to functional blood-flow Doppler modality. We imaged hemangiomas on 14 child patients of the IMIP hospital. The OCT system is a Thorlabs swept source OCT at a wavelength of 1325 nm. The system has a frame rate of 25 images per second, axial and transverse resolution in tissue of 9 μm and 18 μm respectively, maximum detection depth in skin of approximately 1 mm.

Results: We were able to distinguish between normal skin and vascular lesion areas. The lesions present blood vessels of mean diameter 114 μm and mean depth 304 μm. Although quantitative value of blood flow was not assessed, we can qualitatively report a high variability of blood flow intensities.

Conclusion: Our findings in terms of density, size and depths of blood vessels are consistent with previous literature on the subject. The high standard-deviation of our statistics can be explained by the high variability of the lesions as well as variability of vascularity inside one lesion. We are currently enrolling more patients in the study to reach a total of 50 patients and increase statistical significance. We have shown that OCT completed by Doppler OCT is a promising method for non-invasive diagnosis and monitoring of vascular lesions.

#5

LIDOCAINE-INDUCED POTENTIATION OF THERMAL DAMAGE IN KERATINOCYTES, FIBROBLASTS, AND BASAL CELL CARCINOMA IN CULTURE

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Background: Lidocaine acts as a local anesthetic by blocking transmembrane sodium channel permeability, thereby disabling depolarization of neurons and inhibiting painful sensation. Lidocaine also induces the synthesis of heat shock proteins, sensitizes cells to hyperthermia and increases the aggregation of nuclear proteins during heat shock. We previously reported two cases of mature surgical scars treated with non-ablative fractional resurfacing, which developed deep focal ulceration at points corresponding to local lidocaine anesthetic injection sites, despite conservative settings, adequate time and cooling between passes. It was hypothesized that lidocaine had focally sensitized keratinocytes to the thermal damage of laser treatment. The goal of this study was to investigate the effect of lidocaine on heat sensation by using an in vitro model with cell lines representing the skin.

Study: We used human keratinocyte and fibroblast as well as murine basal cell carcinoma cell lines. Cells were seeded in multiwell plates and pre-incubated with lidocaine 1 hour prior heating. Cell viability was assessed 24 hour later by using the MTT assay.

Results: The results of this study show that lidocaine causes dose-dependent thermal hypersensitivity of epidermal and dermal cells. In cultured human keratinocytes and fibroblasts, survival at 44 C was significantly reduced by incubation with 0.1 and 0.2% lidocaine, concentrations much lower than what is used clinically when treating patients (1–2%). In a cultured murine basal cell carcinoma cell line, lidocaine caused even greater

hypersensitivity to thermal injury even at lower lidocaine concentrations of 0.05%.
Conclusion: In summary, this study suggests that lidocaine potentiates thermal injury to both epidermal and dermal cells, which should be considered when administering laser or other thermally-based treatments under local anesthesia. Additionally, with further investigation, it may provide a new therapeutic method for treatment certain neoplasms.

#6

PHOTODYNAMIC TREATMENT OF S. MUTANS BIOFILMS GROWN ON DIFFERENT SURFACES

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Background: Photodynamic therapy (PDT) has demonstrated efficacy in situations where conventional antibiotic therapies are challenged such as biofilms, gram-negative bacteria and resistant organisms. Surface characteristics can affect biofilm adherence and integrity and so may modify the effectiveness of PDT. This study investigates the killing efficacy of PDT on S. mutans biofilms grown on relevant dental substrata.
Study: S. mutans (NCTC 10449) was grown in 48 h biofilms on different substrata, specifically glass, titanium and denture acrylic. During PDT assays, the biofilms were treated with a purpurin based sensitizer ([25 ug/ml] in DMSO) for 30 min., then exposed to light doses of 15, 30 and 45 j/cm^2. Colony forming unit assays were performed to determine survival following treatment. MAIR spectroscopic analysis was performed to investigate PDT effects on biofilm composition.
Results: Survival was reduced in the biofilm cultures following PDT. All light doses achieved a greater than 3-log inactivation on 48h biofilms grown on polished denture acrylic. The higher light dose (45j) achieved greater than 3-log inactivation in 48h biofilms grown on glass, with the (30j) dose achieving greater than 2-log inactivation. Results will be presented for other surfaces, including titanium. MAIR spectroscopy data illuminates how PDT affects the biofilm structure.
Conclusion: PDT experiments using a purpurin based sensitizer and laser light doses of 15, 30 and 45 j/cm^2, against S. mutans biofilm grown on different surfaces, show the effectiveness of this therapy. While considerable disinfection was achieved on all substrata compared to the controls, not all biofilm could be disinfected equally. With demonstrated efficacy against various microbes and on different substrata, antimicrobial PDT shows potential for clinical application in biofilm-mediated diseases like peri-implantitis and periodontitis.

#7

ANTIMICROBIAL BLUE LIGHT INACTIVATION OF MULTIDRUG-RESISTANT ACINETOBACTER BAUMANNII BIOFILMS

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Background: Biofilms of microorganisms are the primary cause of chronic and recalcitrant infections. The therapeutic outcomes of current antibiotics against biofilms have been largely limited by the increasing drug-resistance of biofilm-embedded microorganisms. There is consequently a critical need for new approaches to tackle drug resistance. Antimicrobial blue light has already demonstrated promising effectiveness in inactivating planktonic cells of Acinetobacter baummanii, which is a common causative pathogen of hospital-associated infections.
Study: Biofilms of a clinical isolate of multidrug-resistant A. baummanii were grown for 24 or 72 h in brain heart infusion. These biofilms were subjected to blue light (415 nm) at a fluence rate of 100 or 50 mW/cm^2.
Results: After a single exposure of 48 min. to blue light at 100 mW/cm^2, a >99.9% inactivation of A. baummanii was observed in both 24-h and 72-h biofilms. At 50 mW/cm^2, same exposure time to light, which corresponds to only 50% of the fluence at 100 mW/cm^2, was required to achieve 99.9% inactivation.
Conclusion: Antimicrobial blue light can effectively inactivate A. baummanii biofilms, thus may be potential in treating its chronic infections. The effectiveness of antimicrobial blue light inactivation of A. baummanii biofilms was likely to be more dependent on light exposure time rather than the fluence of light.

#8

TOPICAL AXITINIB SUPPRESSES ANGIOGENESIS PATHWAYS INDUCED BY PULSED DYE LASER

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Background: Port Wine Stain (PWS) blood vessel recurrence induced by pulsed dye laser (PDL)-induced angiogenesis is a critical barrier that must be overcome to achieve a better therapeutic outcome. This study is to determine whether PDL-induced angiogenesis can be suppressed by topical axitinib.
Study: The mRNA expression profiles of 86 angiogenic genes and phosphorylation levels of extracellular signal regulated kinases (ERK), pAKT and ribosomal protein S6 kinase (p70S6K) in rodent skin were examined with or without topical axitinib administration after PDL exposure.
Results: The PDL-induced increased transcriptional levels of angiogenic genes showed a peak expression at days 3 to 7 post-PDL exposure. Topical application of 0.5% axitinib effectively suppressed the PDL-induced increase in mRNA levels of the examined angiogenic genes and activation of AKT, P70S6K and ERK from days 1 to 7 post-PDL exposure. After topical administration, axitinib penetrated to an approximate depth of 929.5 μm into rodent skin.
Conclusion: Topical application of 0.5% axitinib can systematically suppress the PDL-induced early stages of angiogenesis via inhibition of the AKT/mTOR/P70S6K and SHC-1/MEK/ERK pathway cascades.

#9

COMPARISON STUDY OF RAPID REPETITION RATE AND CONTINUOUS NEAR INFRARED (NIR) LIGHT DEVICES: DETECTION OF THE DIFFERENT REACTIVE OXYGEN SPECIES INDUCED OXIDATIVE STRESS IN SKIN DURING IRRADIATION, RESPECTIVELY

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Background: Lipid peroxide and reactive oxygen species (ROS) and, which are produced by ultraviolet and visible light damage skin cells, collagen and elastic fibers in the dermis. Infrared intence pulsed light irradiation are powerful treatments but may lead to generate free radicals. We measured different free radicals generated by light in the skin. Electron spin resonance (ESR) analysis revealed that different free radicals, including hydroxyl radical (OH^*) and superoxide anion radical ($O2^*$), were generated in hairless mice skin with pulsed NIR light device irradiation. ROS damage melanocytes and may induce the production of inflammatory molecules. Further, we determined what kind of radical scavenger suppressed hyperpigmentation in skin after treatment.

Study: Analysis method of free radical signals: 4 types free radical signals were detected on pig skin tissue by spin-trapping agent 20 μl DPPMPO and ESR. The pig skin tissue has been processed several times by rapid repetition rate NIR (800–1400 nm) light device (Sciton, Skintyte, CA, USA) and continuous NIR (1100–1800 nm) light device (Cutera, Titan, CA, USA) with Total 225J/cm3, 3 times respectively. We also compared the pig skin tissue with and without hair.

Results: ESR analysis detected 5 types ROS of OH^*, $O2^*$, hydrogen radical, ascorbic radical and methyl radical generated by light irradiation. OH^* and $O2^*$ have been increased by depending on irradiation energy. After irradiation these radicals kept on increasing for 15 minutes but that was the peak and started to decrease gradually. The amount of the free radical has been measured and compared at the irradiation of rapid repetition NIR and continuous NIR. The comparison has showed that the ESR peak intensity of Hydrogen radical and $O2^*$ has been detected. The intensity of $O2^*$and Hydrogen radical has been detected more when we use and rapid repetition NIR device. The intensity of $O2^*$and Hydrogen radical has been detected more when the skin with hair.

Conclusion: The different light devices generate specific radical species in hairless mice skin. This investigation shows the possibility to reduce pain and side effects during light treatments by inhibition of specific ROS that was induced in each light wavelength.

#10

MODELING AND VALIDATION OF TEMPERATURE VARIATIONS WITHIN A BLOOD VESSEL DURING LASER IRRADIATION

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Background: Numerical modeling can be an effective tool to understand and improve laser therapy of vascular malformations. However, model validation is difficult due to the lack of vascular geometry and temperature measurements during laser-tissue interactions. Using the temperature variations measured with an IR camera during laser irradiation of blood vessels in an animal model, we will be able to validate the numerical models for the purpose of laser treatment parameters optimization.

Study: The depth of a blood vessel in the dorsal window chamber was measured using Doppler optical coherence tomography. The diameter of the blood vessel was measured from a photomicrograph of vasculature in the window. The blood vessel was then irradiated with a 532 nm laser while radiometric temperature was measured simultaneously. The blood vessels geometry and laser parameters were inputted into numerical models which have Monte Carlo light distribution module and finite-element thermal diffusion module. Measured and simulated temperatures were compared with each other.

Results: Blood vessels of various diameters (64–150 m) and depths (66–384 m) were used in the experiments. Numerical simulations indicate that varying blood absorption coefficients within physiological values did not affect the radiometric temperature significantly. However, varying the infrared attenuation coefficient of the tissue did affect the radiometric temperature in medium to deep vessels. Analysis of radiometric temperature measurements in the window chamber revealed that depth influences radiometric temperature while diameter does not. We found good agreement in the initial temperature increase of shallow blood vessels between the simulations and measurements, but discrepancy for deeper vessels.

Conclusion: These findings show numerical models can simulate temperature variation in shallow vessels undergoing laser irradiation accurately. A temperature measurement method that is less affected by tissue thickness is needed to validate the numerical models for the simulation of deeper target.

#11

EVALUATION OF THE LONG-TERM ANTI-AGING EFFECTS OF BROADBAND LIGHT THERAPY

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Background: Continual exposure to ultraviolet light and intrinsic aging result in photodamaged skin. BroadBand Light (BBL) therapy utilizes visible and infrared light to provide a gentle, no downtime treatment for the visual manifestations of skin aging. BBL has successfully provided patients with a decrease in the signs of aging and an increase in clearer, more youthful looking skin. The current study provided a blinded assessment of the long-term, anti-aging effects of BroadBand Light treatment as demonstrated by the delay of visual skin aging. The ages of patient's skin both untreated and BBL treated over a minimum of eight years was estimated by 51 dermatologists, and compared to their actual age.

Study: Eleven subjects were enrolled and treated for overall skin rejuvenation with BroadBand Light (BBL™ Sciton, Inc., Palo Alto, CA). Inclusion criteria included a minimum of one annual treatment over a minimum eight years, and no facial aesthetic throughout the study duration. 51 blinded dermatologist evaluators estimated patient ages based on photographs before and after treatment, and of untreated, sun-protected skin.

Results: The subjects' actual age ranged from 38–65 years prior to treatment, and was accurately estimated by the evaluators. After eight years following the BBL treatment regimen, the evaluators estimated the subjects to be approximately nine years younger than their actual age. The untreated, sun-protected skin was estimated to be the same as the treated skin age.

Conclusion: This is the first blinded evaluation of the long-term effects of BroadBand Light (BBL) therapy for skin rejuvenation. The BBL treated skin which had aged at least eight years was estimated to have aged only one year or less. These results demonstrate that patients who maintain a regular annual or biannual regimen of BBL treatments can reduce and delay the long-term signs of skin aging in a naturally looking way.

#12

LOW LEVEL LASER THERAPY ON THE VIABILITY OF THE HEALING OF BURNS ON RATS

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Background: This study has observed the effect of the irradiation of the Low Level Laser Therapy (LLLT) in the viability of the healing of burn in rats.

Study: 12 EPM-1 Wistar rats were randomly divided into two groups: control group and laser group. All animals were anesthetized with tiletamine hydrochloride (25 mg / kg) and zolazepam hydrochloride (25 mg / kg) and then were performed on the trichotomy backs of the animals. The burns were standardized using a circumferential blade (aluminum) metal measuring approximately 3 cm in diameter with a temperature of 100 °C for 5 seconds. In the control group, no treatment procedures were performed, only the analgesic control. In Laser group was carried irradiation of LLLT with the following dosimetric parameters: 100 mW of power and 7,3J energy. Irradiation was performed in the immediate postoperative period and in the two subsequent days. The percentage of the area of necrosis was measured on the fourteenth day after surgery by the method of paper template. The quantification of collagen cells was performed by birefringence. For statistical analysis, the Kolmogorov-Smirnov test and Student's t-distribution with a significance level of 5% was used.

Results: In the control group the mean area of necrosis was 3.11 ± 1.01 and 2.30 ± 0.84 in the laser group. Analysis of birefringence averaged 5.83 ± 7.56 and the average laser group was 5.38 ± 6.96. In both analyzes, there was no statistically significant difference between groups.

Conclusion: In the present study the irradiation of LLLT was not effective in improving the healing of burns on rats.

#13

A SINGLE EXPOSURE OF ULTRAVIOLET RADIATION AFTER LOW-FLUENCE IPL CAUSES NO INCREASED RISK OF SIDE EFFECTS IN CAUCASIANS: A RANDOMIZED CLINICAL TRIAL

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Background: Low-fluence laser and intense pulsed light (IPL) gains increasing popularity and availability for home-use hair removal. Treatments may be performed in sun-exposed areas, but the impact of ultraviolet radiation (UVR) on IPL-treated skin remains to be clarified. Therefore, we investigated the occurrence of side effects in different skin complexions receiving UVR after low-fluence IPL.

Study: Sixteen subjects with Fitzpatrick skin types (FST) II-V were enrolled. In each subject, three buttock blocks were each subdivided into four sites, randomized to receive one IPL exposure of 0, 7, 8, or 10 J/cm^2. Blocks were subsequently randomized to receive either no UVR or 1 Solar Simulated UVR exposure of 3 Standard Erythema Doses at 30 min or 24 h after IPL (12 interventions in total). Follow-up visits were scheduled at 48 h, 1 and 4 weeks after IPL. Outcome measures were: (i) clinical skin reactions, (ii) erythema and pigmentation measurements, and (iii) pain intensities during IPL exposure.

Results: Subjects with FST II-IV experienced no clinical skin reactions up to 4 weeks after IPL, neither erythema, edema, blisters, crusting, textual or pigment changes ($p = 1.0$). Skin reflectance confirmed no change in erythema or pigmentation after IPL ($p = 0.090$). Exposure to UVR alone induced erythema and post-inflammatory hyperpigmentation ($p = 0.001$). A combination of IPL and subsequent UVR induced skin reactions similar to skin responses from UVR alone ($p = 0.164$). Pain intensities during IPL exposure were generally low (median 1, range 0–4) and correlated positively with IPL dose, FST and skin pigmentation (spearmans rho $= 0.394$, $p < 0.001$). One subject with FST V responded with mild erythema and perifollicular hyperpigmentation after IPL, which were slightly more intense in skin exposed to UVR after IPL.

Conclusion: A single exposure of Solar Simulated UVR shortly after or 1 day after low-fluence IPL causes no increased risk of side effects in individuals with FST II-IV.

#14

ARE WE OVER-STATING THE RISKS OF OPTICAL FIBER BREAKS

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Background: Concerns over the potential for accidental eye injuries during use of surgical lasers lead to the recommended wear of laser eye protection by all of the surgical staff. Although safety standards recommend that laser eyewear use is mandatory only within the "Nominal Hazard Zone," the determination of this zone or designating the entire surgical room as the NHZ frequently leads to controversy. This is particularly controversial when laser endoscopy is performed and eye exposure is not possible except for either a fiber break or by accidental removal when the laser is emitting. The objective was to assess the safety of broken Holmium laser fibers.

Study: A variety of commercial optical fibers were obtained and attached to a Holmium surgical laser. The irradiances present near open or broken fibers were measured to determine realistic hazard distances for Ho laser systems.

Results: The hazard distances were remarkably small, of the order of 30 cm or less. These distances could be used to provide better guidance on recommendation for laser eye protection that would be appropriate to wear for users of such medical lasers.

Conclusion: Below certain laser powers, it is possible to justify eliminating any need to wear eye protection for endoscopic use.

#15

OBJECTIVE EVALUATION OF FAT REDUCTION TREATMENT WITH A NON-INVASIVE 1060 nm DIODE LASER

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Background: Hyperthermic treatment using 1060 nm diode laser has been demonstrated to damage adipocytes non-invasively. A previous study tested on abdominoplasty patients has demonstrated the acute and long term tissue response through histological evaluation from day 1 to 6 months post treatment. The present study was designed to identify clinical endpoints that can help predict efficacy in fat reduction.
Study: Multiple clinical studies were conducted on 96 (55 Flanks, 41 Abdomen) subjects which received a single session with a 1060 nm diode laser. Patient assessment of thermal sensation using a 10 points grading scale during the treatment and post treatment tenderness were recorded. Ultrasound diagnostics of subcutaneous tissue were obtained immediately post, 1 week, 6 weeks and 12 weeks post treatment. The ultrasound signal change in the subcutaneous fat after the treatment was observed. The fat thickness reduction was calculated at 6 and 12 weeks based on template registered ultrasound images. Side effects were recorded during the course of the study.
Results: In a previous study, ultrasound signal changes were found to be related to the fat damage as observed histologically. In the present study, a strong correlation was noted between fat thickness reduction at 6 and 12 weeks post treatment and the finding of ultrasound signal changes in the subcutaneous tissue at 1 week. The majority of the subjects who experienced a mild-moderate (grade 3–5) thermal sensation during the treatment, an observed ultrasound signal change, and also reported post treatment tenderness which lasted 1–3 weeks were found to exhibit fat thickness reduction. Of 22 subjects currently finished 12 weeks follow up, more than 80% of subjects who were noted ultrasound signal change at 1 week had measurable fat reduction at 12 weeks.
Conclusion: A set of clinical endpoints were established to indicate efficacy of fat reduction from the hyperthermic treatment. These included patient thermal sensations during the treatment, observed ultrasound signal change at 1 week and post treatment tenderness. Patients meeting these clinical endpoints are very likely exhibit fat reduction at 6–12 weeks.

#16

EVALUATION OF BACTERICIDAL EFFECT OF LASERS BY IMAGING OF BIOLUMINESCENT STAPHYLOCOCCUS AUREUS UNDER TRANSPARENT NANOCRYSTALLINE YTTRIA-STABILIZED-ZIRCONIA CRANIAL IMPLANT

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Background: Bacterial adhesion to cranial implant biomaterials is the leading factor for biofilm formation, infection, and treatment failure. Staphylococcus aureus (S.aureus) is the most common pathogen associated with cranial implants infection. The transparency of our nanocrystalline yttria-stabilized-zirconia (nc-YSZ) cranial implants may provide a unique opportunity for non-invasive treatment of infection forming under the implant using medical lasers.
Study: A S.aureus strain was transformed with a P.pyralis luciferase gene using electroporation technique, resulting in a bioluminescent phenotype. Nc-YSZ implants were incubated in bacteria suspension at 37 oC for 4 hours. The nc-YSZ discs were then seeded on the surface of agar plates and immediately irradiated with laser, then incubated at 37 oC for 24 hours. The study examined continuous and pulsed mode of 810 nm and 1064 nm laser wavelength with energy density ranging from 0 (control) to 50 J/ cm^2 and power output ranging from 1 to 5 W. During Irradiation, the temperatures of nc-YSZ surface and implant-tissue interface were monitored using an infrared thermal camera and thermocouples, respectively. Bioluminescence relative light units were used to evaluate the viability of bacteria after the laser treatment.
Results: Bioluminescence analysis suggest that the viability of S. aureus was reduced with laser treatment when compared to the control group ($p < 0.01$) and loss of viability depends on both laser fluence and operation mode (continuous or pulsed). The reduction was also observed in the number of colony-forming units. The results demonstrate that both lasers have the ability to eliminate the bacteria under nc-YSZ without adverse effect to the underlying host tissue when appropriate parameters are used.
Conclusion: The results of this study suggest that using nc-YSZ as a cranial implant allows for non-invasive, chronic treatment of the bacteria layer that might form under the cranial implants.

#17

ANALYSIS OF INDIVIDUAL VARIATIONS IN HEMOGLOBIN DYNAMICS IN INCIDENTAL BRUISES USING RADIOMETRIC DEPTH PROFILING AND DIFFUSE REFLECTANCE SPECTROSCOPY

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Background: Time evolution of traumatic bruises (hematomas) is governed by mass diffusion of extravasated hemoglobin (Hb) and biochemical decomposition of Hb as a result of the inflammatory response. We have recently demonstrated that photothermal radiometric (PTR) measurements *in vivo* combined with numerical simulations of laser energy deposition in bruised skin allow assessment of structural properties of the lesion site as well as key parameters describing the Hb dynamics in bruised skin (e. g., Hb mass diffusivity and characteristic decomposition time). In this study we combine the above approach with diffuse reflectance spectroscopy (DRS) to analyze inter- and intra-patient variations of these parameters.
Study: The study involves healthy volunteers (Fitzpatrick skin types I–III), age 20–60, with fresh bruises resulting primarily from sports-related accidents with known time of injury. To date, 24 test sites were included in the study. Each site was irradiated with a single 1 ms pulse at 532 nm emitted from a medical-grade laser (DualisVP, Fotona, Slovenia), and the resulting mid-infrared emission transient was detected. DRS measurements in visible spectral range (400–800 nm) were also performed on the same test sites. The above stated parameters of Hb dynamics in the bruise are assessed by fitting numerically predicted PTR signals and DRS to experimental data.
Results: The examples analyzed thus far indicate significantly lower values of Hb mass diffusivity than reported in literature. The Hb decomposition rates systematically decrease over time, as the inflammatory response of tissue gradually subsides. A transient increase in dermal thickness (attributed to edema) is

also indicated. Stratification of the assessed values and trends with respect to anatomical location, subject\'s age, gender, etc., is currently under way.
Conclusion: The obtained results improve our understanding of the bruise evolution and represent an important step in development of future techniques for objective determination of bruise age in forensic medicine.

#18

COLLAGEN CROSS-LINKS AS FLUORESCENT MARKER FOR BIOMECHANICAL CHARACTERIZATION OF COLLAGENOUS TISSUES: FEASIBILITY STUDY

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Background: The biomechanical properties of the extracellular matrix (ECM) in collagenous tissues are highly modulated by cross-linking of collagen; for example, elasticity which is essential to skin wound healing and cornea repair processes. In this work, we induced changes in the biomechanical properties of two distinct ECMs by modulating the cross-linking of collagen, and used fluorescence spectroscopy to evaluate the corresponding changes in the concentration of cross-links.
Study: Constructs of type I collagen with different concentrations of fibroblasts were cultured *in vitro*. Changes in concentration of cross-links over time were tracked using UV fluorescence spectroscopy. A 30-day toxicity study was conducted to assess the effects of short term UV exposure on cell viability. UV fluorescence spectroscopy and uniaxial tensiometry were used to evaluate collagen cross-linking in rabbit cornea *ex vivo* after RGX treatments – a novel photo-crosslinking procedure that involves Rose Bengal staining followed by green-light irradiation (532 nm).
Results: *In vitro*, the 335/390 nm and 370/460 nm excitation/emission wavelength pairs exhibited increasing intensity over time as the concentration of cross-links increased, as evidenced by the decrease in surface area and increase in stiffness of the collagen gels. Relative to non-exposed controls, short term UV exposure did not alter cell proliferation. *Ex vivo*, fluorescence intensity increased linearly as the exposure to green light increased. Changes in elasticity of cornea exhibited strong positive correlations with duration of irradiation as well as fluorescence intensity of the 370/460 nm pair.
Conclusion: Results from this study demonstrate potential for *in vivo* evaluation of the biomechanical properties of collagenous tissues using collagen cross-links as a fluorescent marker.

#19

PREVALENCE OF ENAMEL DEMINERALIZATION: A SCREENING STUDY USING CLINICAL AND IMAGING TOOLS

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Background: If detected early, enamel demineralization can be reversed using simple remineralization techniques. However, most dental decay is detected at a more advanced stage, when the pathology is no longer reversible so that caries excision and structural replacement become necessary. Conventional visual exam often overlooks incipient decay, and probing can damage the fragile demineralized enamel surface. The International Caries Detection and Assessment System (ICDAS) screening technique reportedly has greater sensitivity, but is complex and laborious. An effective screening tool is urgently needed to allow the implementation of validated prevention interventions. Goal of this study was to identify the prevalence of incipient enamel decay in patients attending a public dental hygiene clinic using conventional clinical exam, the ICDAS-II and a novel autofluorescence-based device.
Study: In each patient, visible decay/demineralization in all bicuspid and molar occlusal surfaces was recorded by a dentist with a head mounted light, but with no magnification. Next, the ICDAS status of all present bicuspid and molar occlusal surfaces was scored (0–6, with 1–2 representing early decay). Finally, a novel prototype caries detection device with polarized reflectance and blue autofluorescence (Carestream, Atlanta, GA) imaging capabilities was used on all bicuspid and molar occlusal surfaces to map decay/demineralization using prescribed cut-off points.
Results: 61% of subjects were diagnosed with early decay using conventional clinical exam. Prevalence measured 70% using ICDAS diagnostic techniques (stage 1–2), and 68% using autofluorescence, with 91% agreement between ICDAS and AF diagnosis.
Conclusion: A polarized reflectance/autofluorescence-based imaging approach may provide an inexpensive, effective and simple means of screening for early decay, providing a much-needed basis for improved prevention interventions in dental public health. Supported by: LAMMP NIH/NIBIB P41EB05890; the Arnold and Mabel Beckman Foundation; University of California SOM Seed Grant.

#20

MAPPING THE EFFECTIVENESS OF ANTI-PLAQUE TREATMENTS

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Background: Tooth decay and periodontal disease are caused by biofilm. Oral hygiene techniques are cumbersome, requiring augmentation by health professionals. Better formulations are needed to support plaque removal and discourage re-accumulation. Goal of this study was to develop an optically-based means of mapping the effects of physical and chemical biofilm control interventions. Specific aim was to test effects of a novel desiccant anti-plaque formulation (HybenX, Epien Medical, St. Paul, Minnesota) on enamel biofilm.
Study: 15 extracted teeth were incubated in saliva to generate dental plaque. Samples were stained with Live/Dead Biofilm marker (Life Technologies, Carlsbad, California), then imaged using non-linear optical microscopy (NLOM). After imaging, teeth were divided into 3 groups of 5 samples each. Samples in Group 1 were cleaned for 2 minutes using an electric spinbrush, then re-imaged. Group 2 samples underwent antiplaque treatment with the test formulation prior to re-imaging. In Group 3, anti-plaque

treatment and imaging were followed by WaterpikR use and re-imaging to evaluate the potential of water flossing for removing residual biofilm.
Results: Spinbrush use altered plaque thickness over 85–95% of tooth surface, with full thickness biofilm removal over 45–60% of tooth surface and variable residual biofilm smear layer. The test formulation achieved 70–80% full thickness biofilm removal depending on tooth roughness and architecture. Residual islands of loosely attached plaque were observed. Additional water flossing detached much of the biofilm residue, leaving an enamel surface 90–95% free of plaque. Because this was an observational study with the primary goal of establishing novel techniques, statistical analysis of the data was not performed.
Conclusion: Using novel NLOM imaging techniques the effects of a novel anti-biofilm formulation were mapped and quantified.
Supported by: LAMMP NIH/NIBIB P41EB05890; the Arnold and Mabel Beckman Foundation; University of California SOM Seed Grant; Epien Medical Inc.

#21

SUSTAINED ACTIVATION OF C-JUN N-TERMINAL AND EXTRACELLULAR SIGNAL REGULATED KINASES IN PORT WINE STAIN BLOOD VESSELS

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Background: Port wine stain (PWS) is a congenital, progressive vascular malformation but the pathogenesis remains incompletely understood. This study is to investigate the activation status of various kinases, including ERK, JNK, AKT, PI3K, p70S6K and PLC-γ, in PWS biopsy tissues.
Study: Immunohistochemistry was performed on 19 skin biopsy samples from 11 PWS subjects.
Results: JNK, ERK and P70S6K in pediatric and adult PWS blood vessels were consecutively activated. Activation of AKT and PI3K were found in many adult hypertrophic PWS blood vessels but not in infants. PLC-γ showed strong activation in nodular PWS blood vessels.
Conclusion: Our data suggest a subsequent activation profile of various kinases during different stages of PWS: (1) JNK and ERK are firstly and consecutively activated in all PWS tissues which may contribute to both the pathogenesis and progressive development of PWS; (2) AKT and PI3K are subsequently activated which are involved in the hypertrophic development of PWS blood vessels; (3) PLC-γ is activated in the most advanced stage of PWS and may participate in PWS nodular formation.

#22

GENE EXPRESSION ANALYSIS IN CULTURED HUMAN SKIN FIBROBLASTS FOLLOWING EXPOSURE TO A PICOSECOND PULSED ALEXANDRITE LASER AND SPECIALLY DESIGNED FOCUS OPTIC

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Background: Fractional lasers are popular methods for the treatment of photoaged skin and fine lines and wrinkles. A non-ablative diffractive optic on a picosecond pulsed alexandrite laser has been proven effective for wrinkle reduction, however the mechanism of action is different than traditional fractional lasers.
Study: Human skin fibroblasts from a 32 year old female (Coriel AG07999) of a low passage were exposed to a picosecond alexandrite laser (0.71J of 755 nm energy at a frequency of 10 Hz to mimic actual clinical use). RNA was isolated at 0.5 hrs or 24 hrs post exposure to examine differences in early and late genetic response to picosecond alexandrite exposure. The RNA was then used in performance of pathway specific microarrays for Extracellular Matrix and Adhesion Molecules, Signal Transduction Pathway Finder and Heat Shock Proteins. The results of 3 experimental replicates were evaluated from the web based software for fold regulation changes between control and exposed cells; as well as statistical significance/p-value determination. The genes on the array(s) were then examined for dysregulation (with or without statistical significance) to determine what areas of the array have the most dysregulation and are most likely to be the processes effected by the laser treatment.
Results: Overall gene expression levels showed no statistically significant genes in any of the arrays at 0.5 hrs post exposure. However, at 24 hrs multiple genes demonstrated statistical and biological significance. Further analysis of functional gene groups indicates gene regulation response involved in extracellular matrix proteases, cell-matrix adhesion, transmembrane molecules, cell-cell adhesion, Small HSPs, HSP70 Family Members, and TGFß Signaling.
Conclusion: Cultured human skin fibroblasts genetic response to picosecond alexandrite laser exposure is in some ways similar to previously reported gene responses to traditional, more thermal, ablative lasers in that they involve HSP70 related proteins and the TGFß signaling pathway. However, there is some additional evidence of dermal matrix remodeling and neutrophil activation. Further genetic expression testing is underway to evaluate which gene expression changes are due to this picosecond, laser delivered by unique diffractive optics.

#23

DOSIMETRY *IN VITRO* AND IN VIVO TISSUE INTERACTION, SAFETY AND EFFICACY OF A RADIOFREQUENCY FRACTIONAL MICROPLASMA DEVICE FOR SCARS AND STRETCH MARKS

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Background: Recently the concept of fractional laser ablation (AFXL) has been introduced to treat a variety of conditions. Microplasma refers to an advanced technology creating ablation and thermal damage zones in human skin comparable to AFXL. This study aims on establishing clinical parameter based on a systematic *in vitro* shoot profile study and to evaluate the safety and efficacy of a fractional microplasma device (AFMP) for scars and stretch marks.
Study: Two pilot studies were conducted: (1) to evaluate safety and efficacy AFMP four tips (Peeling, Atrophic, Traumatic, and Stamp) were used at two standard energy settings in pig skin to evaluate qualitatively and quantitatively the ablation and coagulation pattern and (2) a total of 8 adults with skin types I-II received 4–6 treatments in at 4-week to assess safety and efficacy

while treating stretch marks and scars. Pain levels were recorded using a 10 point VAS scale.
Results: The new AFMP showed a fractional ablation pattern similar to AFXL CO_2-Laser when high energy settings were applied using the Atrophic tip. Using the stamp tip at low energy settings the coagulation pattern was superior to the ablated proportion of the skin. The evaluation of safety and efficacy of AFMP in clinical used revealed a higher efficacy with higher energy applied. However, with an increased power there was a higher rating of pain (up to 5.5–6.9) associated. Stretch marks were categorized as having less erythema, inflammation, and a reduced size. Overall, the tissue of stretch marks had been remodeled towards a more intact skin although still visible to some extent. In scars there was a responding similar to that was is known from AFXL.
Conclusion: Two pilot trials evaluated the new AFMP and determined first parameter settings which were safe and effective in clinical use to treat scars and stretch marks. Further studies are required to define the AFMP capabilities in relation to other fractional ablative technologies.

#24

FEMTOSECOND LASER INDUCED BREAKDOWN SPECTROSCOPY FOR TISSUE CHARACTERIZATION: A PRELIMINARY STUDY

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Background: There is growing interest in ultra-short pulsed laser surgery combined with a feedback control mechanism for high-precision surgery with minimal impact to surrounding tissues. Compared to nanosecond lasers, ultra-short pulsed lasers do not deposit as much heat in the sample and therefore do not cause adverse thermal effects such as fractures. For implementation in the clinic, a real-time feedback control system will ensure that the laser is incident on the targeted tissue and does not cause collateral damage. Our aim is to demonstrate the usability of femtosecond lasers for Laser Induced Breakdown Spectroscopy (fsLIBS) for tissue discriminations without carbonization. Laser parameters such as energy, number of pulses per focal volume, and repetition rate will be investigated.
Study: We are using femtosecond lasers at variable repetition rates and pulse energies below 150 microjoules. The laser light is focused onto bone and soft tissue using a 4x and 10x air objective. A dichroic filter passes the emitted plasma signal out of the microscope and towards a multimode fiber connected to a Princeton spectrometer and CCD camera.
Results: We observed carbonization at high repetition rates and a linear increase in the LIBS intensity as a function of the laser energy. As expected, the fsLIBS intensity changes with the focal spot size of the laser. A ratio algorithm that compares two or more unique spectral peaks should be used for tissue identification. We also demonstrate that fsLIBS can distinguish between different biological tissue samples such as bone and muscle. In addition, fsLIBS is able to discriminate between normal and cancerous bone and may provide insights into the metabolic pathways of tumor formation.
Conclusion: fsLIBS spectra of bone and soft tissue show distinct features that allow for the tissue to be successfully distinguished from one another.

#25

DETERMINATION OF HSP47 REGULATORY SWITCH MECHANISM BASED ON TISSUE RESPONSE TO SHORT PULSE LASER IRRADIATION

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Background: Short pulse laser technologies decrease the spatiotemporal range of non-target tissue damage. However, changes to cell and nuclear membrane potential and permeability following short pulse laser irradiation may cause cytosolic proteins to leak into the extracellular matrix (ECM) producing connective tissue damage. Possible long term heat shock protein (HSP) over-expression resulting from surface or subcutaneous laser ablative procedures has not been investigated. The goal of this study was to ascertain the mechanism for the HSP47 expression regulatory switch.
Study: Human epithelial and fibrotic tissues grown in culture along with Jax® Mice strains with systemic autoimmunity and healthy immune systems were exposed to directed patterns of Nd: YAG laser irradiation with varying exposure interval and duration. Immunohistological and morphological analysis of stained and fluorescently labeled tissue samples utilized phase contrast, Zeiss Axiovert and scanning electroscope microscopy. Tissue mechanical properties were analyzed with an Instron ElectroPuls. SDS-PAGE and mass spectrometry were used to isolate and measure HSP47 and reactive oxygen species concentrations.
Results: Over-expression of HSP47 was not always detectable in the population of cells exposed to an initial stressor but persisted through several cell passages removed from the damaged population. A lag time in HSP47 expression correlated to intensity and duration of thermal stress. The HSP47/heat shock response 1 (HSR1) feedback mechanism appeared to be susceptible to change over time in tissue subjected to multiple and/or excessive stress events.
Conclusion: The level of thermal, mechanical, or cytotoxic stress necessary to initiate and sustain HSP47 production appeared to decay with increased stressor incidence and intensity. Experimental results comparing fibrotic and normal tissue responses to laser irradiation will be combined and correlated to inform a computational model of HSP47 spatiotemporal expression to be used to isolate potential key molecules in the HSP47 expression regulatory switch.

#26

HANDHELD LASER SPECKLE IMAGING SYSTEM FOR NEONATAL BLOOD FLOW IMAGING

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Background: Although abnormal blood flow is linked to clinical risk of neonates, clinicians do not integrate flow measurements into routine monitoring in the neonatal intensive care unit (NICU). We and other groups previously demonstrated the ability of Laser Speckle Imaging (LSI) to image changes in blood flow in both a laboratory and clinical setting. We postulate that LSI, in a clinic-friendly form factor, can provide important hemodynamic information in the NICU. Here, we describe our efforts to develop a handheld LSI system and deploy it to University of California, Irvine Medical Center NICU.

Study: We assessed the system performance of a handheld LSI versus a traditional mounted configuration. We collected multi-user data (n = 7) to assess the variation in flow measurements attributed to user performance. We collected data from in-vivo occlusion models to demonstrate that the handheld device can detect both qualitative and quantitative changes in blood flow. Finally, we collected data from a clinical study (n = 26) in which we collected LSI images of the abdomen and the heel over a period of months.
Results: We demonstrate that the handheld device has little effect on sensitivity by characterizing tissue simulating phantoms with both a mounted and handheld configuration. We show that characterization of these phantoms is not user dependent. We demonstrated that the handheld LSI system measures flow dynamics similar to those reported previously. Significant increases in flow measured at the abdomen during feeding and significant decreases in flow measured in neonates diagnosed with necrotizing enterocolitis suggest that LSI may be capable of detecting blood flow changes in the gut for neonates.
Conclusion: The handheld LSI system can measure changes in blood flow and is minimally sensitive to errors due to handheld motion. Flow changes found in the abdomen warrant further studies to investigate the feasibility of using LSI to detect compromised gut blood flow.

#27

DESIGN AND *IN VITRO* EVALUATION OF ENDOSCOPE-BASED DEVICE FOR FLOW IMAGING

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Background: To treat serious gastrointestinal disorders such as esophageal cancer, surgeons typically perform an esophagectomy, in which part, or all, of the affected tissue is surgically removed. They then reform the upper gastrointestinal tract by attaching the shortened esophagus and stretched stomach at an anastomosis. If the anastomotic site has an inadequate blood supply, it will not heal at a normal rate and may fail to maintain a watertight seal, leading to life-threatening complications. Blood perfusion remains difficult to assess with routine, post-operative examination, since conventional white-light endoscopy does not provide clear hemodynamic information. To address the need for a method to assess non-invasively blood perfusion at the anastomotic site, we propose the use of endoscopic Laser Speckle Imaging (ELSI). As an initial step, we assessed the *in vitro* performance of ELSI using tissue-simulating phantom systems.
Study: Our design objective was to develop ELSI to interface with a traditional endoscope without altering its original capabilities or performance. To this end, we integrated a clinical Olympus fiber endoscope with a 633 nm HeNe Laser and a monochrome Pt.-Grey CCD camera. We collected raw speckle images and processed them using a simplified speckle-imaging algorithm to calculate Speckle Flow Index (SFI) values. We used flow phantoms infused with Intralipid at physiologically-relevant flow speeds and assessed the depth-of-field and dependence of SFI values on working distance.
Results: The ELSI system is capable of detecting flow rates from 0.0–10.0 mm/s with a sensitivity to changes in flow at least as small as 0.5 mm/s. The system's ability to calculate SFI is unaffected by imaging distance up to 0.8 cm, after which a linear decline in SFI with respect to distance is observed.
Conclusion: Based on our *in vitro* data, we conclude that ELSI provides measurements of SFI that are sensitive to flow speeds and working distances relevant to physiological conditions associated with esophagectomies.

#28

THE ROLE OF LASER SPECKLE IMAGING IN EMERGENCY AND TRAUMA MEDICINE

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Background: Laser speckle imaging (LSI) involves capture of a speckle pattern created by coherent light reflected from an object. We and other groups use image processing algorithms to analyze these patterns to extract information related to unique spatio-temporal statistics. When LSI is used to evaluate blood, it provides a measure of critical hemodynamics using a metric known as Speckle Flow Index (SFI). Blood hemodynamics play a critical role in many medical applications. Here, we demonstrate the utility of LSI within the fields of emergency and trauma medicine. Specifically we examine the ability of LSI to quantify the degree of exsanguination during a simulated hemorrhage episode, and while not discussed in this abstract have also been researching LSI's ability to quantify burn severity.
Study: With LSI, we monitored simulated hemorrhages in 10 rabbits. A total of 40cc of blood is removed over eight separate blood draws spanning a time period of 40 minutes. SFI values were compared to mean heart rate (HR), mean systolic blood pressure (SBP), mean diastolic blood pressure (DBP), and oxygen saturation (SPO2).
Results: SFI correlated directly with blood loss. Each blood draw was followed by a subsequent decrease in SFI seen in the rabbit. Changes in SPO2 were minimal, but blood loss and SFI showed a direct correlation to SBP and DBP which all showed an inverse relationship to HR.
Conclusion: LSI exsanguination monitoring offers medical professionals an additional component to vital signs monitoring and it can do so noninvasively.

#29

PORTABLE LASER SPECKLE IMAGING DEVICE FOR THE ASSESSMENT OF PERIPHERAL MICROCIRCULATION

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Background: Laser speckle imaging (LSI) and Doppler Perfusion Imaging (DPI) are technologies that have demonstrated significant potential as tools for medical diagnostics and monitoring. The ability to quantify hemodynamics provides critical information toward improved depth of anesthesia monitoring, peripheral vascular disease diagnosis, early hypovolemic shock detection, sleep apnea detection, and monitoring of diabetes progression. However, current embodiments of LSI and DPI are cumbersome and require trained personnel for use, making them impractical for common widespread application.
Study: Designed to mimic the simplicity of pulse oximeter use, we have designed a compact device that is equally simple to operate and measures microvascular blood flow in the periphery - The FlowMet. The FlowMet is comprised of a compact laser diode and

photodetector that clips onto the finger or toe. This novel implementation of transmission LSI does not require trained personnel for use, minimizes motion artifact due to fixation to the finger or toe, and allows for real-time, accurate blood flow measurement through the entire volume of the digit.
Results: Bench top testing on flow phantoms has demonstrated the FlowMet's superiority in accurately quantifying flow as compared to other widely used technologies such as photoplethysmography and laser Doppler. Ongoing animal and human studies include measuring changes in peripheral blood flow due to ramped exercise, hypovolemic shock, cyanide poisoning, and peripheral vascular disease. Thus far all studies have yielded data that strongly correlate to potential diagnostic markers.
Conclusion: Preliminary research has established proof of concept data demonstrating FlowMet's ability to implement LSI in this novel transmission model within a pulse oximeter form factor. The FlowMet is a device that has the potential to serve as an inexpensive and noninvasive medical tool with widespread utility within medical diagnostics and monitoring.

BIOLOGICAL IMAGING

#30

OPTICAL YIELD POINT DETERMINED BY DYNAMIC SPATIAL FREQUENCY DOMAIN IMAGING

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Background: We show a proof of concept, with the application of a dynamic variation of spatial frequency domain imaging during a laser tissue interactions process. We postulate that there exist a series of hyperbolae and ellipsoidal families of structural light illumination offering optimal amplification during the detection of tissue elastic optical region named the Optical Yield Point (OYP).
Study: The intersected plane between the conical camera view the coherent Gaussian laser beam trajectory results in elliptical domain. The computer algorithm follows changes in the target diffuse reflection properties from laser irradiation. The laboratory prototype uses two CCD cameras with RGB channels. The target are tissue phantoms formulated from DMS (Silicon-Inc.) and pigmented with a botanical extract (Zamora Farm, Puerto Rico). The source is a 469 nm 1 watt laser diode. Using a LCD projector (EPSON EMP-53) produced the hyperbolic patterns modulated in spatial frequency and dynamic displacement. Images capture is scheduled during laser pulse relaxation period. Intensity matrices were evaluated by a differential calculus technique tested the elastic changes of diffuse reflectance.
Results: From computer image processing compared dynamic changes of diffused reflectance due to the structured illumination. Evaluated in elliptical coordinates, asymptotes were modulated from .5 Pi to .85 Pi and mayor axis from 0 to 2 times the focal point length. Dynamic changes were synchronized to imaging frame captured. 90% of combination parameters show no elastic changes in diffuse reflectance properties. Although impaired by a limited repeatability, 10% of the patterns showed limited elastic changes.
Conclusion: Although the current apparatus showed a limited ability to determine OYP, we suggest that further work with enhanced optics, data capture and image processing algorithm will contribute the tabulated look up table with cross references of series of patters to specific phototherapeutic need.

#32

COMBINING TERAHERTZ PULSED IMAGING IN FREQUENCY DOMAIN AND POLARIZATION OPTICAL IMAGING FOR DELINEATING NONMELANOMA SKIN CANCERS

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Background: Nonmelanoma skin cancer (NMSC) is the most common form of cancer worldwide. More than 3 million new NMSC cases are diagnosed annually. NMSC results in about 3,000 deaths per year and the cost of treatments is estimated to exceed $600 million per year. We investigated combining Terahertz Pulsed Imaging (TPI) with polarization enhanced reflectance optical imaging for the delineating NMSC.
Study: Fresh thick samples of skin tissue with residual cancer were obtained within 40 minutes after surgery. The samples were mounted in a sample holder and imaged using polarization enhanced optical and THz systems without remounting between the imaging procedures. Analysis of the TPI results was performed utilizing normalized power spectrum in the frequency domain. Polarization optical images acquired at 440 nm, terahertz and histological images were then overlaid and compared. Both TPI and polarization optical images were evaluated against histopathology.
Results: Our results show that the frequency powers of diseased and normal tissues differ significantly at 0.47 THz. While TPI has demonstrated contrast between diseased and normal tissue, it can also highlight normal structures in some samples. TPI alone lacks the resolution necessary to distinguish between tissue types morphologically. TPI may be used to highlight potential tumor sites, which can then be examined with higher resolution in the optical regime.
Conclusion: Combined THz and optical imaging has the potential for quick intraoperative delineation of cancers.

#33

MEASURING COOLING IN SOFT TISSUES USING MAGNETIC RESONANCE THERMOGRAPHY

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Background: Cold-assisted therapies such as selective cryolipolysis or other novel cooling therapeutic devices are being used more commonly but the underlying physics of tissue response to cooling is not understood adequately.
Study: In this research we are using Magnetic Resonance (MR) imaging to perform the MR Thermometry (MRT). MRT can provide precise three dimensional mapping of the temperature inside the skin during the cooling procedure. Depending on the sensitivity, dependence of the magnetic field strength and tissue type, various MRT techniques use different parameters such as relaxation time T1, diffusion constant, proton spectroscopic imaging and proton resonance frequency to measure temperature. Initially, we tested the Proton Resonance Frequency Shift (PRFS)

technique on agar gel and fat phantoms while they were being cooled in the MRI scanner. We then performed MRT measurements using skin tissue samples being cooled with an icepack.
Results: Anatomic data sets are acquired to capture the structural image of the skin tissue, and then three different MR sequences are used to acquire temperature-sensitive data sets. MR temperature distributions are derived from changes in phase differences of phase images acquired from proton-resonance frequency shift methods during cooling procedure. To measure the absolute temperature variations, MR spectroscopy data was acquired and the shift in the fat and water spectrum during the cooling process was measured. Then temperature changes were derived from relative shifts between water and fat signals during cooling.
Conclusion: MRT using PRF method can provide precise 3D temperature map of skin tissue during cooling process; however, attention is required in in vivo measurements of the skin cooling to correct for the motion artifacts. This technique is efficient for relative temperature measurement. However, in fatty tissues, the influence of heat-induced susceptibility changes may not be neglected for absolute MR thermometry measurements.

#34

REAL-TIME MONITORING OF THERMAL DAMAGE IN *EX VIVO* TISSUES USING DIFFUSE REFLECTANCE SPECTROSCOPY

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Background: Real-time monitoring of tissue status during thermal ablation of tumors is critical to ensure complete destruction of tumor mass while avoiding tissue charring and excessive damage to normal tissue. Currently, MRI-based techniques are commonly used for monitoring the thermal ablation process in soft tissues. Although, MR-thermometry can provide tissue damage information at the treatment site in 3D using Arrhenius damage integral, it is expensive, bulky and often subject to motion artefacts. Optical monitoring of thermal ablation could potentially be a portable and cost-effective solution for monitoring tissue damage. Tissue heating alters the tissue optical properties due to protein denaturation. Many studies have reported differences in optical properties, in the visible and near infrared range, between native and coagulated tissues. However, efforts to quantify the real-time changes in tissue optical properties upon heating have been limited.
Study: A needle-based fiber-optic probe based on diffuse reflectance spectroscopy (DRS) in the visible range (VIS-DRS) has been used to quantify the optical properties between 430–630 nm of *ex vivo* tissues in real-time. The optical properties of the tissue are estimated from the measured DRS spectrum using an inverse Monte-Carlo model.
Results: Results obtained from porcine muscle, porcine liver and beef muscle tissues have showed significant changes in the tissue optical properties in the range of 50–63°C. Also, the effects due to tissue charring on the optical properties were observed at higher temperatures.
Conclusion: The changes in tissue optical properties due to tissue heating have been quantified in real-time. The data suggests that optical monitoring of ablation could potentially be used to assess tissue damage in real-time.

#35

OPTICAL CHARACTERIZATION OF TUMOR HETEROGENEITY IN SOFT TISSUE SARCOMAS

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Background: Soft tissue sarcomas (STS) are a heterogeneous group of malignant mesenchymal tumors managed by surgical resection. The surgical margin is the greatest predictor of local recurrence and outcome, and its assessment is limited by time and spatial sampling restrictions of surgical pathology. Previous studies have suggested the potential of near-infrared Raman and autofluorescence spectroscopy for rapid intraoperative tumor characterization and differentiation from normal tissue. A thorough understanding of STS variability and their optical properties is necessary to confirm the utilization of optical imaging in intraoperative assessment and guidance.
Study: We present a portable near-infrared probe-based Raman and autofluorescence spectroscopy study of 25 patients with soft tissue sarcomas undergoing surgical excision at Vanderbilt University Medical Center. Raman and fluorescence measurements were made of sarcoma, margin, and normal tissues within the resection cavity. Margin assessment and tumor diagnosis was performed by pathologists after data collection as a part of routine standard of care. Intra-operative and post-operative pathological data were collected for correlation of optical data.
Results: We report an analysis of the spectral variability of soft tissue sarcoma subtypes and their normal mesenchymal counterpart tissues. Fluorescence intensity differences display the ability to reflect neoplastic change of mesenchymal tissues. In addition, Raman spectroscopy shows the ability to detect malignancy and differentiate between histologically disparate STS subtypes.
Conclusion: Establishing the ability of optical imaging to account for the inherent STS variability and characterization of STS subtypes is a critical primary step for further studies that will evaluate the application of near-infrared Raman and auto-fluorescence spectroscopy in intraoperative tumor detection and surgical guidance in soft tissue sarcoma resections.

#36

REAL-TIME CLINICAL PERFUSION MEASUREMENTS USING LASER SPECKLE IMAGING OF PORT-WINE STAIN BIRTHMARKS DURING PHOTODYNAMIC THERAPY

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Background: Port-wine stain (PWS) birthmarks affect approximately ~400,000 individuals annually and are characterized by potentially deleterious psychosocial and physical complications. The current standard of care treatment, photocoagulation using lasers, achieves unacceptable PWS lightening in >85% of subjects even after multiple treatments. We and other research groups have studied PDT as a promising alternative or supplement to laser phototherapy of PWS. However, proper light dosimetry during PDT remains a significant hurdle to enable maximally efficacious but safe treatment.

Study: To address this shortcoming, we developed a real-time perfusion measurement system for use during PDT treatment of PWS. This system utilizes laser speckle imaging to provide wide-field quantitative maps of cutaneous blood flow immediately before, during, and immediately after PDT (0.75–1.00 mg/kg dosage of Talaporfin Sodium and light dosage of 50 J/cm^2 at 664 nm). Using this system, we quantified cutaneous blood flow changes within PWS birthmarks before, during, and after PDT, and related these dynamics to treatment efficacy in a pilot study of seven patients. We performed colorimetric assessment to quantify treatment efficacy 12 weeks post-treatment by computing the change in the color difference between each treatment spot and non-PWS birthmark skin in the L*a*b colorspace (?E).
Results: We found moderate correlations between the maximum change and the standard deviation of the changes in PWS perfusion during PDT (R2 = 0.68 and 0.69, respectively).
Conclusion: By focusing on specific changes in the dynamics or magnitude of perfusion in PWS using our system, the clinicians' ability to quantitatively determine when treatment should cease and maximize treatment efficacy and safety, is enhanced. This reduces the risk of under- or over-treating PWS, improving the outcome of PWS phototherapy on an individualized basis.

#37

REAL TIME CONFOCAL MICROSCOPY OF LENTIGO MALIGNA TO GUIDE SURGICAL MARGINS USING A HANDHELD CONFOCAL MICROSCOPE

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Background: Lentigo maligna (LM) and LM melanoma (LMM) represent a diagnostic and therapeutic challenge due to the heterogeneous nature with poorly defined borders, subclinical extension, and location on a background of sun-damaged skin. The advent of newer technologies, including a handlheld reflectance confocal microscopy (RCM), has advanced our ability to better diagnose and manage these challenging lesions via noninvasive examination of the epidermis and papillary dermis on a cellular level. Herein we report the use of a handheld confocal device to rapidly image LM to better define surgical resection margins.
Study: Under IRB approval, imaging of facial LM was performed using the Vivascope 3000 (Caliber ID). Imaging was done in a radial clockwise fashion imaging the clinical lesion first and then standard 5 mm to 1 cm margins. Areas of suspicion were subsequently biopsied to determine positivity and therefore determine subclinical extent before commencing with staged excisions.
Results: 20 cases of LM were imaged. We found that the handheld Vivascope was a rapid and efficient method to scan large surface areas of LM and surgical margins to better determine subclinical extension. Utilizing this technology we were able to customize margin control in a circumferential manner to better map and tailor margins.
Conclusion: The diagnosis of facial LM can be challenging, even with the aid of dermoscopy and Wood's Lamp. As LMM is often a large lesion occurring on cosmetically-sensitive areas, taking random, blind scouting biopsies and performing wide local excisions can be disfiguring. The cellular-level resolution afforded by RCM allows for non-invasive examination of the skin for distinct cytomorphological and architectural features that are unique to LMM, including: epidermal disarray, atypical melanocytes with pagetoid spread, and aggregates of atypical melanocytes surrounding adnexal structures. This technology offers the advantage of assessing large areas of skin in a non-traumatic manner, improving diagnostic accuracy of difficult melanocytic lesions.

#38

FRONTIERS OF OPTICAL IMAGING FOR DERMATOLOGY

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Background: Recently a large number of optical diagnostic products have emerged on the market to assist dermatologists in their clinical decision-making. The possibilities and pitfalls of these various technologies stem from the fundamentally different base physical principles. At present there is limited opportunity for clinicians to overview these techniques. This discussion will provide a broad overview of both the physics principles and present state of clinical art for the seven major non-invasive optical techniques available today.
Study: Comparisons of advantages, limitations, and future potential as well as recent clinical and preclinical research results are reviewed, based on pubmed search and personal correspondence with pioneering researchers in each of these areas.
Results: Optical diagnostic technologies can generally be cateogrized into dermoscopy, multispectral imaging, confocal microscopy, optical coherence tomography, Raman spectroscopy, photoacoustic imaging, and nonlinear optical imaging. All of these techniques except photoacoustic have representative products on the market.
Conclusion: Whereas dermoscopy and as a distant second confocal microscopy have the largest base of clinical experience, unique physical mechanisms of other available non-invasive optical diagnostic techniques have potential to equip dermatologists with unparalleled insights and disease understanding in the future.

CLINICAL GUIDELINES AND BEST PRACTICES

#39

USE OF THE Ho:YAG LASER IN STAGE 1 AND 2 OROPHARYNGEAL SQUAMOUS CELL CANCER

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Background: Laser excision of early stage Head and Neck squamous cell cancers is relatively commonplace. The workhorse laser is the carbon dioxide laser. In the oropharynx, this laser often has insufficient lateral heat spread to stop bleeding. The Ho:YAG laser has more lateral heat spread and allows bloodless surgery with microscopic inspection of the tumor capsule and possible residual disease.
Study: Prospectively 27 patients over a 15 year period with T1, T2, N0, N1 or N2a disease were treated with a combination of microscope controlled Ho:YAG laser excision of the primary, which

was always in the oropharynx, mainly the tonsil (23/27), and modified radical neck dissection.
Results: Margins were always close, often <1 mm. Long term local control without the need for adjuvant therapy was achieved in 19/23 tonsil cases, 2/2 anterior faucial pillar and 0/2 tongue base.
Conclusion: Close margin excision using magnification in a bloodless operative field gives equivalent results to chemoradiotherapy, without long term side effects.

#40

MRI-GUIDED FOCAL LASER ABLATION FOR LOCALIZED PROSTATE CANCER: EXPERIENCE WITH 14 TREATED TUMORS

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Background: To report the technique and outcome results of a minimally-invasive focal therapy using laser ablation under MRI guidance to treat localized prostate cancer while preserving the rest of the gland.
Study: 14 foci of localized prostate cancer in 11 patients (age = 51.8–73.8y, mean = 61.8) were treated with MRI-guided focal laser ablation. Procedures were performed within a 3T-MRI suite. A transrectal MR-compatible needle guide was inserted and imaged with a fast sagittal T2-weighted sequence. A midline image was used to calibrate the needle guide position to a localization software (DynaLOC, Invivo, FL, USA). A 1.0-cm(n = 4) or 1.5-cm (n = 9) active-tip diode laser fiber (Visualase, TX, USA) was introduced within an internally cooled catheter.. A test laser dose of 5 watts was applied for 20s. Definitive ablation was then conducted utilizing 12(n = 2), 15(n = 1), 21(n = 9), or 24(n = 2) watts. Simultaneous temperature maps and cumulative damage maps were obtained, co-registered and overlaid on anatomical images.
Results: All targeted tumors were treatment-naïve Gleason 3 + 3 = 6(n = 10), 3 + 4 = 7(n = 3), or 4 + 3 = 7(n = 1) prostate adenocarcinomas. Target tumor sizes were 1.0–2.8 cm (mean = 1.7 cm). The applied laser energy was 2856–8820J (mean = 4431J) per treated tumor, with dosage calibrated based on real time feedback of tumor response to ablation. Treatments required 1–4 ablation cycles/laser fiber positionings. Patients tolerated the procedures well and were discharged 4–6 hours after procedure. No immediate or delayed complications were encountered. Follow-up durations ranged between 0–31 months (mean = 8.5 months). One of the 14 tumors had a 10 mm focal recurrence at the edge of the ablation zone at his 24-month follow-up time point and was successfully re-treated was another cycle of laser ablation. No recurrence was noted in the remaining 13 lesions.
Conclusion: This report describes a technique for MRI-guided and monitored focal laser ablation for minimally-invasive targeting of localized prostate cancer. The technique is feasible and well tolerated as an outpatient procedure. This small series indicates a promising efficacy for up to 24-month recurrence-free follow-up durations.

#41

MRI-GUIDED LASER ABLATION FOR MALIGNANT RENAL NEOPLASMS: RESULTS OF 23 TREATED TUMORS

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Background: The aims of this investigation are to a) describe the technical aspects of using laser fibers to deliver ablative energy to renal tumors; b) describe patient tolerance and complication rates; and c) report the long term efficacy of laser ablation of renal malignancies.
Study: 13 patients (6M, 7F, age = 28–83y) with 27 renal masses underwent MRI-guided biopsies followed by laser ablations in the same session. Procedures were performed within an interventional MRI suite equipped with 1.5T-wide bore scanner. A laser fiber with 15 mm diffusing tip encased in 5.5 F cooling catheter (Visualase, Texas, USA) was introduced into the target lesion. A test dose of diode laser energy (980 nm,30 sec,9W) was applied to verify the location of ablation nidus.. Subsequently, ablative energy was delivered (27W for cycles of 90–271 sec) with treatment endpoint based on on-line thermal monitoring of growing ablation.
Results: 3 biopsies revealed benign masses. One lesion was not biopsied. This analysis therefore includes 23 renal tumors. Biopsies showed 22 RCCs and one lung cancer metastasis. Target tumor sizes were 0.7–3.8 cm. The short ablation cycle facilitated accurate temperature mapping during controlled suspended ventilation. Applied laser energy was 4050- 79380J per lesion, with dosage calibrated based on real time feedback of tumor response to ablation. One patient had a moderate hematoma related to the biopsy part of the procedure. Otherwise, no early or delayed complications were encountered. Follow-up durations ranged between 1.6–32.7 months (mean = 12.5 months). No residual or recurrent neoplasm was identified in any patient.
Conclusion: This investigation reports the improved access for interactive guidance and real time monitoring of renal ablation procedures performed entirely within an interventional MRI suite. The procedure is well tolerated with a high safety profile. Long-term follow up results for up to >32 months also point to an efficacious ablative technique with no residual or recurrent neoplasms in our series.

#42

A STUDY EXAMINING THE TREATMENT OF SOLAR LENTIGINES WITH THE REVLITE SI Q-SWITCHED Nd:YAG LASER SYSTEM

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Background: Facial solar lentigines (age spots) are melanin rich patches on the skin's surface that are visibly darker than the surrounding areas. Though they are a relatively harmless response to UV exposure and photoaging, their appearances remain a cosmetic concern. This study investigates the effects of combination Nd:YAG laser therapy (RevLite® Laser System) to improve the appearance of moderate-severe facial solar lentigines. Because of melanin fragmentation at the source of production (1,064 nm) and superficial distribution (532 nm), it was hypothesized that marked increase in improvement via the GAIS would be attained with combination treatment.
Study: In a split-faced comparison involving 10 subjects, half of the face received 1,064 nm monotreatment and the other half received 1,064 nm and 532 nm combination treatment. Subjects who were randomly assigned an even identification number received combination treatment on the right side of the face consistently, while odd number subjects received consistent dual wavelength treatment on the left side. Participants received up to 6 treatments, 2–3 weeks apart depending on the individual's response to treatment via investigator assessment. The side of the

patient's face that did not receive dual wavelength treatment during the study was then treated one month after their last treatment visit. The efficacy and safety of this treatment was evaluated with an investigator's blind assessment of progress photographs on the Global Aesthetic Improvement Scale (GAIS), the subject's overall satisfaction rating and adverse event monitoring. Changes in pore size, skin texture, and fine lines were also evaluated.

Results: In a blinded clinical assessment of progress photographs, it was found that dual wavelength treatment improved the appearance of solar lentigines markedly more than those with monotreatment. In addition to having a higher patient satisfaction rating, there was also a greater reduction of pore size, improvement of skin quality and reduction of fine lines associated with dual wavelength treatment of facial solar lentigines.

Conclusion: Our findings suggest that dual wavelength treatment with the RevLite® SI Q-Switched Nd:YAG Laser System is a more effective technique to treat facial solar lentigines. This device not only demonstrated good efficacy, but also proved to be a relatively safe treatment modality for individuals looking to improve their overall facial aesthetic appearance. Minimal downtime and discomfort was reported to be associated with treatment. This research therefore implicates that there are additional treatment benefits when melanin is fragmented not only at is source of production, within the stratum basale (1,064 nm), but also with the simultaneous targeting of melanin that has been distributed upwards towards the stratum corneum (532 nm) upon UV exposure.

#43

OTC LED MASK FOR THE TREATMENT OF PHOTOAGING - A VIABLE OPTION

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Background: Home based phototherapy has evolved over the last several years and, in certain circumstances, approaches efficacy levels previously seen only in the office based setting. An innovative, low power, daily use, led based, wearable mask was evaluated and shown to demonstrate significant efficacy in the reduction of photo-aging.

Study: A single center IRB approved clinical trial was performed over a 10 week period, evaluating the efficacy and safety of a home based LED mask in 50 patients for the treatment of photo-aging. After a 2 week washout period, a lightweight wearable 'Smart' mask containing multiple strips of Red (660 nm) and Near Infrared (830 nm) LEDs was worn for 15 continuous minutes per day for a total of 8 weeks. 30 patients wore an active 'treatment' mask, and 20 patients wore an inactive 'sham' mask, blinding the grading physician and all patients for the study duration. The clinical physician investigator analyzed numerous facial aging parameters and utilized standardized clinical photography. Patient self-assessment was also performed, noting efficacy, satisfaction, and adverse events over numerous facial variables.

Results: Statistically significant improvements ($p < .01$) were noted in 82.4% of clinical attributes at week 4 and 94.1% of the attributes at week 8 for the active 'treatment' mask. The inactive 'sham' mask showed improvements in 23.5% of attributes at week 4 and 8. in addition, the between treatment group comparison, for those patients that improved over baseline, improvement was statistically significant for 29% of patients at week 4, and 59% at week 8, including such wrinkle attributes as Crows Feet and Under Eye wrinkles. Patient self-assessment was strongly and statistically significantly ($p < .01$) positive as well, with 93.3% of attributes at week 4 and 100% of attributes at week 8, showing patient graded improvements in the active mask. The inactive mask showed improvements in 33.3% of attributes at week 4, and 40% of attributes at week 8. Patient compliance and satisfaction were favorable and there were no significant adverse events reported by the patients or the physicians.

Conclusion: Low lever laser therapy utilizing LEDs as the light source have been shown to be efficacious in the treatment of a number of dermatologic and aesthetic conditions, ranging from acne to photo-aging to cancer. The phototherapy mask implemented in this study utilized an innovative design, containing a 'smart' wearable, hyper-efficient array, positioned to maximize irradiance over the most desirable treatment zones. In addition, by utilizing a home-based device, and choosing appropriate treatment parameters for a daily 15 minute per day regimen, efficacy was potentially able to approach that of an office based once per week, or even a one-time dose treatment. In conclusion, LEDs are non-thermal, nontoxic, noninvasive, and safe and have been proven to be an ideal light source for photorejuvenation. Our study showed statistically significant clinical improvement, high patient satisfaction and a strong safety profile. We conclude that home based LED phototherapy should be considered an effective and cost appropriate option in the modern treatment of photoaging.

#44

LASER THERAPY FOR CORRECTION OF LASER AND IPL INDUCED CUTANEOUS SCARRING AND PIGMENTATION CHANGES

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Background: All modalities used for light based therapy have potential to induce undesired adverse effects. Lasers and IPL devices can produce persistent erythema, scarring, textural, and pigmentary changes. It is almost counterintuitive to attempt to use lasers to treat injuries which have resulted from lasers and IPL. However, we present the use of combination Laser Therapy for the treatment of laser and IPL induced side effects.

Study: A total of 22 patients presented post-laser or IPL with sustained cutaneous adverse effects. Seven of the patients experienced adverse effects secondary to therapy for tattoo removal, 7 as a result of photorejuvenation, 3 related to hair removal, 2 due to port wine stain therapy, 2 related to treatments for acne scarring and 1 due to poikiloderma treatment. The laser systems used included ablative, Q-Switch Ruby and YAG, argon, copper-vapor, non-ablative fractional, dye and long pulsed infrared lasers. In additional, various IPL systems were used. Patients presented post-therapy with either singular or combination changes of hypopigmentation (59%), scarring and texture changes (50%), hyperpigmentation (27%), persistant erythema (18%) and tattoo photooxidative darkening (5%). The adverse effects were generally treated only after the adverse changes appeared persistent. Several different laser systems were used for the treatment of the adverse effects. Therapeutic outcome was evaluated by blinded observers of before and after photographs.

Results: Depending on the presenting adverse effects either the pulsed dye, Q-Switch YAG or long pulsed YAG were used sequentially or in combination. The best results were achieved by initially treating any persistent erythema with the pulsed dye laser which also helped with scarring. The Q-Switch YAG was used to treat any residual tattoo pigment or hyperpigmentation. Followed by the long pulsed YAG either alone or with the Q-Switch YAG in combination for residual scarring and hypopigmantion. Level of improvement in Erythema reduction was graded to be 80%, scarring 86.5%, hyperpigmentation 92% and hypopigmentation at 56%. Aside from immediate laser tissue changes, there were no persistent side effects induced by the laser therapy utilized for improvement of the laser and IPL induced complications.
Conclusion: Laser and IPL induced adverse effects can be effectively treated using lasers. Lasers can still be used safely and successfully in this patient population and should be considered a primary standard of care for the correction of laser and IPL adverse effects.

#45

CLINICAL STUDY ON REAL-TIME SKIN THERMOGRAPHY USED AS A THERMAL MONITOR DURING AESTHETIC LASER THERAPY BY INFRARED CAMERA

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Background: Till now, many kinds of laser therapy have been carried out to threat skin disorders. But the detailed skin thermal condition monitor had less been reported. In this study, we applied real-time skin thermography to investigate the epidermal temperature raising course under many kinds of laser treatment.
Study: More than 1200 Chinese cases were enrolled in this study. A portable infrared thermal camera was used to make skin thermography to each case, during laser treatment. The infrared thermal camera was recorded before lasering, immediately lasering and 10 minutes post lasering. The picture and video was stored by computer. Several groups were classified as different laser therapies. There are Q-S laser group, PDL group, Long pulsed infrared laser group, Photodynamic therapy group and Ablative laser group, Fractional ablative laser group and Non-ablative fractional laser group or Surgical laser group. In each group, more than 130 cases were recorded to calculate the average value of skin temperature raising and make thermal curve.
Results: In each laser group, the thermal curve was made. We have got each laser treatment's skin thermography data and thermal curve. The thermal curves were diverted and depend on the laser therapy method which was used. Combined with clinical observation of skin responses, we analyze clinically the thermal and non-thermal laser therapies according to the thermal curve.
Conclusion: Real-time skin thermography can be used as the thermal monitor during laser therapy. It is important to investigate possible potential risk of laser thermal damage.

CUTANEOUS LASER SURGERY

#46

EARLY INTERVENTION OF FRACTIONAL ABLATIVE LASER FOLLOWED BY 830 nm LED PHOTOTHERAPY vs CONTROL FOR ACUTE BURN INJURIES

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Background: Burn and traumatic hypertrophic scars develop during the proliferation phase of wound healing between 3–7 months after injury. We investigated whether early intervention with fractional ablative laser treatment could improve short and long-term healing leading to improved function and cosmesis of skin while producing negligible local trauma. In addition, LLLT therapy, found to have beneficial effects on injured tissue and to modulate inflammatory responses, was investigated to determine if combination with fractional laser treatment or either alone improves wound healing and decreases hypertrophic scar formation versus untreated areas.
Study: 20 patients ages of 21–55 y.o. with moderate-severe acute burn injury within past 1–3 months of burn injury over at least 5% body surface area. Four similar scar areas were divided into 5 cm x 5 cm by a pre-made grid. Four treatment areas included: 120 micron spot fractional ablative laser & LED treatment site, LED only treatment site, Control – no treatment and 120 micron spot fractional ablative CO_2 laser treatment only site. Laser and LED parameters were kept constant.
Results: Treatments and side effects were well tolerated by all subjects demonstrating good healing capacity considering the trauma to the region. Clinicians blinded graded treatment and control areas using standard scar scales. All treated areas improved versus control scar areas. Combined fractional ablative CO_2 and LED appeared to have the most rapid healing trend.
Conclusion: The observation that a course of fractionated CO_2 and LED laser therapy may facilitate wound healing has obvious important implications for the treatment of the acute traumatically injured patients with laser and light therapy.

#47

SYNERGIC USE OF PDL 595 AND CO_2 FRACTIONAL LASER TREATMENT FOR KELOIDS

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Background: To check the synergetic activity of the CO_2 Fractional Laser and Dye 595 Laser together in the same session for a condition of very difficult approach such as keloid scars.
Study: A total of 100 patients were treated with both longitude waves in the same session for a total of 3 sessions with a 45 day interval between each session, each case was evaluated using the Vancouver Scale for keloids and standardized digital photography.
Results: We observed significant improvement in the lesions according to Vancouver parameters and the reduced number of sessions as we compared when using only one longitude wave per session. Noticeable improvement (40, 8% in the height of the

lesions, 64, 7% pliability, 53, 84% in the vascularity, and 23, 52% improvement in pigmentation. One hundred percent of our patients felt significant improvement in the symptomatology of the keloid area. No recurrence after 12 months of follow up.
Conclusion: We based our rationale for this study on the great vascular destruction that provides PDL and the great tissue remodeling capacity of CO_2 fractional laser which both working together at the same session can increase their potential to treat this difficult lesions.

#48

FRACTIONAL CO_2 LASER FOR THE TREATMENT OF CAESAREAN SECTION SCARS - A RANDOMIZED SPLIT SCAR STUDY

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Background: Caesarean section (CS) is a common procedure which inevitable leaves a scar. Apart from cosmetic concerns scars occasionally cause pain, tenderness and itching. Ablative fractional laser (AFXL) may provide benefit for CS scars. Yet, randomized controlled studies are lacking. The objectives are to evaluate the clinical impact of AFXL on the appearance of CS scars and substantiated by reflectance and ultra sound (US) measurements.
Study: Mature CS scars >1 year old were each divided into two similar parts and randomized to receive three fractional laser treatments at 6–8 week intervals or no treatment. Fractional 10600 nm CO_2 laser settings were individually adjusted according to scar characteristics: deep fractional ablation 20–70 mJ, density 5–15% and superficial fractional ablation 70–125 mJ, density 1–3%. Follow-up (FU) assessments were performed at 1, 3 and 6 month post treatment. Primary endpoint was blinded physician and subject evaluation of scar appearance by Patient-Observer-Scar-Assessment-Scale (POSAS, range 1 = normal skin to 10 = worst imaginable scar). Secondary endpoints were skin redness % quantified by skin reflectance measurements and dermal changes visualized by US. Clinical 2D and 3D pictures objectified clinical outcomes. Non-parametric statistics was applied.
Results: We enrolled 12 subjects. At 3 month FU scars remained visible but AFXL-treated scar sides presented significantly more pliable (POSAS, treated vs control: 2 vs 3, $P = 0.003$) and thinner (POSAS, 2 vs 3, $P = 0.016$) than untreated control sides. Post-operative redness % peaked at 1 month FU (median 25.5%) and decreased towards normal skin at 3 month FU (median 20.9%), which was supported by POSAS erythema score. Subjects reported less stiffness of treated scar side vs control side (3 month FU $P = 0.008$). US indicate dermal connective tissue remodulation. Six month data will be presented.
Conclusion: Mature CS scars appear smoother, thinner and less stiff after three AFXL-treatments. Post-operative erythema declines from 1 to 3 month FU.

#49

EVALUATION OF A 1540 nm AND A 1410 nm NON-ABLATIVE FRACTIONATED LASER FOR THE TREATMENT OF STRIAE

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Background: Striae distensae are aesthetically very concerning for patients, but difficult to treat. The purpose of our study was to evaluate and compare the clinical and histopathologic efficacy of a 1540 nm non-ablative fractional laser (Icon™, Cynosure, Westford, MA) and a low energy 1410 nm non-ablative fractional laser (Emerge™, Cynosure, Westford, MA) for the treatment of striae.
Study: Ten patients with abdominal striae were enrolled. Half of the abdomen was treated with the 1540 nm laser (XD: 50 J/cm^2, 15 ms, 2 passes; XF: 50 J/cm^2, 15 ms, 2 passes, total 25% density,) while the other half was treated with the 1410 nm laser (30 J/cm^2, 5 passes, 16% density). Subjects underwent 6 total treatments spaced 2–6 weeks apart. Photographs were taken at baseline and 3 months following the final treatment. Two blinded dermatologists scored the photographs using a 5-point scale. Skin biopsies were taken from 2 subjects (prior to treatment, immediately after the initial treatment, and 3 months after the final treatment), and were reviewed by two blinded dermatopathologists. Additionally, patients were given a self-assessment questionnaire.
Results: Nine patients completed the study, and all demonstrated clinical improvement. Twenty-eight percent of the 1410 nm and 33% of the 1540 nm treated patients were rated as having "good" or "excellent" improvement. Seventy-two percent of the 1410 nm and 66% of the 1540 nm treated patients were rated as having "mild" or "fair" improvement. Overall, the difference in efficacy between the two laser modalities was not statistically significant ($p = 0.747$). All patients were either "very satisfied" (71.4%) or "moderately satisfied" (28.6%) with the treatment. All patients experienced transient hyperpigmentation that was longer lasting on the 1410 nm side. Histopathological results are pending.
Conclusion: Treatments were well tolerated without long-lasting side effects. The treatments with the 1540 nm were significant quicker with less pigmentary change. All patients demonstrated clinical improvement of their striae following both laser treatments.

#50

A PILOT STUDY TO TREAT MILD TO MODERATE LAXITY OF LOWER FACE AND NECK WITH A BIPOLAR FRACTIONATED MICRONEEDLE RADIOFREQUENCY DEVICE

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Background: Laxity of lower face and neck skin is a common concern of cosmetic patients during the aging process. Correction of laxity in this anatomic area can be challenging to achieve without the traditionally invasive surgical lifting procedures. This pilot study evaluated the use of a bipolar fractionated microneedle RF device for the improvement mild to moderate skin laxity of the of lower face/neck area.
Study: Thirty patients (7 males, 23 females, age range 37–71 years old) were recruited with mild to moderate skin laxity of the lower face/neck. A single physician performed all procedures, using a regimen of three sequential treatments at monthly intervals. Each treatment utilized three passes with a RF device (Infini, Lutronic Corp, Goyang Korea), equipped with a handpiece and a 1-cm^2 disposable microneedle tip, which had 49 proximally insulated 34-G microneedle electrodes with a maximum depth of treatment ranging from 1 mm to 3 mm. Evaluation was performed at 6 months post the last treatment, using a primary endpoint of

standardized, computerized measurements of the gnathion and cervicomental angles in the treated area. A secondary endpoint was identification of standardized pre-post photography by panel of blinded investigators.
Results: Average decrease in the cervicomental angle pre-treatment and post treatment was 27.2 ° ($P < 0.01$) Average decrease in the gnathion angle pre-treatment and post treatment was 16 ° ($P < 0.01$). Additionally, patients attained clinically significant change in skin laxity, as assessed by a blinded, independent two-physician panel photographic review (100% correct identification of baseline and post final treatment images).
Conclusion: This study demonstrates the efficacy and safety of a bipolar fractionated microneedle RF device for improvement in lower face/neck laxity.

#51

PROSPECTIVE, SINGLE-SITE, SINGLE-BLINDED, RANDOMIZED, SPLIT-BODY PILOT STUDY OF THE SAFETY AND EFFECTIVENESS OF MICROFOCUSED ULTRASOUND WITH VISUALIZATION FOR LIFTING OF THE BUTTOCK

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Background: The objective of this study is to evaluate the safety and effectiveness of microfocused ultrasound with visualization (MFU-V) for lifting buttock tissue in order to reduce buttock ptosis.
Study: Twenty-four adult females presenting with mild to moderate buttock ptosis per investigator assessment will be enrolled. Subjects will receive two, single-side treatments 90 days apart consisting of 280 treatment lines with each of the 4 MHz-4.5 mm and 7 MHz-3.0 mm transducers. Pre-treatment, all subjects will receive Toradol (60 mg) and optional Valium (10 mg). Efficacy post-treatment (90, 180 and 270 days) will be measured quantitatively by change from baseline in buttock angle measurements, and qualitatively by percentage of subjects reaching aesthetically improved. Adverse events are being collected.
Results: At this interim time point fifteen subjects are enrolled. Average age and BMI were 49 (33–64) and 20.2 (19–23), respectively. Subjects were 93% Caucasian, 7% Asian, and Skin Types I (7%), II (67%), III (13%), and IV (13%). Eight subjects randomized to an assigned treatment side have received a single-side buttock treatment. Average total treatment lines delivered were 561.4. Using a validated Numeric Rating Scale (0–10), subjects' average pain scores reported during treatment for the 4 MHz-4.5 mm and 7 MHz-3.0 mm transducers were 6.4 (range 4–10) and 5.3 (range 2–8), respectively. No adverse events or serious adverse events were reported.
Conclusion: Preliminary results suggest microfocused ultrasound with visualization for treatment of the buttock is well-tolerated. Complete efficacy and safety data will be presented.

#52

A PROSPECTIVE, RANDOMIZED, SPLIT PATIENT STUDY TO COMPARE TWO METHODS OF ANESTHESIA FOR MICROWAVE TREAMENT OF EXCESS SWEATING

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Background: This study was undertaken to determine if the use of tumescent anesthesia (TLA) would provide similar comfort management without negative effects on sweat reduction efficacy for microwave energy treatment of axillary hyperhidrosis.
Study: This study is a randomized, split-patient, unblinded study. Each patient was required at baseline to have significant, symmetric axillary hyperhidrosis. At the time of the first treatment session, axillae were randomly assigned to one of two methods of anesthesia. Method 1 employed stock 1% lidocaine. Method 2 used a TLA mixture delivered through a blunt cannula using a peristaltic pump. Subject pain scores (scale of 1 to 10, with 10 being the worst pain) were gathered. Second treatment sessions at three months used the same randomization. Follow-up visits were scheduled at approximately 3 month intervals. Sweat levels were measured using the HDSS (Hyperhidrosis Disease Severity Scale) scores, and gravimetric assessments.
Results: 17 patients enrolled in the study; 47% female, average age 32. Average baseline gravimetric readings were 204 mg (Method 1) and 191 mg (Method 2). The average pain rating for anesthesia administration for the first treatment session was 4.5 for Method 1 and 3.6 for TLA. The average pain rating during treatment was the same, 1.4, for both methods. The efficacy results were the same within statistical errors for both methods. Gravimetric assessments provided average reductions of 87%, 75% and 83% for Method 1 and 82%, 68% and 75% for TLA at 3, 6 and 9 months respectively. One year follow-up data is pending. The common side effects reported were temporary: swelling and some tenderness. In this series, 3 patients reported infection on the side that had injected 1% lidocaine and were managed successfully with short-term antibiotics.
Conclusion: This study demonstrates that the two methods of anesthesia provided similar comfort management and efficacy. Further procedure optimization is possible.

#53

LONG-TERM REGISTRY FOLLOW-UP FROM A MICROWAVE-BASED TREATMENT FOR AXILLARY HYPERHIDROSIS

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Background: A microwave device for treating excessive underarm sweat has been used commercially for over two years. It is important to track treatment parameters, patient outcomes and satisfaction with the procedure in a non-study setting.
Study: Ten US clinics participated in the program. Patients treated with the microwave system (miraDry System, Miramar Labs, Santa Clara, CA) were given the option of participating in a web-based registry survey. Prior to treatment, patients completed a short questionnaire to document sweat levels, including the Hyperhidrosis Disease Severity Scale (HDSS) score, and Sweat Scores and Odor Scores on a 1 to 10 scale, with 10 representing extremely bothered. Most patients were treated in two sessions, approximately 3 months apart. Follow-up surveys captured the same sweat assessment questions at 3 month intervals after the last treatment session.

Results: 110 patients have completed at least one survey 6 months after all treatment sessions were complete. Demographics were: mean age 33 years; 65% female. Average HDSS score at baseline was 3.4; 9% of patients had HDSS = 2 at baseline. After treatment, the primary efficacy measure (defined as the percentage of subjects reporting HDSS scores of 1 or 2) was 88% (97/110). The efficacy was essentially the same for women (63/71 = 89%) and men (34/39 = 87%). The average Sweat Score at baseline was 8.5; after treatment the average Sweat Score was 3.0. The average Odor Score at baseline was 5.2; after treatment, the average score was 1.9. Patient satisfaction (% of patients that were satisfied with the procedure) was 85%.
Conclusion: This interim report shows that in this registry-like dataset, patients with at least 6 months of follow-up show efficacy results that are consistent with prior published clinical studies. Patient satisfaction with the procedure remains high.

#54

A NEW PARADIGM FOR OPTIMAL TATTOO REMOVAL USING THREE PICOSECOND LASER WAVELENGTHS

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Background: Picosecond lasers that utilize photomechanical effects to shatter tattoo ink bring up the question; Do different wavelengths need to be employed based on the tattoo colors? The present study compares nanosecond and picosecond technology as well as the 532 nm, 755 nm and 1064 nm wavelengths for multicolored tattoo removal.
Study: We enrolled 44 subjects (53 tattoos) with Fitzpatrick skin types I-VI in a prospective IRB approved study for laser tattoo removal. Subjects received up to 10 treatments, scheduled at 1–2 month intervals, and treated with one of the following: the 755 nm wavelength with a pulse width of 500–750 ps, 532 nm with a pulse of 450–500 ps, or 1064 nm wavelength with a pulse width of 500–600 ps. A subset were also treated with a 532 nm nanosecond device. Photographs were assessed by the investigator and blinded evaluators. Subjects rated satisfaction was conducted at the end of the study.
Results: Physician and subject satisfaction rate was high. The picosecond laser was shown to clear tattoos faster than nanosecond laser technology. 31 tattoos containing red, yellow, and/or orange pigments, responded best to the 532 nm picosecond laser and exhibited 75–100% after an average of 2 treatments. 17 tattoos containing blue, purple, and/or green pigments responded best to the 755 nm Picosecond laser and exhibited 75–100% clearance after an average of 2 treatments in 88% of subjects. 7 tattoos containing black ink responded equally in the 755 and 1064 nm picosecond lasers after 1–2 treatments.
Conclusion: The picosecond laser is a safe and efficient tool for tattoo removal; however it is not a colorblind laser. It remains the case that the various colors respond differently to each of the three wavelengths. To clear most inks in the least amount of treatments the combination of at least 755 nm and 532 nm is needed, although the 1064 nm wavelength will likely be preferable for black inks in darker skin phototypes.

#55

EVALUATION OF A PERFLUORODECALIN-INFUSED TRANSPARENT PATCH FOR RAPID MULTI-PASS Q-SWITCHED HIGH FLUENCE LASER TREATMENTS OF TATTOOS

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Background: Perfluorodecalin (PFD) has previously been demonstrated to very rapidly dissipate the opaque, white microbubble layer formed after exposure of tattoos to Q-switched lasers (Reddy et al, 2013, Lasers Surg Med, 45(2), 76–80). The current study was conducted to determine if use of a transparent PFD-infused patch results in more rapid clearance of tattoos than conventional methods.
Study: Black or blue tattoos were divided into two halves in a single-site IRB-approved study with 17 patients with Fitzpatrick skin types I – III. One half of each tattoo served as its own control and was treated with one pass of a standard Q-switched Alexandrite laser (755 nm). The other half of the tattoo was treated directly through a transparent perfluorodecalin (PFD) infused patch (ON Light Sciences, Dublin, CA). The rapid whitening reduction effect of the patch routinely allowed 3 to 4 passes to be performed in less than five minutes. Both sides were treated at highest tolerable fluence, but the optical clearing and epidermal protection properties of the patch allowed significantly higher fluence compared to the control side. Standard photographs were taken at baseline, and before and after each treatment session at 4 to 6 week intervals.
Results: In a majority of patients, tattoos treated through the transparent PFD-infused patch showed more rapid tattoo clearance with higher patient and clinician satisfaction than conventional treatment. No unanticipated adverse events were observed.
Conclusion: Rapid multi-pass treatment of tattoos with highest tolerable fluence facilitated with a transparent PFD-infused patch clears tattoos more rapidly than conventional methods.

#56

PICOSECOND LASER TREATMENT OF EUROPEAN TATTOOS

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Background: Many types of tattoo inks have been used in Europe. In 2008 the Council of Europe - Committee of Ministers implemented criteria for the use and safety of tattoo ink and permanent make-up. Published studies have demonstrated reduced number of treatments and increased clearance rate with the use of the picosecond Alexandrite laser. This study further explores the safety and efficacy of the picosecond laser for the removal of tattoos and compares the efficacy of tattoos obtained pre and post pigment regulations in Europe. Our Center in Germany sees every day about 10–15 new tattooed patients for laser treatments.
Study: 61 subjects with a total of 89 tattoos were enrolled in the study and treated with the 755 nm wavelength picosecond laser with a standard 2 mm spot. A subset of tattoos was studied to compare the response rate and age of the tattoo. 10 subjects were enrolled in group A (>15 years) and 10 subjects in group B (<2 years). Skin types I to IV and all pigment colors were represented. Treatments were scheduled approximately 4 to 8 weeks apart. Standardized photographs were taken at baseline, before each

treatment and at 1 and 3 months post last treatment. Efficacy was assessed as percentage of pigment clearance based on 0–3 scale (<25%, 26–50%, 51–74%, > 75%). Adverse events were also recorded by the treating physician.
Results: Subjects received up to 10 treatments. There was no loss in follow up. Of the 10 tattoos in the "old" group, 8 cleared >75% and 2 had 51–74% clearance within 3 to 5 treatments. In the "younger" group we saw exactly the same results. Green, a typically difficult pigment to remove, responded very well to treatment. Typical adverse effects were transient hypopigmentation and hyperpigmentation. Blistering or other severe side effects did not occur. A moderate pain score was reported (Zimmer cooler was used).
Conclusion: This study confirms and extends reports that the Alexandrite 755 nm picosecond laser is a safe and very effective tool for tattoo removal and clears 50% more rapidly than historical controls for most colors. Treatment efficacy was similar between old and new tattoos.

#57

TREATMENT OF RESISTANT TATTOOS WITH PICOSECOND ALEXANDRITE LASER

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Background: A new alexandrite picosecond laser has been reported to be effective for tattoo removal with fewer treatments than nanosecond (Q-switched) laser. The question posed was whether tattoos that have reached maximum response with nanosecond technology will respond to additional treatments with picosecond pulsing.
Study: An image and chart review of 114 patients treated for tattoos with a picosecond laser (Picosure, Cynosure, MA) was performed. Of those, 37 patients with 6 or more previous nanosecond laser treatments were revealed. All patients had images of before picosecond and after picosecond treatments. Images were evaluated by blinded reviewers and graded on a quartile scale.
Results: Additional tattoo clearing was seen in 36 of 37 patients. Fluence ranged from 2–4 J/cm^2. Close to complete clearing of tattoos (4/4 on a quartile scale) was observed by image review in 15 of 37 patients. For this subgroup, the mean number of picosecond treatments for 90% reduction of tattoo pigment was 2. For the other 21 responders, visible reduction of tattoo pigment was noted with maximum treatment sessions of 4. Anticipated events observed included pain, temporary epidermal barrier erosion and erythema.
Conclusion: Picosecond lasers may be effective when nanosecond laser treatments of tattoos (N = 6 or greater) have reached a plateau with no further improvement. Picosecond lasers may offer additional clearance of Q-switched resistant tattoos not previously attainable.

#58

CLINICAL EVALUATION OF THE PICOSECOND 532 nm, 755 nm AND 1064 nm WAVELENGTHS FOR THE REMOVAL OF TATTOOS

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Background: The purpose of this study was to investigate 3 picosecond wavelengths (532 nm, 755 nm and 1064 nm) for the removal of tattoos and to confirm the efficacy of treatment. A subset of patients were compared with their nanosecond counterparts to demonstrate efficacy of the picosecond pulse duration. Wavelengths used during treatment were chosen based on the colors presenting in each tattoo. Further, 1064 nm was compared with 755 nm to determine the relative efficacy in treating black pigment tattoos with picosecond lasers.
Study: Thirty-five tattoos containing a combination of red, yellow, orange, blue, green and black pigment were enrolled in twenty-seven subjects with Fitzpatrick Skin Types I-V. Treatments were scheduled 4 ± 2 weeks apart. The 755 nm and 1064 nm picosecond wavelengths were compared on a subset of subjects for response when treating blue and black pigment. Standard photographs using 2-dimensional imaging were taken at baseline, before each treatment, and 1 and 3 months after the last treatment. Patient photographs were assessed by 3 blinded, trained and qualified dermatologist evaluators and based on a 6-point scale. Treatment efficacy was defined by the percentage of tattoo clearance (%) by comparison to standardized photographs. Overall provider and patient satisfaction were also assessed at the conclusion of the study.
Results: Most subjects obtained greater than 60% overall clearance. Subjects were satisfied or extremely satisfied with the treatment. Most frequently occurring adverse effects included pain, erythema, crusting and edema. Pain scores were minimal during treatment and post-treatment. No infections were reported.
Conclusion: The picosecond laser is a safe and effective procedure for removing tattoo pigment. Black ink responded slightly better to 755 nm than the 1064 nm picosecond wavelength. Blue and green inks responded best with 755 nm. The 532 nm wavelength cleared red, orange and yellow inks the best. The 755 nm and 532 nm picosecond combination laser is an efficacious device that optimizes treatment of tattoos containing black, blue, green, red, orange, and yellow pigment, which previously have been difficult to clear with one device.

#59

CLINICAL EVALUATION OF A LARGE SPOT SIZE 800 nm DIODE LASER FOR THE TREATMENT OF HYPERTRICHOSIS

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Background: Laser hair removal (LHR) using smaller spot sizes is inefficient and time consuming whereas larger spot size devices may have limitations of longer pulse widths, insufficient fluences and/or poor cooling. Here, we evaluate the clinical efficacy of a 10×30 mm large chilled 800 nm diode handpiece for the treatment of hypertrichosis.
Study: A pilot prospective, self-controlled, multi-center study of 22 subjects with one arm having 4 treatments to both axillae using a long-pulsed 800 nm diode laser with a chilled sapphire 10×30 mm tip at monthly intervals. The second arm of the study compared 3 treatments of the large 10×30 mm 800 nm diode chilled sapphire handpiece to one axillae versus 3 treatments of a standard 10×10 mm 800 nm diode chilled sapphire handpiece to the contralateral axillae. Hair reduction was quantified using macro hair count photographs taken at baseline, and at 6 and 12-month follow-up visits.

Results: 22 subjects enrolled and completed the study treatment protocol. Six month efficacy data is pending completion of a few study subjects.
Conclusion: A large spot size 10×30 mm diode is safe and effective for the removal of unwanted hair with long term hair reduction. The large chilled sapphire tip is more effective than the standard chilled sapphire tip.

#60

LONG-TERM FOLLOW-UP DEMONSTRATING REDUCTION OF AXILLARY HAIR UTILIZING MICROWAVE TECHNOLOGY

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Background: Subjects with their axillae treated with a microwave device have been studied for the effect in underarm hair reduction. We present an update of our multi-center study that includes one year of follow-up to determine stability of results.
Study: This Study is a prospective multi-center evaluation of subjects with unwanted hair in their axilla. Participants that met all the exclusion and inclusion criteria were treated using a non-invasive device employing microwave energy (Miramar Labs, Santa Clara, CA). One to two treatment sessions using standard conservative parameters were employed. Hair counts were calculated from standardized images by a panel of three blinded investigators. Overall hair reduction (average of the two axillae) at the follow-up visits (at 3, 6, 9 and 12 months post-treatment) compared to baseline was calculated.
Results: Forty-three patients (98% female, average age 33, 65% darker hair color) have completed the treatment sessions and at least one follow-up visit, with two sessions for 38 patients and one session for 5 patients. The average hair reduction was 68.0%, 75.3%, 74.5% and 73.4% at the 3, 6, 9 and 12 month follow-up visits. The range of hair reduction for light-colored hair only was 61% - 71%, and for dark-colored hair only was 71% - 81%. However the differences may be due to the energy levels chosen for the treatment.
Conclusion: We report long-term findings using a non-invasive microwave device to reduce underarm hair. Reduction of approximately 70% in both light and dark axillary hair was seen, and is stable through 12 months of follow-up.

#61

CLINICAL EVALUATION OF 1060 nm Nd:YAG VACUUM-ASSISTED HANDPIECE WITHOUT TOPICAL ANESTHETIC IN ALL FITZPATRICK SKIN TYPES

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Background: Laser hair reduction is limited by pain during the procedure, lengthy treatments, and side effects, particularly in darker skin types. We evaluated a novel 1060 nm diode laser handpiece with vacuum suction, longer pulses, a very large spot, and photon recycling in typical hair bearing areas. These features theoretically should allow for rapid hair removal in all skin types without the need for topical anesthetic or lengthy treatments. The primary study objectives included evaluation of hair removal, immediate skin response to treatment and adverse events. Secondary outcomes include length of the treatment, subject perception of treatment, and alterations of hair coarseness and color.
Study: This is an open-label, single treatment arm, prospective, multi-center study. Patients were assigned to receive up to seven laser treatments every 5–7 weeks with each anatomic sub area receiving different treatment parameters and pulse stacking. Patients were treated with a 22×35 mm spot size with the following settings: 1 pulse at 9–12 J/cm^2, 2 pulses at 6–12 J/cm^2 each, or 3 pulses at 6–12 J/cm^2 depending on pain tolerance. The maximum total fluence for any patient for any one pulse train was 36 J/cm^2. Test spots were performed. Pulse durations ranged from 30–50 ms per single pulse. Pulse trains (2–3 pulses), were delivered with the minimal time interval between pulses of 450 ms, making the total pulse duration up to 1.5 seconds.
Results: Fifteen patients (3 male and 12 female) were enrolled with an average age of 37.3 years (range 28–51) and a total of 20 treatment areas bilaterally. Fitzpatrick skin types included II (1), III (3), IV (8), and V (2). All patients tolerated the treatment well without using any numbing cream, with an average pain score of 3.7 out of 10, with a significant increase in pain with increasing total energy ($p < 0.001$, ANOVA 1.95 for 9–12J, 2.73 for 14–18J, 4.79 for 20–24J, 5.10 for 26–36J). The overall reduction in hair was 47%. Trends indicate that higher fluence is associated with better clearance. Following 6 treatments, the axilla had the best response, an average clearance of 68.5%. The laser was effective for dark hair in all phototypes treated (II-V) with a trend toward better response in darker phototype. There have been no burns or crusting and the only side effect was a small vesicle that healed completely. Perifollicular edema was mild.
Conclusion: A novel large spot laser achieved rapid hair loss over the full range of skin types with minimal discomfort and side effects.

#62

ROBOTIC FOLLICULAR UNIT EXTRACTION (FUE) IN HAIR TRANSPLANTATION

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Background: Over the past 20 years, follicular unit transplantation has allowed physicians to consistently create natural appearing transplanted hair for men and women. The standard method for obtaining the donor hair has been the donor ellipse. As with all excisions it leaves behind a linear scar. On the posterior scalp a linear is of no cosmetic significance unless the patients trims their hair. An increasing number of men wear their hair closely cropped in the posterior scalp. Follicular unit extraction has been performed for several years. It utilizes .9–1.1 mm punches to harvest individual follicular units. This creates a minimal scar. For some physicians, there is a challenge of greater follicular unit transection and operator fatigue when harvesting hundreds of follicular units. Recently a robotic device has been introduced to harvest follicular units. A clinical study was performed to determine the efficacy of the robot harvesting follicular units.
Study: 38 consecutive patients were studied with the Artas robotic device (Restoration Robotics San Jose California) to harvest follicular units from the posterior scalp. Each graft harvested was inspected by a surgical assistant, with 15 years

experience in hair transplantation for transection under magnification with polarized LED light, for transection.
Results: The arts robotic device consistently creates high quality grafts to transplant. The rate of transection was on average 5-7% which is comparable to the transection rate when dissecting follicular units from an ellipse. We did note a more variable rate of transection with the Artas robot compared to from an ellipse. The robot was able to harvest 500–700 follicular units per hour.
Conclusion: The Artas robotic device allows rapid accurate harvesting of follicular units from the posterior scalp. The future will better determine the optimal role of the robot with hair transplantation. Currently, elliptical donor harvesting, manual follicular unit harvesting and robotic follicular unit extraction are options for obtaining donor hair for men and women undergoing hair transplantation. Larger better controlled studies are needed to confirm the transection rate when harvesting with the Artas robot.

#63

FOCUSED COLD THERAPY FOR THE TREATMENT OF HYPERDYNAMIC FOREHEAD WRINKLES: A MULTI-CENTER RANDOMIZED CONTROL TRIAL

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Background: To assess the clinical safety and effectiveness of focused cold therapy for the reduction of dynamic forehead wrinkles.
Study: Sixty-three subjects were randomized to either the immediate or delayed treatment group and received focused cold therapy via a novel cryotherapy device at the temporal branch of the facial nerve. Subjects in the delayed treatment arm served as an untreated control group at 30 days post-treatment before receiving treatment at that time. For both arms, dynamic forehead wrinkles at baseline and day 30 were assessed by a panel of three blinded physicians using a validated 5-point Wrinkle Scale (5WS). Wrinkles were also assessed by the investigator prior to treatment, immediately post-procedure and at 7, 30, 60, 90 days post-treatment.
Results: At day 30, 96.9% of subjects in the immediate treatment arm (n = 32) experienced a =1 point improvement on the 5WS, compared to 6.5% in the control group (n = 31). The percent of subjects experiencing a = 2 point improvement was 93.8% in the treated group and 0% in the control group. Twenty-nine subjects in the delayed treatment group went on to receive treatment and were evaluated again at 30 days post-treatment, with 93% of subjects experiencing a =1 point improvement and 89.7% experiencing a =2 point improvement. The percent of the treated population (n = 61) reporting at least a 25% improvement in appearance of wrinkles was 93% and 84% noted at least a 50% improvement in appearance of wrinkles. The most common side effects observed (mild, moderate and severe) were bruising (58%, 18% and 16%), swelling (40%, 25% and 4%) and pain upon palpation (45%, 24% and 4%). Nearly all of these side effects resolved by the 1 week follow-up visit with 3% of subjects reporting continued bruising and 1% reporting continued swelling or pain upon palpation at this visit. All side effects were transient and resolved without intervention. There were no serious adverse events.
Conclusion: Subjects treated for dynamic forehead wrinkles with focused cold therapy showed significant clinical improvement and no serious adverse events.

#64

COMPLICATIONS ASSOCIATED WITH THE USE OF CO_2 FRACTIONAL LASER FOR THE TREATMENT OF SKIN RENEWAL (RESURFACING)

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Background: Nowadays, there is a huge demand for resurfacing clinics specialized in dermatology and aesthetic treatments. The laser of carbon dioxide (CO_2) fractional is recognized as an effective treatment to combat skin aging through a skin regeneration. Although considered a safe procedure, complications can happen. This study aims an evaluation of these complications and its side effects – found on post treatment with CO_2 laser, suggesting parameters for a safe and effective use of treatment.
Study: 901 patients were selected and submitted to a treatment with fractional CO_2 laser. Some complications were detected, such as hipercromia, herpes and, the most important, paralysis in some face muscles. It happened when treatment with fractional CO_2 laser was associated with botulinum toxin. All these complications had been monitored and treated.
Results: The most common complications due to fractional CO_2 laser were hyperpigmentation, herpes labialis, persistent Eristema and face tenderness. The most serious complication was paralysis in some muscles of the face. All complications were followed, treated and reversed.
Conclusion: There is a correlation that increases chances of complications when toxin and Fractional CO_2 Laser are taken together. We need to check the time from the toxin botulin application and the Fractional Laser. All complications were reversed, but it is necessary to determine a safe gap between the application of botulinum toxin and the fractional laser CO_2.

#65

LOW DOWNTIME ABLATIVE FRACTIONAL RESURFACING

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Background: Fully ablative skin resurfacing produces superior results but is more painful and has an increased risk of infection and longer downtime than the newer fractionated lasers. Initial fractional lasers were non-ablative and offered lower downtime, lower risk of infection and less pain but with more limited clinical efficacy. Subsequently, ablative fractionated lasers were developed and offered improved efficacy over their non-ablative counterparts per treatment but with increased downtime, pain, and risk of infection. Although fully and fractional ablative lasers

offer increased efficacy, many patients (and physicians) still prefer the lower downtime, lower risk of infection, and decreased pain of non-ablative fractional laser resurfacing. To develop a protocol that decreases the downtime, pain, and risk of infection for the ablative fractionated laser. With more advanced ablative fractional devices, we can adjust depth and density to titrate the downtime to be equivalent to that of non-ablative devices but still maintain the increased efficacy of an ablative device. The lower density decreases the pain as well as the healing time which decreases the risk of infection.

Study: Thirty patients had ablative fractionated resurfacing of the perioral area using a high-powered CO_2 laser with capability of penetrating to 4 mm in depth. The settings used were modified from traditional ablative resurfacing technique to include low density but increased depth of microthermal zones. Treatment was managed comfortably with topical numbing and local blocks if needed. Prophylactic antibiotics were not used.

Results: By lowering the density of the microthermal zones and increasing the depth, we were able to achieve rapid healing, resulting in downtimes of 24 to 48 hours. There were no incidence of infection. Efficacy was superior to what we would expect from non-ablative fractional resurfacing with equal downtime. Over half of these patients have had 2 or more treatment sessions with additional benefit noted with each treatment.

Conclusion: By utilizing the advanced features of an ablative fractional device that allows deeper penetration, we can reduce the downtime, treatment pain and risk of infection as compared to traditional fractional ablative resurfacing while maintaining the superior efficacy of the ablative treatment over non-ablative treatments. In addition, multiple treatments provide additional benefit.

#66

EVALUATION OF A COMPACT HOME-USE 1440 nm NON-ABLATIVE FRACTIONAL LASER TO TREAT PERIORBITAL WRINKLES

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Background: Rhytides around the eyes are often a specific area of desired improvement. There is a need for non-ablative fractional lasers to treat small areas. This study was conducted to determine the safety and efficacy of a new compact 1440 nm laser focused in treating periorbital wrinkles.

Study: Forty-five subjects, ages 35–70 with Fitzpatrick skin types I-VI, were enrolled in a prospective clinical study. Subjects self-treated their left and right periorbital areas daily for 8-weeks and were followed for 12-weeks after the final treatment. Most treatments were performed at home and lasted approximately one minute per eye area. A panel of 3 independent, blinded dermatologists scored periorbital wrinkles via randomized high quality photographs using the Fitzpatrick Wrinkle Scale. Tolerability and adverse events were monitored throughout the study.

Results: Forty-one subjects completed the study with mean periorbital wrinkle scores improving by 0.9 and 1.0 points ($p < 0.001$) at 4- and 12-weeks post final treatment, respectively. Eighty-three percent of subjects had at least a 1-point improvement around both eyes at 4-weeks post treatment which was sustained through 12-weeks post treatment in 81% of subjects. Adverse device effects (ADEs) were typical of non-ablative fractional treatment with no serious ADEs reported. Mild erythema, stinging, and warm or burning sensation comprised 99% of all reported ADEs and most resolved within hours after treatment. Treatments were very well tolerated with mean pain scores starting low (1.8 out of 10 after the first treatment) and reducing steadily to 1.1 after the final treatment.

Conclusion: At-home treatments with this device resulted in statistically and clinically significant improvement in periorbital wrinkles. Treatments were well-tolerated and resulted in a safety profile consistent with fractional non-ablative treatments. This compact device offers a safe, convenient, and effective home use option for targeted treatment of periorbital wrinkles.

#67

A NEW CONCEPT IN SKIN TREATMENT UTILIZING A WATER-ENERGIZING FRACTIONAL ER, CR:YSGG LASER DELIVERING IRRADIATION AT 2,780 nm WHICH REQUIRES NO ANESTHESIA (TOPICAL OR INJECTION) FOR SKIN RESURFACING

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Background: To report the clinical results and histologic effects of a new concept in skin treatment utilizing a water-energizing fractional Erbium,Chromium:Yttrium-Scandium-Gallium-Garnet laser delivering irradiation at 2,780 nm which requires no anesthesia (topical or injection) for skin resurfacing.

Study: The 2,780 nm fractional Erbium,Chromium:Yttrium-Scandium-Gallium-Garnet, (Er,Cr:YSGG) is a solid-state laser that provides optical energy to atomized water droplets and hydrated surface layer of tissue, resulting in explosive water expansion. Strong mechanical force from rapid water expansion induce separation of surface material, quickly and cleanly ablating tissue. Twenty patients received resurfacing treatments with the Er,Cr:YSGG laser on their face, neck and chest without any form of anesthetics (topical or injection). Efficacy measures included skin biopsy to measure the depth of the laser ablation; photographs at baseline, post-treatment and subsequent follow-up throughout a six month time period. Level of pain perception was assessed through the Visual Analog Scale, a pain scale to assess level of pain from 1–10. Healing rate, complications, patient satisfaction and overall clinical improvement were also evaluated through patient survey.

Results: Analysis of results indicate significant reduction in pain and complications, faster overall healing time, and high level of patient satisfaction as compared to the carbon dioxide (CO_2) and the Er:YAG lasers. The mean visual analog scale result was 1.8 while Patient Satisfaction showed an average of 6.9 out of 10. Operative field was bloodless and clean facilitating ease of the procedure secondary to the laser's hemostatic effect. Days to healing = 4.5 days Histology depth of ablation: 41 microns.

Conclusion: The water energizing Er,Cr:YSGG laser device offers a safe and effective non-invasive skin resurfacing procedure which does not require anesthesia. In addition, overall results show improvement in appearance of the face and neck, healing rate and patient satisfaction.

#68

PICOSECOND LASER FOR REDUCTION OF WRINKLES: LONG TERM RESULTS

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Background: A 755 nm picosecond laser with a focused lens array has been reported to be effective for facial wrinkles and other signs of photoaging with minimal downtime. This report summarizes the long term results of treatment using picosecond pulses focused on the skin surface through microlenses.

Study: The study consisted of 20 female patients, primarily Fitzpatrick skin type II and III, with peri-oral and peri-ocular wrinkles. A 755 nm 700 picosecond laser was delivered via 130 microlenses; 100 microns wide with a 500 micron center-to-center spacing for an average fluence of 0.71 J/cm^2 per lens. Subjects underwent 4 full face treatments with 4000–6000 pulses. Delivery was adjacent pulses with minimal overlap (10% or less). At 6 month post treatment blinded physicians scored satisfaction and improvement. Subjects scored satisfaction and likelihood to recommend to others.

Results: All patients tolerated the treatment well. There were no major complications and only anticipated sequelae. At 6 month follow-up, 94% of subjects scored themselves as satisfied, and 78% were likely to recommend the treatment to a friend. Physician ranking was 78% of subjects improved on a Global Aesthetic Improvement Scale (GAIS), with noticeable results in 83%. The average Fitzpatrick Wrinkle Scale (1–9) at 6 months follow up was 3, with an average overall improvement of 2.7.

Conclusion: A 755 nm picosecond laser utilizing a focused microlens array is an efficient tool to treat wrinkles and global photo damage with minimal side effects and downtime. Results long term show continued improvement beyond 6 months.

#69

CHARACTERIZATION OF THE HISTOLOGIC CHANGES IN THE SKIN FROM TREATMENT WITH A 755 nm PICOSECOND ALEXANDRITE LASER WITH A FRACTIONAL OPTIC

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Background: The treatment of acne scars with a Pico-second alexandrite laser was recently FDA approved. We have presented our initial histologic findings studies with this device on *in vivo* and *ex vivo* skin in 2014. This study expands this pilot study with the investigation of different energy setting using histology and the confocal microscope to characterize the changes observed in the skin.

Study: We used a 755 nm picosecond alexandrite with a fractional optic with three different energy setting to treat *in vivo* and *ex vivo* skin. After treatment, the patients and skin samples were also evaluated with a confocal microscope followed by biopsies which were evaluated histologically.

Results: Histology revealed unique intra-epidermal cavities. The number density and the size of these cavities were dependent on the melanin index and delivered energy when evaluated with histopathology analysis and the confocal microscope. These zones of injury appear to form mends zones which are exfoliated over a 3 week period.

Conclusion: These intra-epidermal cavities result from an area of laser induced optical breakdown (LIOB). This injury is most consistent with a localized plasma formation in the epidermis initiated by the absorption of the high energy Pico-second light by melanin. It appears that treatments with this device and optic result in improvements in dys-pigmentation acne scars with new collagen. The production of this LIOB could directly stimulate an epidermal repair mechanism result in these clinical findings. It is also possible that there is some other dermal injury that could explain the dermal improvement.

#70

CLINICAL AND HISTOLOGIC EFFECTS OF HIGH INTENSITY FOCUSED RF IN THE TREATMENT OF PHOTOAGING AND ACNE SCARS

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Background: Clinical and histologic effects of high intensity focused RF in the treatment of photoaging and acne scars.

Study: A retrospective review of clinical responses to an insulated focus RF needle device was performed. 22 patients were treated at least two times 1–2 months apart and the final assessment was at least two months after the final treatment. The device creates thermal coagulative injury zones surrounding the distal 300 μm unexposed needle tip with a 1 MHz RF generator adjustable up to 50W. Histology immediately after treatment and up to 2 months after was carried out using clinical settings. Patients generally were treated on the cheeks for wrinkles with 3–4 passes. A typical session consisted of the following settings (pass 1, level 12, 400 ms, depth 2.5–3.0 mm, pass 2, level 9, 180–230 ms, depth 1.5–2 mm, and pass 3, level 6, 120–180 ms,depth, 1 mm). Anesthesia was achieved with a combination of 5% lidocaine cream, refrigerated air, and in some cases, blocks were performed in the infraorbital and metal nerve regions.

Results: At depth settings of 1–2 mm and Level 10 (25W), ellipsoids of thermal coagulating injury were observed at clinical settings with zones of injury up to 0.5 mm width and .7–1 mm in height within the dermis. The cross-sectional injury coverage at depth ranged from 5–18% per pass, with larger power levels and exposure times associated with larger zones of injury and corresponding to larger cross- sectional areas of damage. Patients tolerated the procedure well. The immediate appearance showed punctate bleeding which rapidly subsided after wiping with wet gauze. Edema and erythema persisted for two days. In 4 of roughly 67 treatments, focal purpura was observed, typically in older patients (> 60 yr. old) and patients on oral steroids or NSAIDS. All patients receiving at least 2 treatments and at least 2 months after last treatment were scored in a blinded fashion by trained graders. Clinically, patients' wrinkles and acne scars improved over a range of 20–80% and patients were satisfied with results.

Conclusion: A high intensity focused RF treatment delivers operator controllable coagulative injuries over a range of depths and densities. Improvement in wrinkle and acne scars tended to scale in proportion to the number and intensity of treatments.

#71

CLINICAL, HISTOLOGICAL EVALUATION OF A THERMO-MECHANICAL ABLATIVE AND NON-ABLATIVE DEVICE FOR FRACTIONAL TREATMENT OF AGING SKIN

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Background: Clinical overview of a novel ablative thermo-mechanical ablation technology (TMA), with comparison to fractional CO_2 lasers.

Study: TMA device Tixel (Novoxel®, Israel) touch briefly (4–18 msec) the skin with a tip of biocompatible metallic pyramids array of 1 cm^2 heated at 400°C, either ablative D-Tip evaporating craters (100/300μm) or non-ablative S-Tip heat transferring. 3 treatments at 5 weeks intervals, no topical analgesic. Two patients underwent fractional CO_2 laser. Histopathology were taken with TMA and laser-treated skin. Before and after photographs. Pain level quoted on a scale 1 to 10.

Results: 33 females and 3 males, 35–65 years, skin types I-V, follow up 4 months to 2 years. D-tip healing in mean 3 days versus laser 4–5 days, S-tip 1–2 days. Clinical Improvements were similar on fine wrinkles and skin texture on D-tip side compared to laser. Pain level was quoted 1–3/10 for S-tip, 2–5 with D-tip and no analgesic cream, and 7–8/10 with laser plus analgesic cream. No unwanted effect on all patients. Histology results are parameter-dependent, similar. No evidence of necrotic tissue in TMA specimens. Non-ablative TMA provides heating of the epidermis down to the papillary dermis with micro-channels formation and stratum corneum preservation on site.

Conclusion: TMA ablative device is less painful with faster healing than fractional CO_2 laser and comparable efficacy and safety. In non-ablative mode, skin texture improved with no downtime.

#72

EVALUATION OF THE SAFETY AND EFFICACY OF MULTIPLE SAME WEEK PULSED DYE LASER TREATMENTS OF PORT WINE STAINS

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Background: The use of the pulsed dye laser in treatment of ecchymoses has been previously published in the dermatology and plastic surgery literature for postoperative patients and those with traumatic bruising. We hypothesize that repeated treatment of recently treated Port Wine Stain (PWS) with non-purpuric settings is a safe and effective method for rapid resolution of procedure-induced ecchymoses and possible expedited clearing of these lesions.

Study: Prospective randomized, controlled split-lesion single center study to evaluate the efficacy and safety of repetitive pulsed dye laser treatment of treatment-induced ecchymoses in Port Wine Stains. The treatment side received treatment two days after full treatment with standard settings of 7.5 mJ and pulse duration of 6 ms.

Results: Nine men and three women, average age of 41 years (25–56 years) were enrolled and treated. Six (50%) were categorized as Fitzpatrick skin type III, two (16.7%) as I, II, and IV. All PWS were located on the face, with an average treatment area of 106.75 cm^2 (18–255 cm^2). Reduction of bruising in experimental compared to control areas at four days after initial treatment was 48.5% compared to 28.1%, and 64.8% compared to 37.0% after the second treatment. On a four point scale (0:0–25%, 4:76–100%), clearance of experimental compared to control areas was 2.0 compared to 1.7 at one month after one treatment, and 2.4 compared to 2.0 at one month after second treatment. Subjects were satisfied to extremely satisfied 2.3/3 (0:not satisfied; 3:extremely satisfied).

Conclusion: Repeat treatment of Port Wine Stains at 48 hours was proven to be safe and resulted in a more rapid resolution of ecchymoses, with the same or greater amount of clearance at one month after two treatments.

#73

VERRUCA VULGARIS: NOVEL TREATMENT WITH A 1064 nm Nd:YAG LASER

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Background: Verrucae are common benign neoplasms. However, they can present a therapeutic challenge. Previous studies have suggested that some lasers can be beneficial in the management of warts.

Study: To determine the effectiveness and safety of a novel 100 microsecond pulsed 1064 nm Nd:YAG laser for the treatment of Verruca Vulgaris. 25 adult patients with a total of 63 hand verrucae were enrolled in the clinical trial to receive treatment with a low energy (200 mjoule) 1064 nm Nd:YAG laser (PinPointe, NuvoLase, Inc.). Each subject was eligible for 3 treatments administered at monthly intervals. All verrucae were measured before each treatment session and at 6 months after the final treatment.

Results: A complete response was seen in 19 patients and in 41 verrucae. A complete response was defined as complete absence of verrucae with the presence of normal skin dermatoglyphics. All other lesions showed at least partial response. A partial response was defined as a 50% or greater reduction in verruca size.

Conclusion: Low energy 1064 nm Nd:YAG laser treatment may be a promising safe and effective therapeutic modality for the treatment of verruca vulgaris. However, more treatment sessions may be needed for complete clearance and increased efficacy in some subjects.

#74

FIVE-YEAR RETROSPECTIVE INVESTIGATION OF PHOTODYNAMIC THERAPY EXPERIENCE OF A HIGH VOLUME LASER AND DERMATOLOGIC SURGERY CENTER: SUBGROUP ANALYSIS AND OUTCOME DATA

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Background: Photodynamic therapy (PDT) is an effective and FDA approved treatment for actinic keratoses (AKs). This therapy has evolved, with development of new treatment protocols, off-label indications, activating light sources, and photosensitizers. We have performed a five-year retrospective analysis of our centers' experience using PDT. Subgroup analysis of this larger data set (presented separately) is presented here.

Study: Retrospective chart review of patients who underwent PDT January 1, 2007 to December 31, 2011 at a high volume laser and dermatologic surgery center. Clinical data, treatment parameters, and subsequent diagnosis of skin cancer were

recorded. Subgroup analysis was performed for patients treated for AK and/or squamous cell carcinoma (SCC) that had 1 year of follow-up or developed SCC at the initial treatment site within that period.
Results: Of the 1,491 patients in the full review, 580 met subgroup analysis criteria. Sixty-six (11%) subsequently developed SCC at treatment site (SCC subgroup), while 514 (89%) did not develop any SCC at treatment site within 1-year (SCC-free subgroup). No statistical difference in gender between SCC and SCC-free subgroups. SCC subgroup was older (67 years, 13.5%) relative to SCC-free subgroup (60 years, 11.8%). Patients with history of SCC or Fitzpatrick\'s skin-type 1 compared to types 2–5 were more likely to develop SCC at treatment site ($p < 0.05$). Shorter incubation (=60 minutes) were more common in the SCC subgroup ($p < 0.001$). Most common treatment sites in the SCC subgroup were head and neck (61%) followed by lower extremities (22%). Use of blue (76%) compared to red (21%) light sources was similar amongst the subgroups ($p = 1$). The SCC group (66%) more frequently required multiple treatments compared to the SCC-free subgroup (36%).
Conclusion: Subgroup analysis suggests PDT chemoprevention may be more effective with incubations >60 minutes. PDT chemoprevention may be superior in younger patients and those only requiring single PDT treatment. PDT chemoprevention is independent of light source.

#75

COMPARISON OF THE INCIDENCE OF POST-INFLAMMATORY HYPERPIGMENTATION FROM 3 TYPES OF Q-SWITCHED LASER TREATMENT FOR SENILE LENTIGINES IN ASIAN SKIN

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Background: To know the comparison of the incidence of post-inflammatory hyperpigmentation from 3 types of Q-switched laser treatment for senile lentigines in Asian skin.
Study: In this study, 3 different types of Q-switched lasers (Ruby, Alexandrite, and Nd:YAG) were used to treat 176 senile lentigines on the face of Japanese patients. The correlation of the presence of pre-existent melasma to post laser treatment PIH as well as comparison of the length of time required for such PIH to clear was evaluated.
Results: Occurrence of PIH was found to be lowest for the Q-switched Ruby laser while the Q-switched Nd:YAG laser was found to take the shortest duration for PIH to clear and the Q-switched Alexandrite laser was found to require the longest time required for clearing of PIH. The difference between the length of duration taken for clearing of PIH amongst the lasers was found to be statistically significant. Furthermore, an examination of the correlation between duration of PIH and pre-existant melasma revealed to be consistent across all 3 lasers, a higher incidence and longer duration of PIH in participants with pre-existent melasma was found.
Conclusion: We consider that these results are influenced by the difference of penetration depth and degree of absorption by melanin and hemoglobin for each laser. Additionally, our findings suggested that participants with melasma are more prone to develop standard melanin overproduction conditions.

#76

EVALUATION OF NON-ABLATIVE FRACTIONAL PHOTOTHERMOLYSIS WITH THE 1550 nm ERBIUM-DOPED FIBER LASER FOR BENIGN PIGMENTED LESIONS IN DARKER SKIN TYPES

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Background: The removal of benign epidermal and dermal pigmented lesions in individuals with darker skin types poses significant challenges due to the risk of adverse effects and limited options.
Study: Ten patients with Fitzpatrick skin types IV-V presented to our clinic for the removal of various benign pigmented lesions. We used the 1550 nm erbium-doped fiber laser to treat the following 11 lesions: café-au-lait macule (6), Becker's nevus (2), nevus spilus (1), erythema dyschromicum perstans (1), and nevus of Ota (1). The Becker's nevi were pretreated with laser hair removal.
Results: Three patients with café-au-lait macules had 50–75% clinical improvement after 6–10 sessions with spot size 15 mm, fluence 5–11 mJ, and coverage 14–17%, while the other three patients had minimal improvement after 2–4 sessions. The Becker's nevi improved by >75% after 4–8 sessions with spot size 15 mm, fluence 9–45 mJ, and coverage 14–20%. The nevus spilus improved by >75% after 8 sessions with spot size 15 mm, fluence 9–40 mJ, and coverage 14–20%. Patients with erythema dyschromicum perstans and nevus of Ota had noticeable lightening after only 3–4 sessions with spot size 15 mm, fluence 5–16 mJ and coverage 14–17%. Several lesions were also simultaneously treated with topical agents: brightener (5), anti-inflammatory (1), or brightener and anti-inflammatory (1). There were no adverse events.
Conclusion: The 1550 nm erbium-doped fiber laser may be a safe and effective option in the removal of challenging benign pigmented lesions in patients with darker skin types. It was most effective for Becker's nevus and nevus spilus in this cohort. Among patients with café-au-lait macules, those who had at least 6–10 treatment sessions had the most improvement. The 1550 nm erbium-doped fiber laser may also be effective in safely removing other benign pigmented lesions including erythema dyschromicum perstans and nevus of Ota in patients with darker skin types.

#77

595 nm PULSED-DYE LASER IN COMBINATION WITH 1927 nm FRACTIONAL LOW-POWERED DIODE LASER FOR PATIENTS EXHIBITING INCREASED VASCULARITY WITHIN LESIONS OF MELASMA

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Background: Recent reports have suggested that the pathogenesis of melasma may have a vascular component. Spectrocolorimetry can be used to detect subtle telangiectatic erythema within melasma lesions. In the appropriate patient, combining vascular-targeted therapy with pigment-specific treatment modalities may be a more effective approach to treatment.
Study: Retrospective review of 10 subjects with mixed melasma and underlying telangiectatic erythema within their melasma lesions. Erythema was detected utilizing the VISIA™ Complexion

Analysis System (Canfield Scientific, NJ). Subjects were treated with a series of Vbeam 595 nm pulsed-dye laser (Syneron-Candela Corp, CA) treatments at 4–6 week intervals utilizing the following parameters: 10 mm spot size, 10–20 ms pulse duration, 7.5–8.5 J/cm^2 fluence. PDL treatments were combined with Clear + Brilliant^{TM} 1927 nm fractional low-powered diode laser (Solta Medical, CA) utilizing a low treatment level. Topical skin brighteners and daily sunscreen use was encouraged. One investigator evaluated photographs taken at baseline and after average of 3.5 treatments. A quartile improvement score was used to evaluate overall improvement in melasma. Patient satisfaction was graded on a three point scale (0–not satisfied, 1–satisfied, 2–very satisfied).
Results: Ten women, average age 42.6 years, Fitzpatrick skin types II-IV, with mixed melasma and associated telangiectatic erythema were treated. Physician assessment demonstrated greater than 50% improvement in hyperpigmentation in six out of ten (60%) of subjects after average of 3.5 treatments. Three out of ten (30%) experienced greater than 75% improvement. Overall patient satisfaction at follow up averaged 1.5, with all patients reporting 1 "satisfied" or 2 "very satisfied." No rebound melasma, post-inflammatory changes, or adverse events were noted.
Conclusion: Combining vascular-targeted laser therapy with fractional low-powered diode laser therapy improves melasma in the majority of subjects who exhibit telangiectatic erythema within their melasma lesions. This approach is safe and overall patient satisfaction is high. Follow up to determine long-term durability is needed.

#78

TREATMENT OF PIGMENTARY DISORDERS IN PATIENTS WITH SKIN OF COLOR WITH A PICOSECOND ALEXANDRITE, Q-SWITCHED RUBY, AND Q-SWITCHED Nd:YAG LASERS: A RETROSPECTIVE PHOTOGRAPHIC REVIEW

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Background: Laser procedures in skin of color patients is challenging due to the increased risk of dyspigmentation and scarring. A novel picosecond 755 nm alexandrite laser has demonstrated effectiveness for tattoo removal and treatment of acne scars. No studies to date have evaluated its applications in pigmentary disorders. The purpose of this study is to evaluate the safety profile and efficacy of the picosecond laser compared to the current standard treatment, Q-switched Ruby and Nd:YAG lasers, for pigmentary disorders in skin of color patients.
Study: A retrospective evaluation of 70 picosecond 755 nm alexandrite, 92 Q-switched Nd:YAG, and 47 Q-switched Ruby laser treatments, in 43 patients of Fitzpatrick skin types III-VI was conducted in a single center. Treatment efficacy was assessed by two blinded physician-evaluators using a visual analog scale for percentage of pigmentary clearance in standard photographs. Through questionnaire surveys, patients assessed efficacy, satisfaction, and adverse events.
Results: The most common pigmentary disorder treated was Nevus of Ota (37%). The majority of patients receiving Q-switched treatments and picosecond 755 nm alexandrite laser treatments felt satisfied to completely satisfied after 5.46 and 4.11 sessions respectively. The weighted kappa statistic for interobserver variability was 0.095 (95% CI 0.83–0.97). Side effects observed in the patients treated with the picosecond 755 nm alexandrite laser were similar to those commonly observed and reported with the Q-switched technology. These include purpura, crusting, erythema, and swelling, with no long term complications. All side effects were temporary, resolving within 1 month. All patients who were satisfied with their picosecond treatment for lentigines or Nevus of Ota noted a delayed improvement only after 3-months.
Conclusion: The picosecond 755 nm alexandrite, Q-switched Ruby and Nd:YAG lasers are all safe and effective modalities for removal of pigmentary disorders in skin of color patients with no long term complications. Similar to the rapid and successful removal of blue and green tattoos, the picosecond 755 nm alexandrite laser may also have a role in rapid, safe and successful treatment of pigmented lesions in patients with skin of color.

#79

A RETROSPECTIVE STUDY OF A 755 nm PICOSECONDS LASER FOR THE TREATMENT OF BENIGN PIGMENTARY LESIONS IN CHINESE

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Background: Photoaging in Chinese often presents with benign pigmentary lesions. Q-switched laser for pigmented lesions in Asians reported a 25% post inflammatory hyperpigmentation risk whilst long pulsed Nd:YAG was reported to have a lower PIH risk. Recently, picosecond lasers of various wavelengths were introduced. The objective of this study is to assess the efficacy of a new 755 nm picosecond laser for the treatment of benign pigmented lesions retrospectively.
Study: A list of patients who received 755 nm picosecond laser treatment at our center was taken. Those who had any other laser or topical treatment during the period of 755 nm picosecond laser treatment were excluded from the study. The age, skin type, type of lesion, number of treatments performed were recorded. The baseline and most recent standardized photographs were assessed by trained physicians for comparison. A score of 0–4 representing poor 0–24%, good 25–49%, excellent 75–95% and complete 95%+ improvement was given.
Results: A total of 13 subjects were included. The number of treatment sessions received ranged from one to seven. The benign pigmentary lesions consist of nevus of ota, café au lait patches, lentigines, Becker's nevus, Hori's macules and nevus spilus. A case of nevus of ota achieved complete clearance after 4 treatments and two other patients with nevus of ota had excellent clearance after 3 and 4 sessions. Patients with café au lait had fair to good clearance after 1–7 sessions. One patient who has Hori's macules was the most resistant to treatment with fair response after 8 treatments. Two patients developed hypopigmentation, a rate of 4.8% (2 out of 42 treatment sessions) and none had post-inflammatory hyperpigmentation.
Conclusion: The new 755 nm picosecond is effective for the treatment of benign pigmentary lesions in Chinese especially for the clearance of nevus of ota. There is a small risk of hypopigmentation.

#80

MICROPULSE ALEXANDRITE LASER TREATMENT OF SOLAR LENTIGINES IN ASIANS

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Background: The Q-switched lasers are highly effective in the treatment of dermal pigmented lesions, but in dark-skinned patients such as Asians, the risk of complications such as erythema, blistering and post-inflammatory hyperpigmentation are increased. A previous study that compared the response of lentigines in Asian skin using Q-switched vs long-pulsed green lasers at 532 nm found that post-inflammatory hyperpigmentation was less when using longer pulses. Long-pulsed lasers and IPLs are effective with minimum complications. Recently, a new multi-wavelengths Q-switched alexandrite laser has been investigated. The uniqueness of this laser is its 755 nm laser hand piece offer 50-nsec and 100 microsecond, 1064 nm and 532 nm laser handpiece offer 50-nsec pulse duration. The aim of this study is to evaluate the efficacy and complication using micropulse alexandrite laser in the treatment of solar lentigines in Asians.
Study: Twenty-eight Asian patients with sixty-one solar lentigines were enrolled in the study. Each patient was treated with micropulse alexandrite laser (TrivantageTM, Syneron Medical Ltd., Israel) for one treatment (spotsize 3 mm, fluence 22–30 J/cm^2, pulse duration 100 microsec). Patients were examined a week, 3 and 6 months after laser treatment.
Results: All patients tolerated the treatments. 57 of 61 sites showed more than 50% improvement. The average re-epithelialization time was 7.1 days. PIH was observed in four patients but it disappeared within three months. Pinpoint bleeding, Hypopigmentation or scar formation was not observed in any patients.
Conclusion: Micropulse alexandrite laser treatment of Asian solar lentigines is highly effective with minimum complications.

#81

A PROSPECTIVE STUDY TO DETERMINE LONG TERM EFFICACY OF RF-INDUCED NON-INVASIVE FAT REDUCTION

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Background: Non-invasive fat reduction is claimed by many device manufacturers, but proof of efficacy has been difficult to establish. In order to assess the actual volume reduction achieved with one of these devices, 20 patients were recruited into an IRB approved prospective study. In this study, lipodystrophic abdominal subcutaneous tissue was treated with suction coupled radiofrequency and high amplitude, short pulse duration high voltage pulses, once weekly for 8 weeks. Mean patient age was 41.71 years. Average height was 166.47 cm, and mean weight pre-treatment was 151.53 lbs. Average BMI before treatment was 24.62.
Study: Out of the 20 subjects, 17 were evaluated for changes in abdominal contour during and at the conclusion of the study. Two patients\ data points were excluded for excessive weight loss and weight gain, while a third patient did not return for final evaluation. All patients underwent pre and post treatment and inter-current measurement of weight, BMI, high resolution ultrasonic transcutaneous measurement of fat thickness, and Vectra 3D measurement of serial circumferential abdominal measurement followed by independent calculation of actual fat volume lost.
Results: Vectra 3D circumference measurements were taken at 10 mm intervals as measured from the umbilicus, with postural and breathing cycle control. Independent analysis of serial measurements from +60 mm to −70 mm from the umbilical reference point showed a mean abdominal circumferential reduction of 2.3 cm. At one month following the final treatment, the mean abdominal volume loss measured 202.4 cc. At three months after the final treatment, volume loss for the designated region averaged 428.5 cc.
Conclusion: Statistical significance was calculated using bivariate analysis, which showed a p value of <0.05. In addition, ANCOVA formulae were utilized in order to show that no confounding variables such as age, height, or weight influenced the statistical significance. Scanning Electron Microscopy confirmed that permanent adipocyte cell death was caused by irreversible electroporation. Pyroptosis appears to be the mechanism of action.

#82

SAFETY AND EFFICACY OF COLDER TEMPERATURE, SHORTER DURATION CRYOLIPOLYSIS TREATMENTS

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Background: Cryolipolysis (CoolSculpting) non-invasively reduces fat at Cooling Intensity Factor (CIF) 41.6 (−10°C) for 60 minutes using vacuum applicators or 120 minutes with a non-vacuum applicator. This study evaluated cryolipolysis safety and efficacy with alternative parameters: CIF 50.2 (−15°C) for 45 minutes.
Study: The CoolCurve+ vacuum applicator treated 45 subjects unilaterally on the flanks in a multi-center, prospective, non-randomized interventional cohort study. Subjects received up to three non-overlapping treatments in one visit. Each treatment was 45 minutes at −15°C. During 8- and 16-week follow-ups, subjects were assessed for adverse events, efficacy was assessed by ultrasound imaging and photographs, and patient satisfaction was evaluated by questionnaire.
Results: There were 63 flank treatments in 45 subjects. Independent photo review from three blinded physicians found 86% correct identification of baseline photographs. These colder temperature, shorter duration results are consistent with the correct identification rate of 94% (Bernstein et al., 2014) and 79% (Garibyan et al., 2014) reported in recent cryolipolysis flank studies using standard parameters. Ultrasound measurements show mean fat reduction 4.2 mm (standard deviation 2.6 mm, range from reduction 10.7 mm to 0.0 mm). Ultrasound results are greater than recent published cryolipolysis results 3.3 mm (Zelickson et al., 2014), 3.3 mm (Boey et al., 2014), and 2.6 mm (Stevens et al., 2015) using standard parameters. Patient questionnaires reveal 88% satisfaction; 86% noticed visible fat reduction; 86% would recommend to a friend; and 91% were likely to have a second treatment. There were no serious adverse events reported.
Conclusion: Colder temperature, shorter duration treatment parameters deliver safe, effective cryolipolysis treatment to reduce flank fat. Ultrasound measurements found 4.2 mm fat layer reduction. Assessment of clinical photographs found 86% correct identification of baseline images. Colder temperature allowed 25% reduction in cryolipolysis treatment time while

increasing fat layer reduction (by ultrasound) without any reports of serious adverse events.

#83

PARADOXICAL ADIPOSE HYPERPLASIA SECONDARY TO CRYOLIPOLYSIS

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Background: Cryolipolysis is a non-invasive, safe and effective treatment for localized fat reduction. Paradoxical adipose hyperplasia (PAH) is a rare adverse effect in which patients develop painless, firm and well-demarcated tissue masses in the treatment areas approximately 3–6 months following cryolipolysis. The incidence of PAH has been estimated at 0.0051% or 1 in 20,000 treated patients. We report two cases of PAH seen in our practice, which may suggest the incidence is greater than previously reported.

Study: A 44-year-old man underwent cryolipolysis for unwanted fat in the pectoral region. At four month follow-up, the patient had well-demarcated tissue growth in the treatment areas. He elected to undergo additional cryolipolysis treatment to the areas. Two months later, he was found to have further tissue growth in the treatment areas. The patient then underwent corrective treatment with liposuction. A 52-year-old man underwent cryolipolysis for unwanted lower abdominal fat. At one year follow-up, he had a well-demarcated, subcutaneous mass on the lower abdomen corresponding to the treatment site. The patient elected to undergo corrective treatment with liposuction. Adipose tissue samples from the treated and non-treated areas, for control, were collected, processed and stained to evaluate cellularity and tissue structure.

Results: In our practice, the incidence of PAH is 0.47% or 2 in 422 cryolipolysis treatments. This is 100 times greater than the device manufacturer's reported incidence. Histopathologic examination of the subcutaneous tissue mass showed an increased number of adipocytes, fibrosis and scar tissue in the treated areas when compared to controls. No lipoblasts, a marker of malignant neoplastic proliferation, were identified on the histopathologic examination of the affected tissues.

Conclusion: The incidence of PAH is likely underreported. Further investigation is necessary to elucidate its mechanism of action. By understanding the pathogenesis, this rare adverse effect may be avoided, or even utilized as a therapeutic alternative for the treatment of congenital or acquired lipodystrophy.

#84

THE EFFICACY OF A SECOND GENERATION FOCUSED ULTRASOUND COMBINED WITH RADIOFREQUENCY FOR BODY CONTOURING IN CHINESE

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Background: Several modalities for body contouring have been available commercially in the past few years, one of which is focused ultrasound. Fat cell destruction is achieved by ultrasound-induced mechanical effects. The second generation device aims to be safer with improved efficacy. The objective of our study is to assess the efficacy if this second generation focused ultrasound device in Chinese.

Study: 20 subjects were recruited for the treatment of abdominal fat. More than 1.5 cm fat thickness at the target area was required. Informed consent was obtained after going through the procedure and list of contraindications with the subject. All subjects received 3 successive treatments biweekly. Additional six visits were required for follow-up; the last visit was 3 months after last treatment. A combined treatment included radiofrequency treatment in stacking mode followed by ultrasound treatment immediately after. Caliper reading, abdominal circumference and standardized photographs were taken with the Vectra® system at all visits. Circumferential measurement of right thigh served as control. A transparent template for each subject will be used to ensure the same area was treated at each session.

Results: 17 female subjects completed the study. Abdominal circumference showed statistically significant improvement at 2 weeks post second treatment and all subsequent follow ups. Caliper readings were statistically significant at 2 weeks post second treatment till 1 month follow-up visit. The mean pain score reported was 2.3 on the visual analogue scale. 6 incidents of wheal formation appeared immediately after treatment all of which subsided spontaneously within several hours. Otherwise there were no adverse effects.

Conclusion: The second generation focused ultrasound combined with radiofrequency treatment for body contouring showed statistically significant improvement. It was a comfortable procedure with no significant adverse effects.

#85

IN VIVO OPTICAL COHERENCE TOMOGRAPHY AND REFLECTANCE CONFOCAL MICROSCOPY: IMAGING THE DYNAMICS IN CLOSURE OF FRACTIONAL LASER ABLATED MICROCHANNELS

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Background: Optical coherence tomography (OCT) and reflectance confocal microscopy (RCM) are non-invasive, optical imaging techniques with the capability of *in vivo* bedside imaging. Postoperative healing and closure of ablative fractional laser (AFXL)-drilled channels may be relevant in the context of laser assisted drug delivery. The objective was to characterize spatiotemporal healing and closure of AFXL channels using *in vivo* dynamic OCT and RCM techniques.

Study: Volar arm skin of healthy subjects (n = 6) was treated with 10,600 nm fractional CO2 laser using 5% and 25% densities, 120 μm beam diameter, 5 mJ, 15 mJ and 25 mJ pulse energies. Vivosight OCT and VivaScope 1500 RCM were used to image the treatment sites up to 7 days post laser exposure. Images were analyzed to classify whether microthermal zones (MTZ) were completely reepithelialized at specific time points. Data were compared with gold standard histology.

Results: RCM detected cellular structures and laser holes to a depth of 100 μm, OCT presented a 3D scan of the laser grid down to a maximum of 2 mm. MTZ were identified as central ablation defects, surrounded by hyporeflective shadows, reflecting superficial epidermal damage. Oozing and debris was identified

within the ablation defect. Channels gradually reepithelialized depending on energy level used: At 5 mJ 100% of channels were open at T = 0, 64% at T = 6 hours, 60% at T = 24 hours, and < 20% at T = 2 days. At 25 mJ 100% of channels were open at T = 0 and T = 6 hours, 91% stayed open at T = 24 hours. Even at T = 2 days post laser, approximately one third of channels appeared without full reepithelialization. OCT and RCM images were in accordance with histology.
Conclusion: OCT and RCM can be used to image AFXL channels and their spatiotemporal closure. Majority of laser channels remained incompletely reepithelialized up to 24 hours post laser, which may be of importance for delivery of topical substances through AFXL channels.

#86

PRESSURE ENHANCES FRACTIONAL LASER-ASSISTED DRUG DELIVERY

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Background: Ablative fractional laser (AFXL) is rapidly evolving as one of the foremost techniques for cutaneous drug delivery. Thus far, treatments of thick skin lesions have been problematic, potentially due to insufficient drug uptake in deeper skin layers. This study investigated if drug deposition could be improved with pressure, by measuring both drug delivery and laser channel filling.
Study: In Franz diffusion cells, deposition of PEG400 and filling of MAZ channels with a tissue-staining dye was investigated in intact skin (n = 18), AFXL-exposed skin (n = 42), and AFXL + pressure exposed skin (n = 42). AFXL-treatment was performed with a fractional CO_2 (1200 μm deep; 130.5 mJ/channel) and a cycle of pressure-vacuum-pressure was applied using compressed air (100 kPa, 1 min; 100% vacuum, 1 min; 100 kPa, 1 min). Nuclear magnetic resonance quantified the deposition of PEG400. Tissue dye penetration was evaluated by microscopy in frozen horizontal sections at different skin depths.
Results: Applying pressure greatly enhanced (6-fold) the intracutaneous delivery of PEG400 (54 μg/ml vs. 303 μg/ml, $p < 0.01$). The impact was greatest at early time points and declined over time; 600 vs 435 μg/ml at 1 h ($p < 0.01$) and 1106 vs 1113 μg/ml at 4 h ($p = 0.205$). Transcutaneous permeation was observed at 4 h and was significantly higher after pressure application; 84 μg/cm^2 vs. 32 μg/cm^2 ($p < 0.01$). Filling of MAZs was also enhanced by pressure, increasing the channel filling from 44% to 96% at 1000 μm depth ($p < 0.01$).
Conclusion: Applying pressure enhances AFXL-assisted drug delivery, most likely by facilitating MAZ-filling in deeper parts of the dermis. This may translate into more effective treatments for thicker skin lesions.

#87

RAPID DERMAL DEPOSITION OF INGENOL MEBUTATE USING PRESSURE AND ABLATIVE FRACTIONAL LASER

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Background: Topical ingenol mebutate (IngMeb) treatment of basal cell carcinomas necessitates dermal drug deposition. Ablative fractional laser (AFXL) in combination with pressure may provide a new modality for dermal drug delivery. This study investigated bio-distribution of IngMeb over time in intact, AFXL, and pressure-treated skin.
Study: Using Franz diffusion cells, delivery of IngMeb was investigated at 1h, 4h, and 22h in intact (n = 18), AFXL-exposed (n = 18), and AFXL + pressure exposed porcine skin (n = 18). A fractional CO2 laser delivered 130.5 mJ/channel, generating channels measuring 1200 μm deep and 100 μm wide. Pressure-vacuum-pressure was applied using compressed air (100 kPa, 1 min; vacuum 100%, 1 min; 100 kPa, 1 min). Liquid-chromatography–mass-spectrometry quantified deposition of IngMeb in stratum corneum, epidermis, dermis, and receiver chamber.
Results: AFXL combined with pressure resulted in rapid and profound deposition of IngMeb in the skin. Epidermal deposition increased 4-fold with AFXL compared to intact skin (0.8 to 3.0 nmol/cm^2, $p < 0.01$) and increased to 4.4 nmol/cm^2 with pressure application. Dermal deposition in intact skin was nominal at all time points (<7.34 nmol/cm^2) and increased up to 18-fold with AFXL (21.4, 42.2, 82.8 nmol/cm^2 at 1h, 4h and 22h, respectively, $p < 0.01$). Applying pressure resulted in even faster and greater dermal deposition of IngMeb (1h 34.7 nmol/cm^2; 22h, 93.8 nmol/cm^2 $p < 0.01$).
Conclusion: AFXL in combination with pressure induces a rapid and profound deposition of IngMeb in the skin. Dermal deposition of IngMeb may translate into effective treatment of basal cell carcinomas.

#88

RAPID FIBRIN PLUG FORMATION WITHIN ABLATIVE FRACTIONAL CO_2 LASER LESIONS

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Background: Ablative fractional laser procedures have been shown to facilitate topical drug delivery into skin. Past studies have mainly used *in vitro* models to demonstrate enhanced drug delivery and in-vivo studies assumed laser created channels as being static over time. We have noticed that rapid fibrin plug formation occurs in *in vivo* ablative fractional laser lesions. This study is aimed to investigate the time course of such fibrin formation and how the passage of the laser created channels is affected.
Study: A porcine model was used. *In vivo* laser exposures were performed on flank skin of the swine under general anesthesia. A custom-built, pulse-modified fractional CO_2 laser (AcuPulse™ system, AcuScan 120™ handpiece, Lumenis, Inc., Yokneam, Israel) was programmed in QCW mode, 50W, 50 mJ per pulse, 5% coverage, 120 um spot size, 8 × 8 mm square pattern, 169 pulses per scan. 6 mm punch biopsies were procured at 0, 2, 5, 10, 15, 30, 60, 90 minutes after completion of each scan, then immediately

fixed in 10% formalin. 6–8 repeats were performed of each time points. Skin samples were processed for serial vertically cut paraffin sections (5 um collected every 25 um) and H&E staining. Dimensions of MTZ lesions and extent of fibrin plug were assessed and quantified.
Results: Histology procured at various predetermined time intervals after *in vivo* fractional CO_2 laser exposures revealed a rapidly forming fibrin plug initiating at the bottom of the MTZ lesions. With increasing time intervals, the fibrin plug was extending towards the superficial sections. Within the first 5 minutes, more than 25% of entire laser-ablated depth was filled with a fibrin plug. With increased time intervals, the cavity was progressively filled with a fibrin plug. At 90 minutes, more than 90% of the laser-ablated channel was occluded. *In vitro* exposures failed to produce a significant fibrin plug.
Conclusion: The current study has demonstrated rapid fibrin plug formation after ablative fractional laser procedures. It was shown that the passage through laser created pathways is critically time dependent for *in vivo* exposures. In contrast, *in vitro* exposures do not exhibit such time dependent passage capacity. In particular, drug and cell delivery studies for fractionally ablative laser treatments should take this effect into consideration.

#89

FRACTIONAL ABLATIVE LASER FOLLOWED BY TRANSDERMAL ACOUSTIC PRESSURE WAVE DEVICE TO ENHANCE THE DRUG DELIVERY OF AMINOLEVULINIC ACID - *IN VIVO* FLUORESCENCE MICROSCOPY STUDY

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Background: Cutaneous bioavailability of most topically applied drugs is relatively low with only 1–5% being absorbed into the skin. For a topical agent to be active, it must first traverse the rate-limiting outermost barrier of the stratum corneum. Ablative fractional laser (AFL) therapy is a unique modality which has the ability to create ablative channels of varying depths in the skin in a predictable and controlled manner. Laser assisted drug delivery is an evolving modality which may allow for a greater precise depth of penetration by existing topical medications, more efficient transcutaneous delivery of large drug molecules. A transdermal delivery system has been developed to enhance the delivery of topical cosmeceuticals. The hypothesis is this device emits acoustic waves and air pressure which pushes active components deeper into the skin and helps to promote topical absorption. The objective of this study was to evaluate *in vivo* if there is increased efficacy of AFL with immediate transdermal acoustic waves to enhance drug delivery via histologic immunofluorescent evaluation.
Study: ALA is a photosensitizer prodrug used for photodynamic therapy. When topically applied to the skin, ALA is metabolized into protoporphyrin IX. These porphyrins are photoreactive and can be detected by fluorescence measurements. Aminolevulinic acid (ALA) has been chosen to evaluate if the combination of AFL with immediate transdermal ultrasound will enhance drug delivery. Six patients were treated with four treatment areas - topically applied ALA, AFL and topically applied ALA, AFL and transdermal acoustic pressure wave device and topically applied ALA with transdermal acoustic pressure wave device. Differences of diffusion both lateral and depth of ALA diffusion was measured by fluorescence microscopy.
Results: With laser + ALA + acoustic device the protoporphyrin IX lateral fluorescence was 0.024 mm on average versus fractional laser and ALA only was 0.0084. The diffusion with the acoustic air device was an order of magnitude greater.
Conclusion: In our prospective study we found that the combined approach of fractional CO_2 laser and the acoustic pressure wave device was the most efficient in both depth and width of ALA penetration to the skin.

LASER DENTAL APPLICATIONS

#90

THE EFFECTS OF COMBINED LLLT AND MESENCHYMAL STEM CELLS ON BONE REGENERATION IN RABBIT CALVARIAL DEFECTS

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Background: This study evaluated synergistic and isolated effects of low level laser therapy (LLLT) and mesenchymal stem cells (MSCs) on bone regeneration. Background data: Regeneration of extensive bone defects has been always a challenging and unsolved problem.
Study: 48 circular bony defects (6 mm in diameter) were prepared in the calvaria of 12 New-Zealand white rabbits. The defects of each animal were randomly assigned to 4 groups: 1) Control, no treatment; 2) LLLT applied on alternate days; 3) filled with MSCs and scaffoldof new bone formation, remaining scaffold and inflammation.
Results: The histological evaluation showed a statistically significant increase in new bone formation of LLLT group relative to the control and the other two experimental groups ($P < 0.05$). There was no significant difference in bone formation of the control group compared to experimental groups filled with MSCs. Laser irradiation had no significant effect on resorption of the scaffold material. In addition, inflammation was significantly reduced in LLLT group compared to the control defects and the other two experimental groups.
Conclusion: Low level laser therapy could be effective in bone regeneration but there is no evidence of a synergetic effect when applied in conjunction with MSCs.

#91

ER STRESS-MEDIATED BY ATF-4 ORCHESTRATES NEAR-INFRARED LASER PHOTOTOXICITY

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Background: Lasers have been extensively used in medicine for wide range of clinical applications as surgical tools,

photobiomodulation (PBM) and in photodynamic therapy (PDT). PBM therapy is used for a broad range of applications such as promoting wound healing, analgesia and immunomodulation, among others. However, this therapy demonstrates a biphasic response, where low doses are beneficial while higher doses are detrimental (phototoxic) resulting in varying clinical efficacy. Phototoxicity at higher doses highlights the importance of endogenous chromophores for laser mediated damage.
Study: To understand this better, photoabsorption of near infrared laser on mice skin was studied. It was observed that 50% of irradiation was absorbed by mice skin and rest gets absorbed by the underlying tissues. Based on *in vivo* absorption pattern, an *in vitro* model was developed where in laser treatments were performed in black well plates.
Results: Using a standard dose escalation study, we noted increased erythema and tissue damage in mice skin and significant cell death in cultures following laser treatment at 0.09 W/cm^2 or 27 J/cm^2 that correlated with surface temperature of > = 45 degC. Laser phototoxicity involves generation of reactive oxygen species (ROS), coupled with a significant rise in surface temperature that results in endoplasmic reticulum stress and autophagy. Sub-phototoxic laser doses induce Activating Transcription Factor-4 (ATF-4) and Heat Shock Protein 70 (HSP70) mediated autophagy while high doses appear to suppress their expression along with excessive autophagy. Neutralizing heat, ROS or overexpressing ATF-4 rescued laser phototoxicity. Laser phototoxicity were noted to be non-genotoxic and non-mutagenic.
Conclusion: This study demonstrates the use of monitoring surface temperature during treatment as an *in vivo* clinical biomarker to prevent laser phototoxicity, while ATF-4 expression could serve as a molecular biomarker for safe and efficacious PBM clinical protocols. This study also suggests a novel mode of laser mediated photodynamic therapy could utilize the ER stress pathway.

#92

MEASUREMENT OF PULSATILE FLOW IN THE TEETH USING LASER SPECKLE IMAGING

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Background: Endodontists perform root canal therapy on teeth suspected of having compromised blood-flow. Current tests to diagnose tooth vitality rely on a patient's reactions to painful nerve stimulation. We focused on noninvasive assessment of pulpal blood-flow, a more direct indicator of pulpal health. Laser speckle imaging (LSI) is used to quantify blood-flow and perfusion in tissue. This technique detects movement of blood cells, by measuring the interference pattern of incident laser light. To achieve a painless, quantitative, and objective measure of pulpal vitality, we built and tested an LSI device to detect the presence of pulsatile flow in the teeth.
Study: We designed and built a fiber-based LSI device to acquire speckle images of the teeth. The device uses a leached fiber bundle with a custom-built adjustable focusing lens, and delivers light from the lingual side out through the buccal side of the tooth. We performed Fast Fourier Transforms on the acquired speckle contrast waveforms to isolate frequency components. We performed *in vitro* validation tests using a pulsatile pump to infuse Intralipid through an extracted tooth.
Results: We successfully built a fiber-based device to detect pulsatile flow using time-series LSI and frequency domain analysis. We used this device to successfully identify the principal pulsatile frequencies in an in-vitro system at a range of physiological blood-flow frequencies (0.67–2.00 Hz). We also detected a pulse of about 1 Hz in the incisor of a healthy subject, which coincided with the actual heart rate.
Conclusion: We demonstrated the ability of our LSI device to detect frequency components in pulsatile flow. Endodontists can use such information to assess the presence of blood flow in a tooth, making this a critical step towards achieving a clinic-ready solution to this diagnostic challenge. Our future work involves miniaturization of the device and an initial clinical trial to assess its performance.

#93

HISTOLOGICAL CHANGES ON DENTINAL SURFACE IRRADIATED BY Nd:YAG LASER BY USING SCANNING ELECTRON MICROSCOPY

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Background: Dentine hypersensitivity (DH) is one of the most painful chronic problems reported in dental offices. Various methods have been applied for the treatment of DH. However, most of them are either ineffective or last for a short period of time. It is described that lasers especially neodymium-doped: yttrium aluminum garnet laser (Nd:YAG) can help in this issue. However, systematic reviews showed that evidence for this effectiveness is weak. The aim of this study was to evaluate the dentin surface prepared by Nd:YAG laser in different powers and energies.
Study: Fifteen extracted human molars were randomly divided into five groups receiving different powers and energies of Nd:YAG laser (Group A: power: 0.7 W, Energy: 70 mJ, Group B: power: 0.9 W, Energy: 90 mJ, Group C: power: 1.1 W, Energy: 110 mJ, Group D: power: 1.3 W, Energy: 130 mJ, Group 5: power: 1.5 W, Energy: 150 mJ) in three pulse modes. The surfaces of the specimens were studied using scanning electron microscopy (SEM) thereafter.
Results: In output power of 0.7 W in single, double and triple radiation modes sealed dentinal tubules and no smear layer were observed. Prepared surfaces by higher powers of 0.9 W, 1.1 W, 1.3 W and 1.5 W also showed the same features seen in 0.7 W power, single and double pulse mode beside foci of carbonization in 1.5 W power, single pulse mode.
Conclusion: Preparation of the teeth using all tested powers result in sealing dentinal tubules, so using 0.7 W power in double and triple radiation modes is the best power the clinician can apply as it has the minimum energy with less side effects, physical danger and unwanted carbonizations. Experimental and clinical studies especially randomized clinical trials to compare the effect of Nd:YAG lasers with conventional methods are recommended.

#94

ASSESSMENT TO THE OPTICAL ATTENUATION COEFFICIENT OF ERODED DENTIN

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Background: This *in vitro* study aimed to evaluate changes in optical attenuation coefficient of eroded dentine analysed by Optical Coherence Tomography (OCT) after irradiation with Nd: YAG laser and topical fluoride.
Study: The samples were protected with acid resistant varnish, with the exception of the central area of 2 mm diameter and divided into 8 groups (n = 15) and subjected to acidic cycling with citric acid solution for 20 minutes, twice a day, during 20 days. After 10 day submitted to acid challenges, each group received different treatment: control group (no treatment), fluoride group (topical sodium fluoride 2% -by 4 minutes); three laser groups irradiated with Nd:YAG irradiating on contact (1 W, 0.7 W and 0.5 W mean power); and three treated groups associating the fluoride to laser irradiation. The OCT readings were performed at days: 1 prior to first acid challenge (OCT1); at day 5 (OCT2); at day 10 (OCT3); at day 15 (OCT4); at day 17 (OCT5) and at day 20 (OCT6). It was developed a homemade software to retrieve the total optical attenuation coefficient.
Results: It was observed an increase of optical attenuation coefficient among the control group and the others groups. The best result for erosion treatment was the combination of fluoride followed by laser irradiation with radiant exposure of 39.78 J/cm^2.
Conclusion: The optical attenuation coefficient determined by OCT proved to be an important quantitative diagnostic tool.

#95

THE EVALUATION OF EFFECTS OF DIODE LASER WELDING ON SCIATIC NERVE INJURY IN RAT

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Background: Motor nerves injuries and transections are common consequences of war battles, vehicle accidents and other disasters. The standard medication for these includes suturing and anastomosis of transected nerve in the first hours after trauma. Of the other suggested treatments in the literature is laser therapy and irritation of laser beam directly to the injured site.
Study: The aim of present study was to evaluate the effect of neurorrhaphy and laser nerve welding by diode laser plus biologic solder on transected sciatic nerve and eventually comparing these methods to each other. In second group neurorrhaphy was done by 10-0 prolene suture.
Results: 30 mature male ficher – 344 wistar rats went for surgical intervention of transecting right sciatic nerve under general anesthesia. Rats randomly were assigned for 3 groups:1- Laser group 2-Microsurgery group 3-Control group. In first group nerve welding conducted by diode laser (P: 500 mW) plus biologic solder. All the samples evaluated by Foot print test biweekly.12 weeks post-surgery and after testing rats by EMG device, sample were sacrificed for histopathologic evaluation. The student's T test was used in statistical analysis.
Conclusion: Laser nerve welding is a comparable method for nerve injuries treatment and there is no serius problems with this method.

#96

APPLICATION OF PHOTOBIOMODULATION IN A GENERAL DENTAL PRACTICE

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Background: Photobiomodulation has been shown both clinically and in research to improve wound healing, decrease pain sensations, reduce inflammation, improve nerve regeneration, reduce muscle trismus and stimulate lymphatic flow and circulation. This presentation will review the primarily and secondary responses from cells which allow for these effects to occur. In addition, the principles of biostimulation and bioinhibition, as well as Laser Therapy parameters such as wavelength, dosage, power density and light source will be discussed for various clinical applications, including: • Pain reduction after extractions, surgery and root canals • Dry socket • Dentin hypersensitivity • Sinus problems • Soft tissue lesions such as cold sores, apthous ulcers and mucositis • Facial pain; TMJ pain, neuropathic pain such as trigeminal neuralgia, and myopathic pain • Nerve regeneration The goal of this presentation is to give attendees the opportunity to learn the clinical applications of photobiomodulation while enabling them to evaluate these applications in an evidence-based format. Participants will leave this course with all the tools required to utilize photobiomodulation in their practice comfortably and predictably.

#97

IN VITRO PHOTODYNAMIC INACTIVATION OF CANDIDA ALBICANS BY PHENOTHIAZINE DYE (NEW METHYLENE BLUE) AND INDOCYANINE GREEN (EMUNDO®)

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Background: Application of new generation of photosensitizers for increasing efficacy of antifungal photodynamic therapy (aPDT) is an important aspect of PDT. So the aim of this *in vitro* study is to evaluate antifungal efficacy of photoelimination of candida albicans with photothermal and antifungal photodynamic therapy.
Study: aPDT with new methylene blue and photothermal therapy with EmunDo® were applied in fungal suspension and then subcultured in sabouraud dextrose agar (SDA). Colony counting of candida albicans performed base on colony forming unit per millimeter CFU/ml).
Results: aPDT with either EmunDo® or new methylene blue (NMB) considerably diminished the viability of inoculated C. Albicans ($P < 0.001$) with respective percent of reduction of 86 and 93% compared to the control group. Antifungal Potency or dark toxicity of two photosensitizers alone were not differed remarkably ($P = 0.70$). The same trend was observed for the light sources (wavelength: 810 nm vs wavelength: 630 nm) with no significant difference ($P = 0.78$).
Conclusion: Photoelimination of C.Albicans by either new methylene blue or EmunDo® as a photosensitizer can reduce viability of fungal cells. Although the result of this study is encouraging, further investigations warranted to determine clear

protocols to apply it as a reliable and safe method in clinical practice.

#98

TOPICAL PHOTODYNAMIC THERAPY OF LEUKOPLAKIA IN ORAL CAVITY - SIX MONTHS STUDY

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Background: Aim of this study is to demonstrate new possible and promising method in treatment of pre-malignant lesions in oral cavity, topical photodynamic therapy (tPDT). Systemic Photodynamic therapy (sPDT) is approved method for many premalignant or malignant lesion in head and neck region. They are two main limitations of sPDT: Systemic photosensitization of whole body and costly and time consuming protocol. Those obstacles made this procedure very rarely indicated in Europe, mostly in position of infrequent alternative. tPDT changed dermatology in last years and it is method of choice for most common cancer, superficial basal cell carcinoma in Europe. This procedure takes only hours (not days like sPDT), it is cheaper and safer. It is hot topics with multiple new photosensitizers, irradiation techniques and pre-treatments. Why not use this simple technique in oral cavity, which is easy to access as skin? Main problem is proper incubation in aggressive oral environment, another challenge is regular irradiation of mouth in some difficult to access areas (under tongue for example). We prepared some different formulas of aminolevulic acid for this application in special adhesive gel in last years.
Study: Two-centric prospective study. Adhesive hydrogel with 20% ALA (aminolevulic acid) 2 h incubation time intraoraly. 36 patients (20 women, 16 men). Average age 63 ± 4,2Y. Leukoplakia-homogeneous 29, non-homogeneous 10. 2 treatments in 1 months. Blinded evaluation of CR after 6 months. Histopathology.
Results: CR 0–25% 1; 25–50% 13; 50–75% 22; 75–100% 4. No malign transformations.
Conclusion: Intraoral tPDT is feasible method for treatment of premalign lesions in oral cavity. Effectiveness is significant but not absolut, mostly incomplete. Futher development of this promising method is necessary.

#99

PLACE DENTAL IMPLANT ONLY WITH LASER

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Background: The objetive of this work is to demonstrate and to evaluate the possibility of placing dental Implants with Er: YAG without the traditional drilling to prepare the bone. This work also aims at evaluating the use of diodo laser to facilitate and to improve both the length of the bone integration procesos and the reparation of the tissues where the implant is place.
Study: A group of patients aged between 25 and 60 with lost dental pieces had implant of titanium placed in this maxillary or this mandible. The anesthesia applied was local,u sing only 0,4 ml carticain to eliminate the soft tissue. Er:YAG láser was used to prepare the cavity in the bone. After placing the implant, Diodo laser of 980 nm was used to stimulate the growth factors and improve post treatment. Bone integration was che les with Rx before the treatment, right after the implant placement and 15, 45 and 60 days post treatment. Only 75 days after the treatment, a prothetics crown was placed. The control with Rx continued for one year.
Results: Patients had a perfect bone integration of the implant. There were no cases of implant loss due to fibrointegration or necrois. Rx always showed a good growth of the bone aro una the implant and a good bone integration. The soft tissue cicatrized faster than with the traditional method and they were not contaminated. The amount of anti-inflammatory medication post treatment was reduce to compared to the amount used with the traditional method.
Conclusion: The Er:YAG laser is effective, fast,secure and confortable to prepare the bone before placing an implant. This method can replace the traditional drill because the bone has a favorable reaction to laser application. Moreover the use of diodo laser helps reduce the length of the bone integration process and allows an early placement of the prosthetics crown. Finally,the laser offers new and useful possibilities to oral implantology providing a shorter and more conservative option.

#100

COMPARISON OF ANTIMICROBIAL PHOTODYNAMIC THERAPY AND Er,Cr:YSGG LASER ASSISTED PERIODONTAL POCKET THERAPY IN THE TREATMENT OF AGGRESSIVE PERIODONTITIS: A PILOT STUDY

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Background: The treatment of aggressive periodontitis has always been presented as a challenge for clinicians, but there are no established protocols and guidelines for the efficient control of the disease. Various adjunctive anti-infectious therapeutic possibilities are available as an adjunct to conventional mechanical nonsurgical and surgical treatment methods. Photodynamic therapy (PDT) or Laser assisted pocket therapy could become new methods of antibacterial treatment and may be used as adjunct to or as conventional therapy for the treatment of aggressive periodontitis. The study aims at finding a treatment modality that will be free of side-effects of currently used modalities for the treatment of aggressive periodontitis like systemic antibiotics.
Study: 5 patients with age between 18 to 35 years suffering from aggressive periodontitis were selected from the outpatient department of periodontics. Two sites were selected based on the inclusion and exclusion criteria and then randomly assigned to different modalities of treatment: PDT or Er,Cr:YSGG Laser assisted pocket therapy. Pocket Depth (PD) and Clinical Attachment level (CAL) were recorded at baseline and at 3 months.
Results: Statistical analysis using non parametric (Wilcoxon Signed rank) test demonstrated no differences between groups at baseline for all parameters ($P > 0.05$). Both the treatments yielded significant improvements in terms of PD decrease and CAL gain compared to baseline values ($P < 0.05$) after 3 months. There was no significant difference between the two groups for PD reduction and CAL gain.
Conclusion: This pilot study gives promising results for the treatment of aggressive periodontitis using photodynamic therapy (PDT) and Er,Cr:YSGG laser assisted pocket therapy (ELAPT). Further investigations with larger sample size are required to evaluate the effects of both the modalities.

#101

USING DENTAL LASERS TO TREAT MEDICALLY COMPROMISED PATIENTS

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Background: This presentation will present the utility of using lasers in a traditional dental office setting of complex, medically-compromised patients. In consultation with medical colleagues, patients had their dental treatment done in my office without hospital admission and remaining on their medication regimes.
Study: Five complex cases and their management will be presented. Case 1. Extraction on a patient that had emergency heart surgery 7 days prior. Case 2. Extraction on secondary myeloplastic anemia patient Case 3. LLLT/PBM on Parkinson patient with severe tremors Case 4. Root canal on patient undergoing chemotherapy. Case 5. Periodontal treatment of severe lymphedema patient.
Results: In cases one and two these patients were able to have extractions done in my office without hospitalization due to the hemostatic properties of Nd:YAG and Diode lasers. Target tissue of these lasers is dark pigmented tissue especially hemoglobin. LLLT/PBM treatment was noted to reduce involuntary tremors and allowed the root canal, extractions, bridge work and impressions for dental procedures. During her chemotherapy regime, a patient reported with a broken tooth and was managed with diode and Nd:YAG lasers. In the severe lymphedema patient we were able to obtain our result due to the homeostasis and bactericidal properties of these lasers.
Conclusion: Dental lasers allow us to treat some medically compromised patients of all ages in traditional dental offices without the added expense and discomfort of hospital stays and changes in medication regimes.

#102

EVALUATION OF LOW LEVEL LASER THERAPY IN TEMPOROMANDIBULAR JOINT DISORDERS

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Background: The temporomandibular joint disorders (TMDs) have been considered as an important cause of orofacial pain. They may encompass features of psychophysiological orofacial pain, masticatory dysfunction, or both. Anxiety or psychosocial factors influence the treatment outcomes in patients with TMD. Low level laser therapy (LLLT) has been found to have analgesic, anti-inflammatory and bio-stimulating effects. It is a noninvasive intervention that may be beneficial in TMDs. The aim of this study was to monitor and evaluate the effectiveness of LLLT in pain intensity reduction and improvement in maximal mouth opening in patients presenting with TMD. Additionally, the anxiety scores before and after treatment was compared.
Study: The study consisted of 20 patients with TMD, classified on the basis of the Diagnostic Criteria for Temporomandibular Disorders. Patients were treated with a semiconductive GaAlAs laser emitting radiation wavelength of 810 nm at the painful points, twice a week for three consecutive weeks. Pain was recorded using a 10 cm Visual Analogue Scale. Maximal mouth opening and pain intensity were recorded at baseline, after laser application at each visit and 30 days after last application. The level of anxiety was recorded on the hospital anxiety depression scale.
Results: The mean age of subjects was 38.43 ± 14.56. For pain reduction, mean difference for all visits was found to be statistically significant, but the highest significant reduction in pain was found to be between first and last visit ($p = 0.004$). Maximal mouth opening was significantly greater after 30 days of laser therapy when compared with the last visit ($p < 0.034$). Anxiety scores were found to be significantly lower after therapy.
Conclusion: Laser application resulted in the immediate decrease of painful symptoms and increased range of mouth opening in the treated patients. Laser application can be a supportive therapy in the treatment of TMD in an effort to improve the quality of patients' lives.

NORTH AMERICAN ASSOCIATION FOR LASER THERAPY (NAALT)/VETERINARY APPLICATIONS

#103

INTERNAL ORGAN APPLICATIONS IN SMALL ANIMAL VETERINARY MEDICINE

Ronald Riegel
American Institute of Medical Laser Applications, Marysville, OH

Background: Present Case Studies of novel applications of photobiomodulation (PBM) within the veterinary field.
Study: Respiratory, cardiac, hepatic, renal and digestive system cases will be presented with their respective treatment parameters and protocols.
Results: Case studies were compiled from multiple Veterinary practices. Presented Case Studies demonstrate successful clinical outcomes after the application of PBM.
Conclusion: The administration of photonic energy is of great benefit to a wide range of disorders

#104

EFFICACY OF PHOTOBIOMODULATION IN THE TREATMENT OF OSTEOARTHRITIS IN THE CANINE SPECIES

Ronald Riegel, Ann Bancroft, Jennifer F. Johnson, Greg Emmert, Debbie Gross, Laurie Dunbar
American Institute of Medical Laser Applications, Marysville, OH; MedVet Medical & Cancer Centers for Pets, Worthington, OH; Stoney Creek Veterinary Hospital, Morton, PA; McGee Street Animal Hospital, Norman, OK; Wizard of Paws Physical Rehabilitation for Animals, LLC, Colchester, CT; Pointe Claire, Quebec, Canada

Background: The purpose of this study was to evaluate the effectiveness of Photobiomodulation (PBM) in the treatment of Osteoarthritis (OA) within the coxofemoral joint of the canine.
Study: Five different veterinary practices using Laser Therapy for PBM were supplied with case study forms specifically designed

to retrospectively collect information to evaluate the effectiveness of PBM in the treatment of OA within the coxofemoral joint of the canine. Forty two cases were collected and reviewed, of which thirty met predetermined inclusion and exclusion criteria, and had sufficiently complete medical histories and treatment protocols to be included in the study. All case study forms included information on range of motion of both the left and right coxofemoral joint (degrees), in flexion and extension, lameness score at a walk, and pain score; measured and recorded prior to initiating Laser Therapy and at four and six weeks post initiation of PBM. As well as Laser dosages at each treated coxofemoral joint, frequency of laser treatments and a notation of any reduction in medical therapy. All information was collected and summarized.
Results: After six weeks of Laser Therapy all patients demonstrated an increase in range of motion, and a decrease in pain, lameness and functional disability.
Conclusion: PBM effectively treated OA within the coxofemoral joint of the canine significantly increasing the patients' quality of life.

#105

PDT IN SQUAMOUS CELL CARCINOMA: TREATMENT OF SKIN CANCER OF CATS

Katalin Kovacs
Small Animal Laser Clinic, Budapest, Hungary

Background: Cats treated in our specialized clinic often suffer from SCC (e.g. squamous cell carcinoma) mainly caused by sunlight irradiation in outdoor cat. SCC appears in areas of body where there is lack of fur or pigment of skin or it is bright colored. Mostly affected areas are the ears, nose and the muzzle. Photodynamic therapy (PDT) is not currently in everyday use in veterinary praxis. PDT selectively destroys carcinoma cells without damaging healthy tissues.
Study: The purpose of this study is to evaluate the clinical usefulness, handling and result of PDT of temoporfirin and Ceralas PDT 652 diode laser. Presentation of 6 cases and technical details are documented. Systemic administration of new formulation of photosensitizer, m-THPC; Foslip was applied. The dosage was adjusted according to the characteristics of the tumor, which resulted in the drug's optimal activation and entry into the target tissues. After application of Foslip and certain period of time, varied case by case, the area was treated with heatless laser light (wavelength: 652 nm). Removal of dead tissues took weeks, new tissue was generated from the unaffected, healthy tissues, lying below the tumor. Repeated treatments were applied within the recommended 4 weeks interval after treatment to reach complete destruction of the tumor. In other cases, treatment was repeated respecting the 4 weeks interval.
Results: In every case, tumor regression reached 100%. Tumors did not relapse within 6 to 12 months after treatment. The patients' symptoms significantly alleviated already with the first treatment. Appetite and vitality improved. We found that this liposomal formulation of Foslip is extremely well tolerated by cats. The rapid drug accumulation and the fact of well-tolerance is an advantage for clinical application of PDT, because the therapy can be accomplished in several visits, which is substantial advantage for clients. Regeneration was excellent in all cases, functional and anatomical integrity was preserved, which enabled patients to continue their routine life.

#106

LOW LEVEL LASER THERAPY OF SERIOUS WOUNDS OF DOGS

Katalin Kovacs
Small Animal Laser Clinic, Budapest, Hungary

Background: Dogs often suffer serious injuries in fights or attacks by other dogs with behavioral problems. These injuries are often deep, torn and the wound itself is extented size. These injuries recover with difficulty, deteriorate the average state of the dog and often end up with death of the animal. Other dogs suffer such accidents which from the chance of recovery is minimal. Aim of the study is to give evidences of level laser therapy in deep, extended skin injuries and documentation of results of recovery.
Study: Infrared medical Laser device (wavelength: 810 nm Spectra Vet) was applied for laser therapy. Dose – area relationship, dose – depth relationship and dose – time relationship were calculated based on "target volume" of biological answer. Data are presented in tables case by case, concerning the healing process. For surface cleaning chlorhexidine solution was used. Narcosis was applied only at the first treatment for deep cleaning and removal of necrotized tissues. Post-treatments procedures as cleaning and laser therapy happened in awaken state of dogs. Follow up photos of most demonstrative 5 cases are presented.
Results: In every case the regression of pain at the injured area was evident soon after the first treatment. Effect of low level laser therapy resulted unexpected full regeneration of skin, gingival, and mucosal damages. Even aggressive animals turned to be cooperative during the treatments. The esthetic effects were also superb with regeneration along the residual scars was spectacular.

NURSING/ALLIED HEALTH

#107

COMPLICATIONS IN LASER SURGERY: HOW TO AVOID THEM AND THEIR MANAGEMENT IN DERMATOLOGIC LASER PRACTICE

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Background: Inherent to any procedure is the risk of complications. This holds true in laser surgery as in any field. We review here the most common complications of laser procedures for treatment of vascular lesions, tattoos and pigment containing lesions, and unwanted hair, as well as complications of laser resurfacing (ablative, non-ablative, and fractional devices) and Intense Pulsed Light (IPL) devices.
Study: Review of complications in laser surgery from experience in a high volume laser and dermatologic surgery center.
Results: In our center, laser procedures for treatment of vascular lesions, tattoos and pigment containing lesions, and unwanted hair, as well as laser resurfacing (ablative, non-ablative, and fractional devices) are performed daily. We present the most common adverse events, how to avoid them, and their management.
Conclusion: Review of common adverse events in laser surgery, how to avoid them, and their management.

#108

NOVEL USES FOR LASERS AND ENERGY BASED DEVICES IN CLINICAL LASER PRACTICE

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Background: Innovations in laser technology continue at a rapid pace with novel therapies are on the horizon. With the evolution of laser technology it is critical for both safety and efficacy that providers are up-to-date on the most current therapies available. We review here novel applications of lasers and energy based devices in practice. Specific attention is given to picosecond lasers for tattoos, high peak power Nd:YAG lasers for cutaneous vascular lesions, microwave energy for hair removal, and enhanced topical drug delivery with combination therapies.
Study: A review of novel uses for lasers and energy based technologies.
Results: Constant evolution and improvement in laser and energy based device technology has allowed for novel uses of these devices in clinical practice.
Conclusion: We review novel uses for lasers and energy based devices based on our experience in a high volume laser and dermatologic surgery center.

#109

LASER TREATMENT OF VASCULAR LESIONS IN CHILDREN

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Background: Cutaneous vascular lesions are a common indication of for laser treatment. However, many clinicians are not familiar with the complexity of treating these lesions in children. We review here the special considerations important to the laser treatment of vascular lesions in children. Specific attention is given to the treatment of port wine stains and infantile hemangiomas. We review the pre-operative, operative, and post-operative care for treating this special population.
Study: A review of Laser Treatment of Vascular Lesions in Children.
Results: In our center, laser procedures treating of vascular lesions in children are performed daily. We present a review on the intricacies of treating this special population.
Conclusion: Special care must be taken when treating cutaneous vascular lesions in children. We provide a review on our office protocols to ensure optimal patient care.

#110

BODY CONTOURING NURSING CONSIDERATIONS

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Background: An increasing number of patients are seeking non-invasive laser and energy treatments to improve the appearance of the body. As demand increases, the number of devices and therapeutic regimens available to consumers is expanding such that there is a need for a consistent standard of nursing care to ensure safe and effective clinical delivery of body contouring treatments.
Study: Our practice has developed detailed patient management protocols based on the high volume of noninvasive body contouring procedures performed in our office. We offer numerous noninvasive body contouring procedures including: cryolipolysis, radiofrequency, intense focused ultrasound and combination devices. Each treatment has specific pre-operative, intra-operative and post-operative considerations to ensure the best outcome. Side effects and complications, while rare, require expedient recognition and management to reduce related morbidity.
Results: We present an extensive review of non-invasive body contouring devices, including their primary indications, patient selection criteria, patient preparation, intraoperative and postoperative care plan. Each body contouring device 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. In addition, a holistic approach is needed to ensure that patients are within current body mass index (BMI) guidelines or counseled towards achieving these goals.
Conclusion: As more patients seek non-invasive body contouring treatments, guidelines for patient management are essential. Detailed patient counseling regarding realistic expectations, photographic documentation, clinical measurements and close follow- up care are vital for optimizing patient satisfaction.

#111

ONYCHOMYCOSIS - LASER AND LIGHT TREATMENTS FOR TOE NAIL FUNGUS

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Background: Onychomycosis is a persistent and common problem affecting between 2–8% of the general population. Over the counter anti-fungal preparations used to paint the offending fingers and toes have been used with poor results for many years. Systemic oral anti-fungal medications available possess the possibility of serious side effects including damage to the liver. Laser and light devices offer a potentially safe and effective alternative.
Study: A comparative study using a variety of lasers and light devices (Nd:YAG [long pulse], Q-switched Nd:YAG, Q-switched KTP, a combination of both Q-switched wavelengths and Intense Pulsed Light) have been trialed for efficacy. Patients are excluded from using any topical or systemic drugs while part of the study. Prior to treatment the nails may be debrided if required to thin the nail plate. Four treatments, one week apart treating infected nail plus all other nails on both feet to reduce risk of cross infection. Photographs are taken at baseline, 3 months and 6 months post treatment for evaluation.
Results: Clinician evaluations of patient's nails using the GAIS 5 point scale showed a mean reduction in nail bed fungus.
Conclusion: This small trial to showcase various laser and light devices available to treat Onychomycosis show promising reduction in nail bed fungus as a safe and effective alternative to OTC anti-fungal preparations and oral medication.

#112

MICROEXFOLIATION & MICROCIRCULATION WITH DNA REPAIR INFUSION

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Background: Microexfoliation has proven highly beneficial for photodamage, melasma, fine rhytides, acne scarring, blemishes and oily/sebaceous skin. By adding in the circulation component (aka microcirculation, microexfoliation with a vacuum lifting technique), skin is greatly improved. Microcirculation helps to support the inflammatory response in the dermis as well as supply the exchange of oxygen and nutrients. It also helps to regulate fibroblasts and creates a controlled dermal injury for increased collagen remodeling. The free radial theory of aging has hypothesized that aging results partly from damage to DNA, cells and tissues from cumulative exposure to reactive oxygen molecules. In order for cells to maintain homeostasis, cells must eliminate various and degraded components. Peptides and enzymes stimulate skin's DNA repair mechanisms (which lessen as we age) to self-correct DNA errors induced by the environment, UV, pollution, etc. They also help to prevent the formation of fine lines and aid in collagen synthesis. Microexfoliation treatments are a popular, well-liked non-invasive procedure for photo-aging as well other common aesthetic concerns, and peptides and enzymes are emerging as a leading anti-aging ingredient in today's skin care products.
Study: The objective is to show that most advantageous results are obtained when combining microexfoliation and microcirculation followed by a DNA repair infusion applied in a single procedure. Microexfoliation (microdermabrasion, mechanical exfoliation or microresurfacing) employs the use of a medium, such as a bristle, diamond or plastic tip. The tip is combined with vacuum for optimal exfoliation of the stratum corneum as well as circulation, which supports the inflammatory response in the dermis. An increase in collagen remodeling from the controlled dermal injury is shown as well as the stratum corneum normalizing and achieving a healthy 'basket weave' appearance. The controlled dermal injury also increases fibroblasts which leads to collagen remodeling, leading to firmer, thicker skin. When the stratum corneum is removed immediately prior to the DNA repair infusion, the peptides and enzymes will have increased penetration into the skin. This maximizes the results of the DNA repair properties (collagen synthesis and skin regeneration) from the peptides and enzymes.
Results: Microexfoliation, microcirculation and the use of topical DNA repair enzymes and peptides show an improvement in the skin, but the non-invasive combination therapy of microrexfoliation and infusing peptides, enzymes and HA immediately post delivers a synergistic result; the results greatly improved.
Conclusion: Patients today demand results with little to no downtime, and the combination therapy of microexfoliation and microcirculation with a DNA repair infusion during a single in-office procedure capitalizes on these desires.

#113

EFFECTIVENESS OF CLASS 4 LASERS FOR ACHILLES TENDINOPATHY

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Background: The combination of eccentric exercise and low-level laser therapy (LLLT) may be beneficial in treating Achilles tendinopathy. Controversy exists over LLLT parameters and dose, especially irradiance and the 100 mW/cm^2 limit set for Achilles tendons. The optimum dose has yet to be defined. The aim of this work was to assess the effectiveness of a class 4 laser device delivering an irradiance above 100 mW/cm^2 as an adjunct to an eccentric exercise regime for Achilles tendinopathy.
Study: A double blind randomized controlled trial utilizing 2 groups; 1 (Exercise + placebo LLLT), 2 (Exercise + active LLLT). The primary end-point was at 12 weeks, and the main outcome measure was the Victorian Institute of Sports Assessment-Achilles Questionnaire (VISA-A). Forty participants 18–65 years of age with a diagnosis of Achilles tendinopathy and who had not had treatment for the condition within the last 3 months, were randomized into the two groups. LLLT or placebo was administered twice per week for the first 4 weeks prior to a supervised exercise session with a physiotherapist. The laser parameters used for this application were; power output 10 W; pulsed 100 Hz; time 30s; energy 150J, for a total time of 1:30 min and total energy delivered of 450J. The exercise regime was continued unsupervised for a further 8 weeks. Data was analysed using ANCOVA with baseline scores as the covariate on an intention to treat basis. Missing data was replaced using the multiple imputation method.
Results: There was no difference between groups at baseline, and both groups significantly improved from baseline to 12 weeks. The between group difference on VISA-A at 12 weeks was statistically significant in favor of the LLLT group, (11.34; 95%CI, 3.03–19.64; $p = 0.002$).
Conclusion: Four weeks (8 treatments) of LLLT as an adjunct to an eccentric exercise regime of two sessions per week provide superior results compared to exercise alone.

PAPDT (PHOTODYNAMIC THERAPY)

#114

NO-NEEDLE JET INTRADERMAL ALA-PDT FOR RECURRENT NODULAR BCC: A TREATMENT ALTERNATIVE TO MOHS MICROGRAPHIC SURGERY

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Background: Basal cell carcinoma is the most frequent type of skin cancer in humans. Nodular variant is the most common form (nBCC). A wide range of treatment options exist to treat nodular BCCs (e.g., cryotherapy, Imiquimod 5% cream, laser, radiotherapy and PDT) and surgical excision yet, Mohs micrographic surgery remains the gold standard treatment for this condition. Actually, Mohs surgery patients doubled since 2001. Unfortunately, postoperative scars are often visible and undesirable on areas such as the face. One possible limitation of PDT in nodular BCC is the penetration depth of the photosensitizer into the thick tumor volume, which can impact subsequent treatment efficacy. The application of ALA intralesionally, as opposed to topically, has been suggested as a mean to increase the penetration of photosensitizers (Intralesional PDT).
Study: To enhance homogenous delivery of 5-ALA intradermally, a needleless jet injector prototype (using a high-speed jet to puncture the skin without the side effects of needles) was used in 4

patients with recurrent nodular BCCs. Photoactivation was then performed using red light emitting diode [CW @ 630 nm, irradiance 50 mW/cm^2, total fluence 50–100 J/cm^2].
Results: Three patients (2 F and 1 M) presenting with a recurrent nasal nBCC and a men with multiple dorsal nBCCs were first evaluated and biopsied (age range 56 to 87). Aside from mild crusting present for up to a week, no other adverse signs were noted. Two patients needed a second procedure 2 months after the first. Excellent cosmesis was obtained. Clinically & histopathologically, there was no recurrent lesion up to 4 years post intervention (range 1 to 4 years).
Conclusion: No-needle intralesional PDT is a promising therapeutic modality for nBCC especially for tricky areas like the nose and/or when better cosmesis is desired. It may become an interesting treatment alternative to Mohs surgery. Additional studies with more patients are needed to further evaluate this new technique.

#115

THE PHOTODYNAMIC THERAPY EXPERIENCE OF A HIGH VOLUME LASER AND DERMATOLOGIC SURGERY CENTER

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Background: Photodynamic therapy (PDT) is used extensively and is FDA approved for treatment of actinic keratoses (AKs) although multiple off-label indications are reported. Despite frequent use for AKs, no clear consensus exists regarding comparative efficacy of photosensitizers, light sources, incubation times, and overall parameters.
Study: Retrospective chart review of patients who underwent PDT between January 1, 2007 and December 31, 2011 at a high volume laser and dermatologic surgery center. Demographic information, clinical history, treatment data, and subsequent diagnosis of skin cancers of eligible patients were recorded. The data included here is the completion of data analysis presented at ASLMS 2014 annual meeting.
Results: 1,560 patients were identified and 1,491 patients (96%) found eligible for inclusion for review. Mean age 59(± 13) years, 60% women, 85% skin types I-II, 61% with history of =1 non-melanoma skin cancer (NMSC), 11% with history of previous malignant melanoma, and 56% previously underwent Mohs micrographic surgery. The most frequent indications for treatment included actinic keratoses (95.7%), non-melanoma skin cancer (3.0%), and acne (1.1%). The head and neck was the most common treatment site (86%). Most patients had photoactivation with blue light (74%, 405–420 nm), 7% with PDL (595 nm), and 23% with red light (23%). A combination of light sources was used in 4% of patients and 45% of patients received multiple PDT treatments. The photosensitizer ALA (99%) was used most commonly and the most frequent delivery method was topical application (98%). Incubation time was =60 minutes (92%) in the majority of patients, compared to >60 minutes (7%). Intralesional administration of the photosensitizing agent was used in 2.2% of patients.
Conclusion: The most frequent indication for PDT in our center was actinic keratoses, followed by NMSC, and acne. Shorter incubation times (=60 minutes) were used in the overwhelming majority of patients and very few patients received intralesional administration of the photosensitizing agent.

#116

CLINICAL STUDY OF A PAINLESS PDT PROTOCOL FOR ACTINIC KERATOSES OF THE FACE AND SCALP

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Background: Pain is a major, undesirable side effect during aminolevulinic acid (ALA) photodynamic therapy (PDT) of actinic keratoses (AK). We hypothesized that low levels of PpIX, wth photoactivation over an extended time, might be sufficient to kill preneoplastic epithelial cells while reducing PpIX diffusion into peripheral nerve endings.
Study: Twelve patients with nonhypertrophic AK of the face and scalp were enrolled in a study to test a modified ALA-PDT regimen in which light is delivered immediately upon application of topical ALA. After an initial clinical exam and photographs, ALA (Levulan® Kerastick™) was applied to the entire scalp or face (Day 1). PDT was then performed in two stages in this bilaterally controlled, intrapatient comparison study. First, one side of the face/scalp was shielded and the contralateral side was exposed to blue light for 30, 45, or 60 min. At 1 hour post-ALA application, the first side was now covered and the second side exposed to blue light for 16 min 40 sec. Patients returned at day 4 for assessment of erythema reaction, and at month 3 for assessment of AK clearance. Endpoints included subjective pain scores during illumination, photographs, and lesion counts.
Results: All patients have now completed the PDT treatment, and in every case, reported pain scores were much lower on the immediate-illumination side than on the traditional PDT side. In all but one case, the intense erythema reaction observed at day 4 was indistinguishable between the two sides. These data and the results of AK clinical responses at month 3 will be presented.
Conclusion: The possible benefit of this study is the demonstration of a new ALA-PDT regimen for actinic keratoses that provides a therapeutic result equivalent to current regimens, yet minimizes the pain that patients must endure.

#117

FROM ZERO TO DEATH: MECHANISTIC STUDY IN PHOTODYNAMIC THERAPY USING VERTEPORFIN IN HUMAN KB CARCINOMA CELLS

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Background: *In vitro* study of Photodynamic Therapy (PDT) with Verteporfin (VD) in human KB carcinoma cells revealed the mechanism of cell injury to cell death upon photodynamic therapy.
Study: We report real time monitoring of; singlet oxygen (SO) generation, reactive oxygen species (ROS), mitochondria integrity and chromatin integrity in live cells by irradiating VD treated cells with mercury lamp light source and 515–555, 590–650 and 663–738 emission filter. We also observe the effect of PDT in cytoskeleton remodeling and cytochrome C release using immunofluorescence technique. We investigate apoptotic effect of PDT by using live and dead assay. We performed quantitave analysis for SO, ROS and mitochondrial potential change using

image J. Image colocalization analysis between VD and mitochondria is performed by BioImage software. All imaging were performed using Nikon Ti-E A1R confocal microscope.
Results: Our result suggest the mechanism of cell death in KB cells induced by VD-PDT as follows: VD localize in cells mitochondria (38.5% colocalization) that lead into increasing SO (357%) and ROS generation and localizing to the nucleus following PDT. PDT with VD decrease (330%) mitochondrial potential over time that lead into mitochondrial deformation. These phenomena suggest the disruption in mitochondrial retrograde signaling which is marked with nuclear changes in VD treated cells and also the depolymerization of actin cytoskeleton.
Conclusion: In the end, VD treated cells show increase number of cell death upon irradiation compared to control. We conclude the mechanism of cell destruction in KB cells by VD in PDT therapy started with its localization in mitochondria, therefore study for better mitochondria targeting drug in PDT therapy is recommended.

#118

NEW PROPOSAL TO EVALUATE *IN VITRO* THE TRANSDERMAL DRUG PERMEATION USING OPTICAL PERMEATION METHODS

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Background: In the literature in vitro methods that mimic the process of transdermal drug *in vivo* have been studied using diffusion cells (Franz cell diffusion). This system monitoring the drug release profile and its rate, being widely used for quality control testing of pharmaceutical products for topical and transdermal application. However the evaluation of drug permeation through skin in the different layers is not estimated. These studies have intention to demonstrate the correlation between the permeation data obtained *in vivo* and *in vitro* using porcine skin models. In this way, the successfully of ALA and M-ALA mixtures in topical PDT procedure was studied using fluorescence analyses.
Study: In study *in vivo*, the cream was applied at 2 cm^2 and an occlusive dressing placed. Seven mixtures were applied at skin, varying on 20% the percentage of ALA and M-ALA combinations and the PpIX production was monitored using widefield fluorescence imaging after 3h of cream application. In the study *in vitro*, the skin was cut in small slices and added in a culture plate of 24 wells in medium culture (DMEM). After 24h, the mixtures cream was added in the superficial layers of skin by an incubation time around 5, 7 and 24 hours.
Results: The results found show a delay in the best time to PPIX production in vitro. The PPIX production was greater and more homogeneous using around 40–60% of ALA and M-ALA mixtures for both models.
Conclusion: These results suggest that *in vitro* experiments can be useful to predict the drug permeation behavior in studies *in vivo*, using porcine skin model, as well as the future predictions in human skin, due to large similarity between the skin models. This is a greater advantage to establish new protocols in clinical topical PDT using ALA and its derivatives (Financial support: FAPESP).

#119

MEASURING AND MODULATING TUMOR MICROENVIRONMENT IN PHOTODYNAMIC THERAPY

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Background: The efficacy of PDT will depend on photosensitizer accumulation and light delivery to the diseased site, but is also affected by pre-existing and PDT effect on tumor physiologic properties. Measurements of tumor physiologic properties before and during illumination can inform the delivery of PDT.
Study: Tumor oxygenation and blood flow were measured by noninvasive optical spectroscopy using instruments that are previously described and validated. Measurements were made at timepoints before and after illumination, and, in certain investigations, throughout the course of light delivery. Preclinical studies were performed in murine models; clinical investigations were conducted as part of a phase I trial evaluating PDT with 5-aminolevulinic acid in patients with pre-malignant or superficial microinvasive lesions of the head and neck.
Results: Clinical studies of fractionated light delivery identify patient-specific changes in the physiologic properties of lesions of the oral cavity. In most patients, PDT increased lesion hemoglobin oxygen saturation (StO2) during fractionation and at treatment conclusion. The only patients in whom StO2 did not decrease at PDT conclusion were those who received the lowest light fluence (50 J/cm^2). Murine studies tested a real-time, hemodynamic-informed light delivery system. This interactive system measures PDT-induced changes in blood flow, and then automatically adjusts illumination fluence rate when flow reductions exceed a pre-determined threshold. Adjustable PDT using this system produced more vascular damage than unadjusted illumination at a fixed fluence rate of 75 mW/cm^2.
Conclusion: The ability to measure and modulate tumor physiologic properties in clinical applications of PDT will provide a means for the personalized delivery of treatment. Clinical studies confirm that PDT alters the oxygenation of even superficial oral lesion. Novel interactive monitoring systems that control light delivery could provide a means for hemodynamic-based personalization of light delivery.

#120

MEMBRANE STRUCTURE AND SUSCEPTIBILITY OF BIOFILMS TO PDT

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Background: Rising antibiotic resistance remains a major healthcare concern. Options for the treatment of Gram-positive infections exist however, the lack of drugs in the pipeline for Gram-negative infections is a cause for concern. Microorganisms develop biofilms in which the microbes become protected, via their own phenotypic changes and polymeric exudates, from disinfection by antibiotics. Biofilm formation is a multistep process involving initial surface attachment, cell growth and micro-colony formation with resultant maturation into a three-dimensional

biofilm. Biofilm exopolymers, usually considered as slimes, provide a mechanism for bacteria to protect themselves from host defenses.
Study: Experiments were conducted to determine the bactericidal activity of a broad range on human pathogens which included gram-positive, including B. thurigiensis and B. atrophaeus; and Gram-negative types, S. enterica sv typhi, Y. intermedia 29909, N. gonorrhoeae ECMC-2 and H. influenzae 3198. Bacteria (~10 7 CFU/ml) were incubated with varying concentrations of porfimer sodium, or other photosensitizer followed by appropriate light activation.
Results: Gram-positive bacteria subjected to PDT demonstrated high susceptibility to (6–8 log kill) to the treatment regardless of the photosensitizer employed. The sensitivity of Gram-negative strains varied in their sensitivity with some demonstrating resistance regardless of the parameters used. Conversely, Gram-negative bacteria exposed to non-cationic photosensitizers of the purpurin class of photosensitizers exhibited significant sensitivity.
Conclusion: The data demonstrate that PDT can exhibit significant levels of bacterial cell kill in a broad spectrum of strains. However various isolates of the same strain vary in their susceptibility. Gram negative organisms that were tested which have demonstrated sensitivity to PDT, interestingly all express lipooligosaccharides (LOS) and not lipopolysaccharides (LPS). Based upon the results there is compelling evidence that the varying susceptibility of Gram-negative strains in particular is dependent on the expression of LOS versus LPS.

#121

USE OF FACTORIAL DESIGN TO DETERMINE THE BEST PARAMETERS FOR ANTIMICROBIAL PHOTODYNAMIC INACTIVATION OF MULTISPECIES BIOFILM

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Background: Now days the only form of treatment for biofilm infections that cannot be mechanically or surgically removed is the administration of various antimicrobial drugs for a long period of time. However, the large increase in resistant pathogens to several antibiotics, coupled with the limited development of new antibiotics, make it imperative to find new strategies for microbial control. Among these new potential therapies the photodynamic inactivation (PDI) is an option to control localized infections. In this study it was evaluated the effect of Hypericin (Hy) and methylene blue (MB) as photosensitizers (PS) for PDI in multispecies biofilm formed by interaction of Escherichia coli, Candida albicans and methicillin-resistant Staphylococcus aureus.
Study: In order to determine the best PDI parameters for biofilm employing Hy or MB, it was used a full factorial design 23, where the factors were concentration of PS (2.5 and 5 μg mL-1), incubation time of the PS with the biofilm (20 and 30 min), and the light dose (15 and 30 J cm-2) using a white LED (420–680 nm). The phototoxicity of PSs was determined by the survival index using the MTT method.
Results: Results showed that both photosensitizers were effective in promoting reduction of the biofilm population. The maximum reduction by Hy (82% ± 4) was obtained at 5 μg mL-1 with incubation of 30 min and dose 30 J cm-2, while MB in the same conditions had reduced 75% ± 1 being statistically equal. The factorial design showed that for Hy the light dose was the most important parameter, followed by the PS concentration and the incubation time had no signification. For MB the incubation time was the main factor followed by light dose and concentration of PS.
Conclusion: These results suggest that both Hy and MB are powerfull PS to inactivate multispecies biofilm using PDI.

#122

ANTIMICROBIAL EFFECT ON CANDIDA ALBICANS BY DIFFERENT COUPLING OF WAVELENGTHS AND COLORS IN PHOTODYNAMIC PROTOCOLS: *IN VITRO* AND *IN VIVO* STUDY

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Background: The aim of this study was to test the application of different laser wavelengths in combination or not with different photosensitizing dies on Candida albicans *in vitro* or in photodynamic therapy protocols *in vivo*.
Study: Laser application was realized on Candida albicans cells suspended in saline solution or cultured on solid medium for the *in vitro* study and in a model of infection in Galleria mellonella for the *in vivo* study. Protocols were realized with three different wavelengths in the visible spectrum of light without and with photosensitizing dyes coupled with the wavelength based on color affinity: red diode (650 nm) and toluidine blue, blue-violet diode (450 nm) and curcumin and green diode (532 nm) and erythrosine. Laser irradiation has been performed in continuous mode with 3 different values of applied fluences: 10, 20 and 30 J/cm^2.
Results: No inhibitory effect was obtained without photosensitizers on yeast cells in saline solution. The maximum inhibition was obtained with the blue diode and curcumin, with a 100% of inhibition growth at any used fluence. Red diode laser used with toluidine blue produced an inhibition variable between 2.27% and 82.93%. Green diode laser used with erythrosine produced an inhibition variable between 9.48% and 45.38%. Inhibition growth on solid culture medium was not for any plate without dye. For culture plates with dye, an inhibition area proportional to irradiation dose was visible in the presence of curcumin at any fluence. with the most important results for plates with erythrosine. In the *in vivo* study, red laser and toluidine blue led to the best result in terms of survival rate of Galleria mellonella infected by Candida albicans.
Conclusion: The right combination of laser light and photosensitisers may change dramatically the results in terms of antimicrobial effect.

PHOTOBIOMODULATION

#123

EFFECTS OF LASER PULSING ON CELL VIABILITY

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Background: Continuous wave photobiomodulation (cwPBM) has been shown to induce cell proliferation in many different cell lines both *in vitro* and *in vivo*. While pulsed wave photobiomodulation (pwPBM) has shown similar effects, the parameters for pwPBM are not as well characterized as cwPBM. Laser treatment can be manipulated by changing a variety of pulsing parameters including pulse interval, pulse duration, pulse train interval, and pulse train duration in addition to total irradiance and time providing more treatment variables than cwPBM. These parameters could facilitate better optimization of PBM for therapeutic benefit.
Study: This study investigates how various pulsing parameters affect cell viability and proliferation of oral keratinocyte and fibroblast cell lines. Cells were irradiated with an 810 nm diode using different pulsing parameters and following incubation for 24 hours, proliferation was quantified using an Alamar Blue assay and compared to untreated controls.
Results: We noted that keratinocytes were more responsive to the effects of the laser than fibroblasts, resulting in a discrete set of optimal pulsing parameters for each cell type. Pulsing allows significant control on therapeutic dosing as it allows the ability to distinct eliminate thermal damage while facilitating increased dosing. Keratinocytes were observed to respond differently to changes in pulse intervals, pulse durations and total irradiance than fibroblasts. We further characterized that the cell type responses were due to variations in their inherent redox potentials.
Conclusion: This study demonstrates the effects of laser pulsing on distinct cell types and suggests that optimization of laser treatments based on target cell types could improve clinical efficacy and therapeutic benefit for photobiomodulation.

#124

LOW LEVEL LASER THERAPY IN THE REPAIR OF RAT TIBIAE EXPOSED TO IONIZING RADIATION: HISTOLOGICAL EVALUATION

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Background: High doses of ionizing radiation (IR) affect the balance between osteoblasts and osteoclasts, constraining bone remodeling and repairing processes. Low-Level Laser therapy (LLLT) improves cell proliferation and differentiation, optimizing the bone repair. We investigate the effects of LLLT on cellular recruitment during repair process of rats tibiae exposed to IR.
Study: Seventy-two healthy Wistar rats were distributed into the following groups: Group I, sham control; Group II, LLLT; Group III, IR; and Group IV, IR and LLLT. Groups III and IV received a single dose (30 Gy) of gamma radiation and underwent surgery 28 days later. A non-critical size bone defect (diameter 2.5 mm) was surgically performed in all groups. Groups II and IV received 3 post-surgical applications of LLLT (GaAlAs, 808 nm, 100 mW, 0.028 cm^2, 3.57 W/cm^2, 20 s, 2J) on alternate days.
Results: The samples were evaluated on days 7, 14, and 21 after surgery. On day 7th, it was observed an accentuated presence of osteoblasts, resulting in newly formed bone in Groups I, II and IV, when compared to Group III ($p < 0.05$). On day 14th, Group II presented significant reduction of osteoclasts ($p < 0.05$) and the substitution for medullary tissue, indicating a more advanced stage of bone repair. On day 21st, no significant difference was observed in medullary repair among Groups I, II and IV. Group III still presented a marked osteoblastic activity ($p < 0.05$), in comparison to Groups I, II and IV.
Conclusion: LLLT abbreviated the inflammatory process of bone repair, providing an earlier recruitment of the osteoblasts and osteoclasts, on rats tibiae submitted to IR. The present pre-clinical study suggests that LLLT may be employed to stimulate bone repair on patients that need facial rehabilitation surgery after radiotherapy for head and neck cancer treatment.

#125

IN VIVO MECHANISMS OF PHOTOPREVENTION IN A PIG MODEL

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Background: It is commonly accepted that the UVB exposure is responsible for almost all deleterious photo-induced effects on human skin. At this time, minimizing the amount of UV irradiation that reaches the skin remains the only method for protecting skin against UV-induced damage. This is achieved mostly by avoidance of sun exposure and the use of traditional sunscreens. The protective efficacy of topical sunscreens is dependent on its own limitations which include water or perspiration, spectral limitations and user allergies as well as compliance. Recent studies suggested that Low Level Light Therapy (LLLT) in the red to infrared spectrum pre-irradiation prepares skin cells to resist and/or to repair UVB-induced DNA damage. The objective of the study was to assess the efficacy and safety of LLLT against upcoming acute UVB-induced damage using an *in vivo* porcine model.
Study: Pig skin was exposed to LLLT with different parameters (660 nm vs. 940 nm, pulsed vs. CW and timing of LLLT exposure: 4h vs. 24 h prior to UVB exposure). Four hours later, one area was exposed to UVB (MEDs: 0.5, 1, 2). Twenty-four hours later, a second area pre-treated with LLLT or no light was exposed to UVB. Acute UVB effects was investigated 24 hours after the last UVB exposure by means of clinical assessments (dermaspectrometer) and microscopic examinations (PCR).
Results: Results showed that pulsed 940 nm applied 4h or 24h prior to UVB exposure provided significant protection against UVB-induced acute actinic damage to pig skin compared to control.
Conclusion: The potential applications of this approach include protection against upcoming photodamage, such as first degree sunburn. The underlying mechanism may involve the p53 pathway which triggers natural skin protection and repair processes. Further studies are needed.

#126

CHARACTERIZATION AND MODULATION OF MACROPHAGE/MICROGLIAL ACTIVATION IN AN ANIMAL MODEL OF NEUROPATHIC PAIN

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Background: Neuropathic pain is common and debilitating and effective treatments are limited. Our aim was to characterize the activation and polarization of macrophages/microglia after peripheral nerve injury and modulate their response using photobiomodulation (PBM).

Study: The Spared Nerve Injury model was performed on adult male Sprague-Dawley rats. Mechanical allodynia was assessed with an electronic Von Frey device. A 980 nm wavelength CW laser was used in the treatment group (n = 21) every other day starting on post-surgical day 7. Treatment areas/parameters: affected hind paw (output power 1W, 20s, 41 cm above skin, power density 43.25 mW/cm^2, dose 20J), affected dorsal root ganglia (output power 4.5W, 19s, in contact with skin, power density 43.25 mW/cm^2, dose 85.5J) and spinal cord (output power 1.5W, 19s, in contact with skin, power density 43.25 mW/cm^2, dose 28.5J). Immunohistochemistry was used to characterize general (Iba-1), pro-inflammatory (M1; CD86), and anti-inflammatory (M2; CD 206) macrophage/microglia activation.
Results: Injured groups demonstrated increased mechanical allodynia from day 1–30 post-surgery ($p < .01$). After 2 treatments, the treatment group began to recover ($p < .01$); by day 26 mechanical allodynia reached baseline levels ($p = 0.96$). General macrophage activation was increased in dorsal root ganglia (DRG) at day 7 and 14 in the injured groups ($p < .01$). Microglial activation peaked at day 7 in the spinal cord and gracile nucleus, and was sustained until day 14 in the spinal cord dorsal column and day 30 in the gracile nucleus ($p < .01$). Pro-inflammatory microglial activation was increased in the spinal cord in the injured group ($p < .01$) compared to the treated and sham group. Photobiomodulation caused an increase in anti-inflammatory macrophages in DRG at day 14 and 30 post-operatively ($p < .01$).
Conclusion: Peripheral nerve injury caused significant, region-specific, activation of macrophages/microglia along the dorsal column pathway. The injury caused an increase in pro-inflammatory microglial activation, while PBM with near-infrared light increase anti-inflammatory macrophage/microglial activity.

#128

EFFECTIVENESS OF LOW-LEVEL LASER THERAPY FOR TREATMENT OF TOENAIL ONYCHOMYCOSIS

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Background: Fungal infection of the nails, or onychomycosis, cause nails to become discolored, thicken, crumble and separate. Currently affects approximately 10% of all U.S. adults, onychomycosis is difficult to treat and recurrence is common. The purpose of this clinical trial was to demonstrate the safety and efficacy of low-level laser therapy (LLLT) for treatment toenail onychomycosis.
Study: Subjects seeking treatment for toenail onychomycosis were enrolled. For ethical reasons, there was no placebo or control group. Using a dual diode (635 nm & 405 nm) device, LLLT was administered to affected toenails for 12 minutes once weekly for 4 weeks (Lunula^{TM} Laser; Erchonia Corporation, McKinney, TX). Subjects were evaluated at baseline and immediately after the last treatment (Week 4) and after 12, 36 and 48 weeks. Changes in clear nail growth and percent of onychomycosis disease involvement was determined using digital photographs and topographical software. Each digital image was sent to an independent outside laboratory for objective evaluation. ClinicalTrials.gov Identifier: NCT02242019.
Results: Adult subjects (N = 109) with onychomycosis of the great toe (N = 109) or multiple toenails (N = 30) were enrolled. At 36 weeks, 96% of treated toenails met individual success criteria, defined as = 3 mm of clear nail growth. The mean (SD) clear nail growth was 8.4 (4.1) mm ($p < 0.0001$). The mean percentage of onychomycosis disease decreased from 63.2 (23.9)% at baseline to 8.1 (13.9)% at 36 weeks ($p < 0.01$) and 86 subjects (62%) had achieved completely clear nails. Each efficacy parameter showed further improvement after 48 weeks. There were no reports of adverse events.
Conclusion: LLLT is a safe and effective tool for treating toenail onychomycosis. There was no evidence of re-infection over a 48 week period following four week treatments.

#129

EFFECT OF CULTURED MESENCHYMAL STEM CELLS WITH SCAFFOLD AND THERAPEUTIC LASER ON HEALING RATE OF ARTICULAR CARTILAGE DEFECTS IN RABBIT: A HISTOLOGICAL STUDY

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Background: The aim of this study was to evaluate the effectiveness of the application of cultured bone marrow mesenchymal stem cells (BMSCs) with scaffold and low level laser therapy (LLLT) on repair of articular cartilage defects in rabbits.
Study: After bone marrow aspiration from 10 white New-Zealand rabbits, mesenchymal stem cells isolated, cultured in monolayer, suspensed on type I collagen scaffold and then implanted on to a full-thickness osteochondral defects (4 mm in diameter) artificially made on the patellar groove of the both knees in same rabbit. After that, one knee selected randomly in each rabbit as experimental group and subjected to Ga-Al-As (810 nm) laser irradiation with energy density of 4 J/cm^2 every other day for three weeks. Other knee was not received LLLT as control group. After this period, animals were sacrificed and then, osteochondral defects were evaluated by histomorphometric methods. The one way ANOVA test was used to compare the results between the two groups. A p-value of less than 0.05 was considered to be significant.
Results: Cartilage neoformation showed no statistically significant difference between two groups ($P > 0.05$). However, there was significant bone neoformation in experimental group ($P < 0.05$). No significant difference in inflammation was found between two groups ($P > 0.05$).
Conclusion: In terms of our research, although further bone formation was seen in the experimental group, the combination use of BMSCs and LLLT could not significantly accelerate healing of osteochondral defects compared with that of the use of BMMSCs alone.

#130

PHOTOBIOMODULATION-INDUCED FIRST-ORDER PHASE TRANSITION OF MYOBLAST PROLIFERATION

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Background: A proliferation in its proliferation-specific homeostasis, a negative feedback response maintaining a proliferation at its optimum level, is called a normal proliferation. The synergistic activation of N normal proliferation-specific signal transduction pathways (NSPs) maintains the Nth-order normal proliferation. Straussman et al. (2012) have found hepatocyte growth factor induced the first-order phase transition of the normal proliferation of 6 melanoma cell lines on the seventh day. The similar phenomena were found for myoblast proliferation.
Study: The C2C12 myoblasts were cultivated in glucose at 22.5 mmol/L (normal glucose, nG) and fetal bovine serum (FBS) at 0, 5, 10, 13, 20, 23, 30, 33, 47 and 50% for 8 days after 2 h horse serum shock, respectively. The C2C12 myoblasts in nG and 10% FBS (L0) were irradiated with red light at 640 nm from light emitting diode array (RLED) at 0.035 (L1), 0.067(L2), 0.098 (L3), 0.194 (L4), 0.558 (L5), 0.885 (L6), 0.330 (L7) and 0.530 (L8) mW/cm^2 for 6 days, respectively. All the parameters were routinely assessed.
Results: At day 8, the proliferation of horse serum shocked myoblasts increased with FBS in a stepwise way, and there were no significant differences between the groups in 20 and 23% FBS, the groups in 30 and 33% FBS and the groups in 47 and 50% FBS. At day 6, the proliferation of RLED groups increased from L0 to L8 in a stepwise way, and there were no significant differences among the groups L1-L6, and between groups L7 and L8. At day 3, RLED in group L1 increased IGF-1 mRNA expression, decreased the mRNA expression of FOXO3a and BIM, but did not affect p27 mRNA expression.
Conclusion: RLED may induce the first-order phase transition of myoblast proliferation. One of the NSPs mediated the second-order normal proliferation of myoblasts may be mediated by IGF-1.

#131

LOW LEVEL LASER THERAPY IN THE DORSAL ROOT GANGLION FOR TREATMENT OF CHRONIC LOW BACK PAIN: A PILOT STUDY

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Background: Chronic axial low back pain is a public health issue worldwide with high socioeconomic impact. The dorsal ganglion of the second spinal nerve (GDL2) is a cluster of neuronal bodies responsible for sensory afferent inputs from more than 80% of lumbar region. Low-level laser therapy (LLLT) is proven to be an effective tool to relieve pain. The project's aim is to determine the LLLT's effect on GDL2 when applied to chronic axial low back pain assisting in treatment.
Study: 12 patients were randomized into three groups: radiofrequency, local anesthetic and laser. Surgical procedure: by percutaneous puncture guided fluoroscopy the intervertebral foramen (2nd–3rd) lumbar vertebrae were accessed. In Anesthetic Group: local lidocaine injection without vasoconstrictor into the tubes G17 to the target were administered. In radiofrequency Group neuromodulation (300 seconds at 42C) were held. In the laser group, Diode CW Laser Photon III® with P = 100 mW, DE = 300 J/cm^2, T = 120 seconds through 600 μm fiber into G14 cannulas were applied. The Digital temperature along the low back skin and visual analog scale (VAS) pre and postoperatively were applied. The aspirate periganglionar sample, trans-operatively, to biochemical were studied.
Results: All patients in local anesthetic and laser group referred at least 50% postoperative pain reduced, immediately and during follow up. In radiofrequency group and in laser group, 40% pain was diminished and maintained in the follow up. In radiofrequency group at least 2C increased and laser group at least 1C digital temperature was reduced.
Conclusion: Lasertherapy decreased the pain as quick as local anesthetic and as longer as pulsed radiofrequency to control low back pain and improved quality of life, with cost-effectiveness.

#132

A RANDOMIZED, DOUBLE-BLIND, SHAM-CONTROLLED STUDY USING LOW-LEVEL LASER THERAPY TO TREAT LOWER BACK PAIN

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Background: Back pain is a common neurological ailment in the United States second only to headache in prevalence. Back pain is estimated to affect 80% of people during their lifetime. The financial burden of back pain is estimated to be ~$50 billion. Low-level laser therapy (LLLT) has numerous beneficial effects on injured tissues, including increased metabolism, collagen and capillary formation, and analgesic and anti-inflammatory effects. The objective of this study was to evaluate the use of LLLT as an adjunct therapy for minor chronic low back pain.
Study: Subjects seeking relief of episodic chronic low back pain of musculoskeletal origin for =3 months and having a severity of >40 on a 100-point visual analog pain scale (VAS) were enrolled to undergo active (N = 31) or sham treatment (N = 31). Subjects underwent two 15-minute LLLT or sham treatments each week for 3 weeks. The LLLT device consists of three adjustable 635 nm red laser diodes, each having a mean output of 17 mW (Erchonia® MLS Scanner; Erchonia Corporation, McKinney, TX). The center diode of the device was centered 3–4 inches above the lower back and the other two diodes above the hip flexors.
Results: After 4 months, 84% of LLLT-treated subjects achieved the individual subject success criteria, defined as a =30% decrease in baseline VAS pain scores, vs. 29% of sham-treated subjects ($p < 0.0001$). Among the LLLT-treated subjects, the mean (SD) VAS scores decreased by 39.32 (22.50) points vs. 5.52 (20.17) among sham-treated subjects ($p < 0.0001$). There were no reports of adverse events.
Conclusion: Low-level laser therapy represents a safe and effective adjunct therapy for minor chronic low back pain of musculoskeletal origin.

#133

EFFECTS OF LASER ON ENDURANCE OF THE ROTATOR CUFF MUSCLES

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Background: The purpose of this study was to measure the effects of therapeutic laser (TL) on endurance of the shoulder external rotator muscle group during isokinetic dynamometry.

Study: Twenty healthy subjects participated in a double blind, cross-over design study, approved by the University of Tennessee at Chattanooga IRB. Informed consent was obtained from all subjects meeting the inclusion criteria. Subjects were trained and tested using the BIODEX System 3 Pro isokinetic dynamometer. The protocol consisted of a 5 minute warm-up on an upper extremity ergometer, followed by testing. Subjects had their dominant arm positioned at 30 degrees of shoulder horizontal adduction and 45 degrees of shoulder abduction, and performed 21 repetitions of external rotation in each of 12 sets, at 60 degrees/second, with standardized rest between sets. Subjects were acclimated to the isokinetic testing to eliminate a possible training effect prior to being entered into the treatment portion of the study. In the last two sessions, subjects randomly received TL or placebo laser (PL). Laser, 810 nm and 980 nm with a combined output power of 10 watts, was applied immediately prior to testing to the infraspinatus and teres minor muscles at an average fluence of 10 J/cm^2 (1.8 W/cm^2).
Results: A factorial ANOVA was performed to compare TL to PL at all 12 sets for peak torque, peak torque normalized by body weight, average torque, total work, and power. In sets 1–9 there was no statistically significant difference (NSSD) between any of the variables. In set 10 results varied from NSSD to $p < .01$ depending on the variable. In sets 11 and 12 TL treated subjects displayed greater endurance for all variables ($p < 0.001$).
Conclusion: Laser increased endurance of the shoulder external rotators in the latter stages of endurance exercise.

#134

STANDARDS AND SAFETY FOR LASER THERAPY PRACTITIONERS

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Background: A universe of laser standards, terminology, regulations, guidelines, professional recommendations, and policies has proliferated around the world in an effort to provide standardized management of Class 3b and Class4 healthcare lasers. Adaptations or variances of these standards were never considered for laser therapy practice settings. Professionals working with lasers in photobiomodulation practices are often unaware of which standards apply, or how to develop and maintain a standards compliant laser safety program that will be relevant to their practice settings and equipment. Many administrative and procedural requirements were meant for surgical lasers in the operating room, and not for therapy applications. Therapists may also be faced with trying to work within a program run by a LSO in a hospital setting, who is not familiar with assessing risks associated with low level lasers, and insists on compliance with inappropriate and sometimes unattainable requirements.
Study: Everyone's goal is to establish and maintain a safe treatment environment for themselves, and their colleagues, with resulting safety in patient care, but most report that they routinely feel disadvantaged by lack of correct and useful information, and challenged when required to demonstrate compliance with the current complex of standards documents. This paper will discuss the meaning of standards and their terminology, and will offer strategies for understanding the application of the standards. ANSI Z136.3 and relevant OSHA rules will serve as the reference documents for this presentation.
Results: Education that is focused on all aspects of laser safety and extends beyond wearing laser protective eyewear and hanging a Danger sign on the door, provides the foundation for a compliant laser practice. This should be developed and presented in a clear, understandable, and clinically relevant manner, based on knowing how to assess risk for the lasers in use. Once risk assessment is understood and applied, low level laser safety will be easily managed, and healthcare professionals will be able to demonstrate compliance without liability or stress.

#135

A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED STUDY USING LOW-LEVEL LASER THERAPY FOR REDUCING HIP, WAIST AND UPPER ABDOMEN CIRCUMFERENCE OF OBESE INDIVIDUALS

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Background: Previous studies have demonstrated the effectiveness of low-level laser therapy (LLLT) for reducing hip, thigh and abdomen circumference of persons with a body mass index (BMI) <30 kg/m2. This randomized, double-blind, placebo-controlled parallel group study assessed the effectiveness of a LLLT device for reducing body circumference of persons with a BMI of 30–40 kg/m^2.
Study: Obese but otherwise healthy adult men and women with a BMI of 30–40 kg/m^2 were enrolled. The LLLT device consists of 10 independent 17 mW, 532 nm green laser diodes positioned 120 degrees apart and titled 30 degrees (Erchonia® Obesity Laser; Erchonia Corporation, McKinney, TX). The sham LLLT device emits similar inert visible light when activated. The hips, waist and upper abdomen circumference of each subject was measured prior to receiving three weekly 30-min LLLT treatment sessions over a 4-week period, treating the front and back of the target areas for 15 minutes. Outcome measures included a significant difference in the proportion of subjects achieving a =3-inche reduction in combined baseline hip, waist and upper abdomen circumference and subject satisfaction. ClinicalTrials.gov Identifier: NCT01821352.
Results: Fifty-three subjects were randomized to the LLLT (N = 28) and the placebo groups (N = 25). Among subjects in the LLLT group, 71.43% attained a =3-inch decrease in combined circumference measurements vs 12% in the sham group ($p < 0.00005$). Among subjects with a =3-inch decrease, the mean decrease was 6 inches. Most subjects (79%) in the LLLT groups were Very Satisfied or Somewhat Satisfied with the results they achieved vs 16% of sham-treated subjects. There were no changes in body weight or BMI. There were no reports of adverse events.
Conclusion: LLLT safely and effectively reduced the hip, thigh and abdomen circumference of persons with a BMI of 30–40 kg/m^2.

#136

CLINICAL RESPONSE APPLYING LOW LEVEL LASER THERAPY AND PHOTODYNAMIC THERAPY FOR VULVAR LICHEN SCLEROSIS: A PILOT STUDY

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Background: Vulvar lichen sclerosis (VLS) is a lymphocyte mediated inflammatory dermatosis that leads to significant clinical implications, as: dyspareunia, intense itch results in excoriations, labia minora fusion, introit stenosis, severe vulvar atrophy and painful to defecate/urinate. The aim of this study was to investigate clinical response applying low level laser therapy (LLLT) and photodynamic therapy (PDT) to VLS.
Study: Menopauses women's VLS, by genitoscopy and histology biopsy at Pérola Byington Hospital, were diagnosed. The main symptoms were itching persisted over several years/period with severe vulvar atrophy and intense dyspareunia, divided in 2 groups: G1 (LLLT): Diodo CW laser- wavelength (?) = 630 nm, output power = 50 mW, power density = 250 mW/cm^2, fluence = 10 J/cm^2, exposition time = 39 seconds/point in contact w/ vulvar skin, once a week for 4 weeks, were applied. G2 (PDT): all patients received intralesional injection (2% methylene blue in aqueous solution with 2% lidocaine) w/ same laser parameters were treated.
Results: In LLLT Group- The G1patients reported diminish itching in less than 1wk post the 1st treatment. After 2nd LLLT applications patients exhibited great trophism response and dyspareunia improvement. The vulvar temperature decreased 20C, immediately after LLLT. In G2, most patients related some itch improvement after couple PDT applications. Over 2/3 of PDT patients (after several treatments) showed trophism response and following months no itch was reported.
Conclusion: The PDT and LLLT for VLS, when comparing both techniques, it is feasible to conclude that the sole laser application, without external photo-acceptor (drug free), were effective, less invasive and improved patients' quality of life. Laser therapy seems to be a promising management for decreasing symptoms quickly, restoring functional vulva and still keep the patient in more time free to symptoms recurrence following photobiomodulation. Thus, LLLT and PDT show to be a suitable treatment for vulvar lichen sclerosis, restoring the functional vulva with cost-effectiveness and without side effects.

#137

EVALUATION PROCEDURE OF POST-LASER AND PHYSICAL THERAPY RESULTS ON TRAUMATIC SPINAL CORD INJURIES: A PROPOSAL

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Background: Since 2003 until today we treated 244 patients with Traumatic Spinal Cord Injuries (TSCI), using Non-Surgical Laser Therapy (NSLT). The goal of our study is to improve obtained results and its immediate evaluation on motor and sensory functions with objective tools and procedures.
Study: In 2014, 30 patients with documented TSCI, occurred at least one year before laser treatment, were enrolled. Lasers used were 808 nm, 10600 nm, and 1064 nm, applied with a first cycle of 20 sessions, four a day. Dosage parameters of each laser followed our protocol already published. In addition, patients were involved in a specific physical therapy training two times a day, eight sessions at all. Before treatment under the level of lesion, muscles' activity was tested with EMG system of surface (sEMG). Muscolar force at specific joint angles were assessed by some electronic dynamometers and goniometers while trunk's ROM and balance were evaluated through an accelerometer and a balance board set on a dynamic standing device. Clinical evaluations included the research of superficial and deep tactile and thermal sensory under the level of lesion. Equal objective and clinical evaluations were repeated at the end of each cycle of treatment, replicated in average each two month.
Results: Results were regarded as positive if the sensory sensibility increased minimum two metamers under the level of lesion. sEMG showed positive modifications in CNS-muscle conduction spikes, under the same level. Objective assessment of force, trunk's ROM and balance displayed encouraging results in all patients. Follow-up is positive after 1 year in average.
Conclusion: Objective clinical evaluations and diagnostic tools seemed to be very useful as tests for an immediate assessment of TSCI Laser and physical therapy associated procedure. Correct evaluation of muscle improvement could establish best physical therapy for each patient.

RESIDENT/FELLOW

#138

OUTCOMES OF DIODE LASER ENUCLEATION OF THE PROSTATE FOR BENIGN PROSTATIC HYPERTROPHY

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Background: Laser enucleation of the prostate is rapidly evolving as an alternative to traditional trans-urethral resection for the treatment of benign prostatic hypertrophy. Holmium laser has been shown to be an effective tool to achieve improvement of voiding function. Diode laser enucleation of the prostate (DiLEP) is an emerging option which is characterized by enhanced vaporization and coagulative properties; little is known about its efficacy. Our goal was to assess objective and subjective outcomes of the DiLEP procedure in patients who demonstrated bladder outlet obstruction on urodynamics testing.
Study: We reviewed the records of 50 consecutive patients who underwent DiLEP between May 2012 and December 2013. All of these patients demonstrated bladder outlet obstruction on urodynamics testing. Objective evaluation of efficacy was determined by comparing preoperative values for post-void residual volume (PVR) and peak flow (PF) to postoperative values at 4–16 weeks and after 1 year. Subjective evaluation was determined by comparing American Urological Association symptom scores (AUASS). Analyses were conducted using paired Student's t-tests.
Results: The 50 patients had an average age of 69 and an average prostate size of 75 grams determined by cystoscopy or ultrasound. The average hospital stay was 1.5 days. Foley catheters were removed after an average of 1.6 days, with 70% removed on postoperative day 1. The mean decrease in PVR following DiLEP was 216 ml at 4–16 weeks ($p < 0.0001$) and 220 ml at 1 year ($p < 0.05$). The mean increase in PF was 16 ml/s at 4–16 weeks ($p < 0.0001$) and 17 ml/s at 1 year ($p < 0.05$). AUASS improved by a mean of 6.83 points ($p = 0.059$), and by 1.53 points on the quality of life question ($p < 0.005$).
Conclusion: Patients showed significant improvement in PVR and PF following DiLEP, and reported a decrease in severity of lower urinary tract symptoms. The diode laser is an effective treatment modality for benign prostatic hypertrophy.

#139

TWO CASES OF LOCALIZED SCLERODERMA TREATED WITH ABLATIVE FRACTIONAL LASER THERAPY AND INJECTABLE FILLERS

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Background: Scleroderma is a chronic autoimmune disease characterized by progressive connective tissue sclerosis and microcirculatory changes. Localized scleroderma (morphea) is considered a limited disease. However, in some cases marked disfigurement may occur.
Study: We present two cases of localized scleroderma treated with ablative fractional laser therapy and injectable fillers for tissue contouring.
Results: The cornerstone of morphea fibrosis is an imbalance of increased collagen production (via various cytokines) and decreased breakdown (via decreased matrix metalloproteinases responsible for collagen degradation). Morphea treatment options tend to target this imbalance by increasing the production of matrix metalloproteinase from the fibroblasts of sclerotic morphea plaques. Furthermore, because fractional ablative lasers have been shown to upregulate matrix metalloproteinases, it is possible that these devices could facilitate softening of morphea plaques through a similar mechanism.
Conclusion: The long-term effects of ablative fractional treatments in morphea-related defects are unknown and further study in this area is needed.

#140

CASE REPORT: PORT WINE STAIN TREATED WITH PDL AND TOPICAL SIROLIMUS OINTMENT

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Background: A port wine stain (PWS) is a type of capillary vascular malformation where malformed dilated blood vessels are present in the skin. Pulsed dye laser (PDL) is the treatment of choice for PWS. Studies have shown that a delay in treatment results in a higher proportion of patients who develop hypertrophy and nodularity within lesions that are more resistant to therapy. Although PDL is very effective, there is a resultant revascularization of vessels after treatment. Oral sirolimus and topical imiquimod have shown promise as adjunctive therapies but have significant side effects. Recent studies have shown that application of topical sirolimus results in reduced angiogenic markers following PDL treatments. Our patient is a 56 year old male with an extensive PWS involving over 50% of his face and neck. After surgical debulking for removing redundant tissue and initial improvement with PDL alone, the laser treatments appeared to plateau. Topical sirolimus 0.5% ointment was added to his treatment regimen as an adjunct to PDL to enhance clearance of the PWS. We wish to demonstrate the utility of topical sirolimus to reduce revascularization after PDL treatment.
Study: This is a single case report of a patient being treated with 595 nm PDL (Candela Corp, Wayland, Mass) every 4–6 weeks with the following laser settings: fluence 9–11 j/cm^2, pulse duration 0.45–1.5 ms, spot size 7 mm, cooling Sirolimus 0.5% ointment is applied to the area twice daily without a change in the fluence.
Results: Our patient shows significant improvement in color and texture of his PWS with PDL. Since starting sirolimus ointment we have observed continued improvement and maintenance of results between PDL treatments. Notably, the patient has not noted delayed wound healing.
Conclusion: Topical sirolimus 0.5% ointment is a safe and effective adjunct to PDL in the treatment of PWS.

#141

FRACTIONAL ABLATIVE CO_2 LASER FOR TREATMENT OF CHRONIC ULCERS IN EPIDERMOLYSIS BULLOSA

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Background: Dominant dystrophic epidermolysis bullosa (DDEB) is a mechanobullous disorder resulting from dominant-negative mutations in the Collagen VII. This abnormal epidermal basement membrane results in chronic painful blistering following minor trauma to the skin. Previous studies have shown improvement in DDEB chronic ulcerations following autologous skin grafts from both genetically abnormal and normal skin. Patients with normal skin but with ulcers from other causes have demonstrated improvement after treatment with fractional ablative 10,600 nm CO_2 laser (FACL) treatment. This study looks at the effect of treatment of chronic ulcers in a DDEB patient with FACL vs. FACL in conjunction with skin grafting vs skin grafting alone.
Study: This is a single patient case study. Patient selected is a 33 year old male with DDEB with a chronic shawl like ulcer across the upper back and shoulders. Treatment areas were selected from this ulcer: #1) FACL only, #2) FACL with autologous skin graft, #3) autologous skin graft only. 1 cm areas were treated; sites #1 and #2 were treated with the ActiveFX (Lumenis). 3–5 mm diameter pinch grafts were taken from the right anterior thigh and placed on treatment sites #2 and #3. The entire treated area was covered with Mepilex transfer and secured with a pressure dressing.
Results: On post-treatment day 5, patient returned for wound check. All grafts were intact, graft donor site healing without complications. Through day 30 he continued showing significant improvement in all 3 treatment areas with new epithelialization covering the entire area and extending into non-treated ulcer.
Conclusion: FACL with and without autologous skin grafts may be a therapeutic option for EB patients with chronic ulcers recalcitrant to conventional wound care therapy. Skin grafting is limited by morbidity associated with injury to the donor site and by supply of non-ulcerated skin. FACL alone could be used to treat widespread ulcerated areas without these limitations.

#142

A CASE OF LYMPHANGIOMA CIRCUMSCRIPTUM SUCCESSFULLY TREATED WITH FRACTIONAL CARBON DIOXIDE LASER ABLATION AND ELECTRODESSICATION

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Background: Management of lymphangioma circumscriptum (LC) remains challenging because of high recurrence rates, regardless of the treatment modality chosen. Treatment is typically undertaken for cosmetic reasons or complications such as fluid drainage, pain, and infection risk that can negatively impact quality of life. Treatment with the fully ablative CO_2 laser has

been reported widely, however, there is only one report of using the fractionated CO_2 laser for the treatment of LC in the literature. This case report evaluates the efficacy of a fractionated 10,600 nm CO_2 laser along with electrodessication for the treatment of an adult with symptomatic LC.
Study: We report a case of a 27-year-old female with Klippel-Trenaunay Syndrome who presented with a 5-year history of well-circumscribed lesions on the right lateral and anterior thigh that drained clear lymphatic and serosanguineous fluid, respectively. These yellow and violaceous, verrucous-appearing translucent lesions caused her significant emotional distress because of uncontrolled oozing requiring numerous clothing changes. The lesions were spot treated with Lumenis UltraPulse fractionated 10,600 nm CO_2 laser, using the Deep FX settings (two passes at 25 mJ and 20% density), followed by curettage and electrodessication of the base of the lesions.
Results: The patient tolerated the procedure well with no side-effects. Two weeks after her initial treatment, excellent interval clearing of lesions was observed and leakage of fluid had ceased. At the 2-month follow-up, the patient reported no further drainage and was extremely content with the excellent outcome. Treatment of the remaining lesions was offered, but the patient declined further sessions until her symptoms recur.
Conclusion: We recognize that short-term follow-up cannot conclusively demonstrate effectiveness of this treatment and that longer-term observation is needed before making definite conclusions. However, based on the significant improvement in our patient, fractionated CO_2 laser along with electrodessication and curettage may be an additional well-tolerated, effective treatment option for LC.

#143

A NEW MINIMALLY INVASIVE METHOD OF TREATING BASAL CELL CANCERS IN A PORT WINE STAIN: A CASE REPORT

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Background: The development of a Basal Cell Cancer (BCC) in a Port Wine Stain (PWS) secondary to sunlight and radiation exposure has been described in the literature. Usually such lesions are treated with Mohs micrographic surgery or surgical excision which carries a higher risk of postoperative bleeding due to the vascularity of PWSs. We describe a novel method of treatment of multiple BCCs in a facial PWS using a combination of CO_2 laser and Photodynamic therapy (PDT).
Study: The combined treatment is only effective against nodular and superficial BCCs (1). Hence, the histological diagnosis was obtained before the treatment was offered to the patient. The lesions were treated with UltraPulse® CO_2 Laser (Lumenis, UK) set at 175 mJ, 15 Hz, with a 2 mm collimated beam. This was followed by application of Methyl Aminolevulinate (METVIX®) covered with an occlusive dressing for three hours. At the end of three hours, the PDT was activated using Aktilite 16 LED lamp. Antibacterial ointment was applied at the end of the procedure. A total of two treatments were carried out 2 weeks apart.
Results: There were no complications after the treatment and at the two month follow up, all areas were healed with no evidence of recurrence.
Conclusion: The combined therapy with CO_2 laser and PDT is an effective treatment for nodular BCC's developing in port wine stain and produces superior cosmetic result whilst minimizing bleeding complications. References: Shorkrollahi K, Javed M, Aeuyung K et al. Combined carbon dioxide laser with photodynamic therapy for nodular and superficial basal cell carcinoma. Ann Plast Surg. 2014 Nov;73(5):552–8.

#144

CO_2 LASER ABLATION OF SUPERFICIAL AND EARLY NODULAR BASAL CELL CARCINOMA GUIDED BY REFLECTANCE CONFOCAL MICROSCOPY WITH RESPONSE CONTROL BY MOHS MICROGRAPHIC SURGERY

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Background: Nearly 5 million people are treated annually for skin cancer; the majority of which are basal cell carcinoma (BCC). Surgical excision is the gold standard for treatment of BCC, but can lead to excess tissue removal, scarring, and may be challenging in certain locations. Laser ablation represents an alternative therapy for BCC removal. Reflectance confocal microscopy (RCM) provides non-invasive cellular-level resolution of the skin *in vivo*, and can detect features of BCC. We wish to investigate the role of confocal microscopy for guiding and improving laser ablation of these tumors.
Study: In a preliminary study, we developed a protocol for image-guided carbon dioxide (CO_2) laser ablation of BCCs. Pre-ablation, lesions were imaged with RCM to delineate lateral and deep margins and select ablation parameters. Lesions underwent 2–3 passes of a CO_2 laser (wavelength 10600 nanometers, pulse duration 750 μsec, fluence 8.5 J/cm^2), followed by topical application of aluminum chloride (35%, 1 minute) and RCM imaging to assess response after each pass. The entire lesion was then removed with Mohs micrographic surgery for histopathologic correlation.
Results: Seven patients with eight basal cell carcinomas (7 superficial; 4 had nodular component; 1 had infiltrative component) participated in this pilot study. RCM identified tumor presence pre-ablation in all 8 lesions. After ablation, RCM confirmed complete removal of tumors in 6 cases and residual tumor in 2 cases. Mohs histology confirmed the complete clearance of tumor in 6 cases. The histology correlated with confocal findings for the presence or absence of tumor in all patients.
Conclusion: Reflectance confocal microscopy may help guide and thus augment the CO_2 laser ablation of superficial and early nodular BCCs. Future studies are planned to assess the ability to longitudinally monitor lesions treated with laser ablation using RCM.

#145

NOVEL ASSESMENT OF BRONCHIAL ASTHMA WITH LASER SPECTROSCOPE

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Background: Laser spectroscope is a recent promising noninvasive tool for detection of exhaled breath nitric oxide in asthmatic patients. Therapy decision of asthma requires serial investigations to achieve asthma control. The fundamental and strongest absorption band of exhaled nitric oxide is centered in the mid infrared region approximately 5 microm. Using reflective

multipass cells improves the sensitivity of absorption method. The purpose of this review is to evaluate efficacy of laser spectroscope in assessment of bronchial asthma.
Study: A retrospective review recruiting 125 asthmatic patients and 700 healthy control. The laser spectroscope techniques detecting exhaled nitric oxide are tunable diode laser absorption spectroscopy, quantum cascade and photo acoustic spectroscopy during follow up visits, exacerbation and after inhaled corticosteroid. Exhaled breath based on American Thoracic guidelines.
Results: A statistical significant difference p value < 0.001 of the mean exhaled nitric oxide between healthy and asthmatic patients as regard age and sex. Reduction of exhaled nitric oxide to near normal level after steroid therapy compared to steroid native asthmatic patients (approximately 44 parts in 10(9)) to (< 20 parts in 10(9)). The reported ultra-high level of exhaled nitric oxide at follow up indicates worse respiratory condition than during exacerbation. The concentration achieved at 1 second is 0.5 ppbv allow asthma monitoring regardless degree of airway inflammation.
Conclusion: Laser spectroscope is valuable and trustable for asthma assessment and therapy decision.

#146

UV FLUORESCENCE EXCITATION IMAGING IN WOUND HEALING: WOUND SIZE AND WOUND CLOSURE MEASUREMENTS

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Background: A wide-field UV fluorescence excitation imaging system, developed to image highly-proliferating cellular processes (295/340 nm excitation/emission wavelengths) and collagen cross-links (335/390 nm), was used to study wound epithelialization in skin organ culture. The objectives of the study are to assess the effect of different media culture on re-epithelialization of wounds of different size and to evaluate the feasibility of using UV fluorescence excitation imaging to monitor skin re-epithelialization.
Study: Circular dermal wounds of 3, 4 and 5 mm diameter were created in *ex vivo* human skin and cultured in different media: DMEM (EGF+/−), DMEM/F-12 (EGF+/−), Epilife (EGF+) or saline. Fluorescence images, standard color images, histology (H&E staining) and immunohistology (pan-keratin) were used to assess epithelialization. In addition, we measured the expression of the nuclear protein Ki67, which is associated with cellular proliferation, to confirm the correlation between proliferation of cells and endogenous fluorescence.
Results: Proliferating keratinocytes forming new epidermis expressed higher endogenous fluorescence upon excitation of light at 295 nm wavelength. Fluorescence images at 295 nm were complementary to images at 335 nm, confirming the extent of the re-epithelialization area. Keratinocytes proliferation was highest in DMEM (EGF+) as compared to DMEM (EGF−), DMEM/F-12 (EGF+/−) or Epilife (EGF+). Wounds of 3 mm diameter closed completely at day12 in DMEM (EGF +) culture. Wounds of 4 and 5 mm diameter had closure extents of 91.1% ¡ À 11.7 and 79.9% ¡ À6.7 at day 20. By week 4, wounds of 4 mm diameter completely re-epithelialized and wounds of 5 mm diameter were 95.9% ¡ À5.2 closed. H&E and immunohistology (pan-keratin, Ki67) show that endogenous fluorescence excitation at 295 nm wavelength correlates with newly formed epidermis.
Conclusion: We have established an organ culture model and imaging method for studying epithelialization processes in wound healing of skin, our approach provides a non-destructive, objective, direct method for quantitative measurements in wound healing.

#147

MILD TEMPERATURE HYPERTHERMIA INDUCING DOPPLER OPTICAL COHERENCE TOMOGRAPHY ENDOSCOPE FOR EARLY DETECTION OF COLORECTAL CANCER IN A MOUSE MODEL

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Background: Colorectal cancer is the third deadliest cancer in the United States. Colonoscopy and sigmoidoscopy are the predominant diagnostic procedures. While these methods are characterized by high sensitivity and specificity to medium and large polyps, studies have shown up to 25% miss rates for polyps smaller than 5 mm in diameter. It is known that the new vessels developed to support growing dysplastic polyps are dysfunctional. The aim of this work is to design a non-destructive imaging method for automatic detection of pre-malignant polyps by exploiting the vessel dysfunction.
Study: The hemodynamic response to heat of the microvasculature of the colon submucosa was detected to differentiate normal and dysplastic tissue regions. The azoxymethane (AOM) mouse model of colorectal cancer was used. The distal 30 mm region of the colon of ten mice (6 AOM, 4 control) were imaged using Doppler optical coherence tomography (OCT) before and after heating the tissue by $\sim 3^{\circ}$C. The mice were imaged 12 week after AOM injection to allow for numerous polyps to develop. The detected blood vessels were segmented and the change in blood flow due to heating was measured within regions of interest. The regions classified as dysplastic will be compared to gold-standard histology.
Results: A miniature endoscope has been constructed and used for in vivo mouse imaging. The change in blood flow was measured using Doppler OCT. We are currently analyzing the data to determine if this technique can be used to differentiate healthy tissue from dysplastic polyps.
Conclusion: Several studies have noted that tumor-originated vessels are dysfunctional, including their response to hyperthermia. Owing to its high spatial and flow resolution, Doppler OCT is an attractive imaging modality for non-destructively detecting dysfunctional vasculature near the tissue surface.

#148

FUNCTION-SPECIFIC PATHWAY-MEDIATED PHOTOBIOMODULATION ON THE EXTRACELLULAR TRAPS FORMATION OF STUDENT NEUTROPHILS

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Background: There are two kinds of antimicrobial activities of polymorphonuclear neutrophils, respiration burst and neutrophil extracellular traps (NETs) consisting of chromatin and granular proteins. The effects of red light (640 ± 15 nm) from light emitting diode array (RLED) on the NETs formation (NETF) and its mechanism were studied in this paper.

Study: Neutrophils were isolated from the blood of healthy volunteer students and cultivated in RPMI 1640 medium supplemented with 0% and 2% fetal bovine serum, respectively. The neutrophils were treated with dexamethasone (DEX) at 1 Ìmol/L and a sirtuin 2 (SIRT2) inhibitor, AGK2, at 7 Ìmol/L, respectively, irradiated with RLED at 0.4 mW/cm^2 for 150 s, and then treated with 100 mU/ml glucose oxidase to induce NETF. All the parameters were routinely assessed.

Results: The NETF increased among sedentary male, female students and male students with physical exercise habit. RLED promoted the DEX/AGK2 inhibited NETF, and increased the SIRT2 level of the AGK2 treated student neutrophils. In serum-free medium, the DEX did not affect the SIRT2 level of student neutrophils, but decreased the one of RLED irradiated sedentary female students and male exercisers, respectively. For RLED irradiated and DEX/AGK2 treated student neutrophils in serum-free medium, there was no significant difference of the SIRT2 level between the DEX treated male exercisers/ sedentary female student neutrophils and the AGK2 treated neutrophils, but the SIRT2 level of the DEX treated sedentary male student neutrophils was higher than the one of the AGK2 treated neutrophils.

Conclusion: There may be two redundant NETF-specific signal transduction pathways (NSPs), DEX-resistant NSP1 and DEX-sensitive NSP2. The full activation of NSP1 may maintain the neutrophils of sedentary female students and male exercisers, but the activation of their partially activated NSP2 may be promoted with RLED. The RLED may promote the activation of the partially activated NSP1 of sedentary male students.

#149

A SYSTEMATIC APPROACH TO UNRAVEL HOW LIGHT IMPACTS PRIMARY HUMAN DERMAL FIBROBLASTS

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Background: Photobiomodulation using visible and near-infrared light induces versatile therapeutic responses in a range of clinical applications. However, the literature is difficult to interpret given the considerable variability in parameters including wavelength, irradiance, radiant exposure, and pulsing. Moreover, a wide range of biological models and cell culture conditions were investigated. Finally, the data underlying the photo-biological processes mostly naming cytochrome c as a chromophore, are rather inconclusive, especially with respect to opsin-mediated light impacts on human cells. This study aims at performing a novel and systematic investigation of the impact of optical parameters on cellular responses, including those via opsin and chryptochrome receptors in human primary dermal fibroblasts under defined culture conditions.

Study: Primary fibroblasts from papillary and reticular dermis were isolated from human facial skin within 8 hours post-surgery, seeded onto 24-well culture plates, and cultured in 2% FBS until 60–70% confluence. Cell responses to six discrete wavelengths (447 nm, 505 nm, 530 nm, 590 nm, 655 nm and 850 nm), a range of irradiances, and radiant exposures (0.1 to 100 mW*cm^-2 and 0.1 to 100 J*cm^-2, respectively) were tested systematically and assessed in terms of cell viability and proliferation using Alamar Blue® Cell Viability Assay and total collagen production using the SircolTM collagen assay. The expression of light-sensitive receptors was analyzed based on qPCR and immunohistochemistry.

Results: This systematic investigation will show the impact of several optical parameters on cellular response of human primary dermal fibroblasts under defined culture conditions. The impact of light at different optical parameter settings will be presented in terms of viability, proliferation, and collagen production.

Conclusion: Understanding mechanisms of action of photobiomodulation in relation to its therapeutic value requires interdisciplinary approach, including systematic studies on the impact of different optical parameters on cellular responses, optical modeling translating parameters from in vitro to in vivo situations, and identification of light-receptor-based signal transduction pathways.

#150

LIGHT PARAMETERS IN LOW-LEVEL LIGHT THERAPY: A SYSTEMATIC LITERATURE REVIEW

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Background: Photobiomodulation induces versatile therapeutic responses, ranging from hair regrowth to stem cell differentiation. The increase in number of related FDA-approved devices and interest among cell and molecular biologists highlights the need to better understand how light parameters applied in vivo and in vitro impact on compartments located more deeply in skin in order to elucidate the underlying processes including those interacting with light receptors. This study was aimed at performing a systematic literature review of applied parameters and to interpret how photon densities can be extrapolated from in *vivo* to *in vitro* scenarios and vice versa.

Study: Wavelength, irradiance, and radiant exposure were extracted from 70 peer-reviewed scientific articles available via Pubmed (1987–2014) on *in vivo* clinical and *in vitro* studies (human and animal) for wound healing and hair regrowth. These parameters were compared to those of several FDA-approved home-use devices for hair regrowth. Photon densities were extrapolated inside the skin using a proprietary optical model of light transport in turbid medium.

Results: Our literature review revealed a very broad range of reported parameters. Ranges were 400 nm to 1000 nm, 0.1 mW*cm-2 to 100 mW*cm-2, 0.1 J*cm-2 to 100 J*cm-2, for the wavelength, irradiance, and radiant exposure, respectively. Yet, photon densities extrapolated *in vivo* to *in vitro* conditions fell within the reported ranges for *in vitro* studies, showing relative

consistency. Parameters of the studies performed at more restricted wavelengths form smaller clusters.
Conclusion: While irradiances inducing reported therapeutic effects in the literature span a two orders of magnitude range, this may still be compatible with physiologic dose ranges reported in plant photobiology and mammalian cell biology. With this perspective in mind, we recommend a systematic *in vitro* study using ranges of optical parameters, optical modeling for *in vitro*-to-*in vivo* extrapolations, and statistical tools to better identify potential trends in the reported parameters.

#151

TREATMENT OF TRAUMATIC TATTOO USING PICOSECOND ALEXANDRITE LASER

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Background: Picosecond laser devices are an emerging technology that have been used to successfully treat ink-based tattoos and melanocytic lesions in fewer treatments than previous Q-switched devices. To our knowledge, there is no published data on the use of picosecond laser devices in the treatment of traumatic tattoos. We report near complete clearance of a traumatic asphalt containing tattoo of the face with a picosecond alexandrite laser.
Study: A 62 year-old man presented to UCLA dermatology requesting treatment of a traumatic tattoo of the face. The tattoo was the result of a bike vs car accident several years prior. It had never been treated before. A test spot was performed to a single are on the nasal sidewall using a 755 nm, picosecond alexandrite laser at 2.83 J/cm^2 and a 3 mm spot size.
Results: Six weeks later the test spot showed near complete clearance and the remainder of the lesion of was treated using the same settings. At six week follow up the entire lesion showed near complete clearance which was sustained at 6 month follow-up.
Conclusion: While the efficacy of picosecond devices for ink-based tattoo is well established, we report the first safe and successful treatment of a traumatic tattoo with this class of device. More subjects and data need to be collected to establish ideal settings and parameters for these tattoos moving forward.

#152

COMPLETE RESOLUTION OF MINOCYCLINE PIGMENTATION WITH FRACTIONAL PHOTOTHERMOLYSIS PLUS Q-SWITCHED ALEXANDRITE LASER

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Background: Pigmentation secondary to minocycline ingestion is an uncommon adverse event affecting 3.7–14.8% of treated individuals for which few effective therapies are available. Three patterns of minocycline pigmentation are observed with characteristic clinical and histological appearance. The pigment composition in each variety is different and occurs at different skin depths. Accordingly, a tailored approach according to the type of minocycline pigmentation is crucial for treatment success. The purpose of this intervention was to evaluate the efficacy of fractional photothermolysis plus Q-switched alexandrite laser for the treatment of type I minocycline pigmentation on the face.
Study: The following is a case report detailing a patient with type I minocycline pigmentation who was treated with 1550 nm erbium fractional photothermolysis plus 755 nm Q-switched alexandrite laser and then observed clinically to determine the outcome of this modality.
Results: Following 1 treatment session with each device, the patient noted 100% clearance of all blue facial pigment and remains clear at 8 months post treatment.
Conclusion: Fractional photothermolysis plus the Q-switched alexandrite laser should be considered for treatment of type I minocycline pigmentation.

#153

FIRST REPORT OF ERBIUM LASER AS THE PREFERRED TREATMENT IN A COMPARISON OF FIVE MODALITIES FOR STEATOCYSTOMA MULTIPLEX

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Background: Steatocystoma multiplex (SM) is a disorder of the pilosebaceous unit characterized by an eruption of numerous sebum-containing dermal cysts, and may present with a localized, generalized, facial, or acral distribution. In this series, we report the first comparative evaluation of five different treatment modalities for SM. Erbium laser was the superior modality with respect to overall efficacy, pain, and side effect profile.
Study: Case 1: An 18-year-old male presented with multiple yellow nodules on his chest and arms, with biopsy revealing SM. We elected to attempt four different, concurrent, treatment modalities to assess efficacy and tolerability. Modalities included electrocautery, incision and drainage, punch biopsy and Erbium laser. Laser settings were 25 J/cm^2 with 2 mm single spot handpiece at an ablation depth of 100 um, with 2–3 pulses stacked until the cyst contents were expressed. Case 2: A 37-year-old female with a five year history of SM presented with innumerable shallow dermal nodules on her abdomen, chest and bilateral axilla. Four lesions were treated with excision, with seven others treated with the 2940 Er:YAG laser at settings of 20 J/cm^2, with an ablation depth of 100 um and 5–8 pulses stacked until the cyst contents were expressed.
Results: Recurrence was noted in several lesions treated with incision and drainage, with all other treatment modalities effectively eradicating treated cystic lesions, with no recurrence noted at 6 months follow-up. Each treatment type was associated with mild post-treatment erythema erythema and temporary post-inflammatory hyperpigmentation. Both patients preferred treatment with Erbium laser, reporting minimal pain as compared with excision, along with improved speed of treatment, smaller resultant scar, and better overall clinical efficacy.
Conclusion: For the shallow steatocystomas treated in this series, Er:YAG laser was considered superior in efficacy, speed of treatment, pain and scarring for our two patients in comparison to elliptical excision, punch excision, electrocautery, and incision and drainage. As such, Er:YAG laser should be considered as the treatment of choice for shallow multiple steatocystomas.

#154

FRACTIONAL BIPOLAR RADIOFREQUENCY (SUBLATIVE) FOR THE TREATMENT OF PERIORAL WRINKLES

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Background: Perioral wrinkling is a common cosmetic complaint. Traditional treatments such as laser resurfacing and deep chemical peels give excellent results with substantial downtime. Procedures with less downtime and comparable improvements are in demand. Fractional resurfacing speeds up healing by only treating a portion of the skin, leaving nearby untouched skin as a reservoir for healing. Radiofrequency (RF) utilizes an array of multi-electrode pins to deliver controlled energy with minimal superficial (epidermal) ablation and significant deep (dermal) heating.

Study: This was a single center study of patients with at least mild perioral wrinkling on the Perioral Lines Severity Scale (POLSS) and the Fitzpatrick Wrinkle Scale (FWS). Subjects underwent three perioral treatments (62 mJ/pin, 5 passes), spaced 3–4 weeks apart, with a 1-month follow-up visit. Physician Global Aesthetic Improvement Scale (GAIS) and subject self-assessments were also performed and adverse effects were monitored throughout the study.

Results: 10 Caucasian women (ages 43–70, Fitzpatrick skin types II-III) were enrolled in the study. Patients achieved a 45% improvement (2.72 to 1.5) on the POLSS and a 60% improvement (21.5 to 8.6) on the FWS from baseline to the final visit. All patients achieved "much improved" (33%) or "very much improved" (67%) on the GAIS physician assessment. All patients noted a "significantly marked improvement" on the Subject Improvement Scale and were "very satisfied" on the Subject Satisfaction Scale at the final visit. The most common side effects seen were mild to moderate erythema, edema, bleeding and crusting. All side effects resolved fully between visits without any sequelae.

Conclusion: Treatment with a 64 pin fractional RF applicator (sublative) is a safe and effective treatment for perioral wrinkles for those wanting little downtime or complications.

#155

OPTIMIZATION OF LASER EXPOSURE PARAMETERS IN FRACTIONAL PHOTOTHERMOLYSIS TO AVOID BULK HEATING

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Background: Fractional photothermolysis (FP) was introduced as a method to achieve skin remodeling without the side effects associated with classic laser resurfacing. Microscopic treatment zones undergo laser exposure, resulting in thermal destruction (nonablative FP) or removal (ablative FP) of tissue. While FP is well-tolerated, scarring has been reported, due to excess tissue ablation and/or bulk heating. To date there has been no systematic study to define laser parameters that result in excessive heating.

Study: Ablative FP using a CO_2 laser (Ultrapulse, Lumenis, San Jose, CA) was performed on cadaveric pig skin with densities of 10% and 20% and energy per pulse (EPP) of 10–80 mJ. A thermal camera (e40, FLIR, Wilsonville, OR) measured temperature at skin surface during and immediately after exposure. Additionally, preliminary experimentation was performed on live anesthetized abdominal pig skin using densities of 3% and 5% and energies of 25–100 mJ. Biopsy of treated pig skin performed 1 day after exposure allowed for assessment of necrosis.

Results: Peak temperature (C) of cadaveric abdominal pig skin at baseline temperature of 23C for 10% and 20% density, respectively: 10 mJ: 29, 36; 20 mJ: 31, 54; 40 mJ: 52, 67; 80 mJ: 62, (out of range). Peak temperature (C) of live anesthetized abdominal pig skin at baseline temperature of 35C for 3% and 5% density, respectively. 25 mJ: 35–38, 35–36; 50 mJ: 36–37, 36–41; 100 mJ: 36–37, 41. Necrosis was observed at 5% density and 100 mJ.

Conclusion: *In vitro* experiments demonstrated increased (nonlinear) temperature rise with increases in density and EPP. *In vivo* experiments demonstrated a trend toward increased temperature with increased EPP at 5% density but not at 3% density. Scarring was observed only at the higher density and energy. Together, the data support the hypothesis that below a yet-to-be-defined threshold, heating of tissue is not significant in ablative FP. Beyond this threshold, temperature—and the risk of scarring associated with bulk heating—rises with increased density and EPP.

#156

EROSIVE PUSTULAR DERMATOSIS OF THE FACE FOLLOWING TRADITIONAL FULLY ABLATIVE CO_2 LASER RESURFACING

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Background: Erosive pustular dermatosis (EPD) is a rare, chronic inflammatory dermatosis presenting with erythematous, pustular, crusted erosions primarily involving the scalp of elderly patients. Although the etiology is unknown, trauma often initiates the condition. Here, we report a case of EPD confined to facial areas treated with the traditional fully ablative CO_2 laser.

Study: A 57-year-old woman was referred to us following fully ablative CO_2 laser resurfacing for acne scars and dyspigmentation. Initially, she experienced normal healing, but six weeks after the procedure, the patient rapidly developed persistent weepy erosions on her forehead, cheeks, and chin, as well as scattered pustules over her temples and chin.

Results: Punch biopsy demonstrated non-specific findings, including impetiginized scale-crust with underlying dermal fibrosis and acute and chronic inflammation. Swabs for bacterial, fungal, and viral cultures were negative. Blood tests, including ANA and pemphigus autoantibodies, were negative. The best diagnosis was EPD. The erosive lesions were refractory to minocycline, clobetasol cream, tacrolimus ointment, and several months of prednisone. Improvement over 12–18 months was noted with a combination of systemic and topical dapsone, low-dose isotretinoin, dilute vinegar soaks, azithromycin for superinfection with Staphylococcus aureus, and dimethicone emollient.

Conclusion: To our knowledge, this is the first reported case of facial EPD secondary to fully ablative CO_2 laser resurfacing. Previously, EPD of the face has been reported after temporal cutaneous biopsy and on the scalp following CO_2 laser treatment for extensive actinic keratoses. As EPD is a diagnosis of exclusion, infection, immunobullous disorders such as pemphigus vulgaris/foliaceus, and other pustular dermatoses must also be considered. Treatment options include potent topical or systemic steroids, topical calcineurin inhibitors, oral tetracyclines, and for severe cases, isotretinoin and topical or oral dapsone. Our case highlights

the challenge of recognizing and treating this rare condition following resurfacing procedures.

#157

DEFINING THE ABSORPTION SPECTRUM OF A POPULAR SUNLESS TANNER, DIHYDROXYACETONE, USING REFLECTANCE PHOTOSPECTROMETRY

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Background: Despite growing awareness of the harmful effects of ultraviolet induced tanning on photocarinogenesis and photoaging of the skin, the tanned look remains popular among Americans. Tanned skin has had documented interference and complications when combined with laser treatment. Dihydroxyacetone, commonly found in sunless tanning lotions and spray on tans, is the only FDA approved color additive for use as a tanning agent. It binds in the stratum corneum and forms brown-black compounds called melanoids, giving the appearance of a tan. Reflectance spectrophotometers have been used in dermatology to measure the absorption spectrum of the various chromophores in the skin, which may predicts their interaction with the ever growing number of lasers used in dermatology.
Study: We performed reflectance spectrophotometry on non-sun exposed underarm skin both before and after seven days application of dihydroxyacetone to better quantify the absorption spectrum of dihydroxyacetone.
Results: Increased absorption was seen in the 300–700 nm range.
Conclusion: DHA has increased absorption in the 300–700 nm range, which is unique from melannin. Care should be taken with lasers in that range including KTP (532 nm), PDL (585–595 nm) and IPL (400–1200 nm). Due to the epidermal nature of melanoid deposition, most likely side effects would be epidermal crusting and decreased efficacy of treatment due to overestimation of skin type. We recommend waiting 7–10 days after application of DHA to allow for shedding of the stratum corneum prior to using these lasers in practice.

#158

LASER TREATMENT OF SURGICAL AND TRAUMATIC SCARS

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Background: Lasers have changed the landscape for the treatment of surgical and traumatic scars. Traditional therapies such as cryosurgery, corticosteroids, silicone sheathing, retinoids, dermabrasion, pressure therapy, excision and radiation can lead to suboptimal outcomes and high rates of recurrence. In 1983, Anderson and Parrish introduced the medical community to the theory of selective photothermolysis. By the late 1980 s, experimental trials with lasers were showing promise for the treatment of scars.
Study: Today there is a rich armamentarium of lasers available for the treatment of surgical and traumatic scars that will be reviewed with attention to Pulsed Dye Laser (PDL) and fractional lasers. The question of when to initiate treatment and an assessment of the potential side effects of laser treatment will be addressed.
Results: The discovery of fractional photothermolysis resulted in a fundamental shift in the therapeutic approach to surgical and traumatic scars. PDL and fractional lasers afford patients and clinicians with effective, well-tolerated and safe alternatives to traditional therapies. Lasers have been shown to improve the aesthetic, functional and symptomatic sequelae of scars. In regards to laser settings, treatment frequency and duration of therapy, diverse opinion exists in the literature. In general, low to moderate fluences and a short pulse duration are advisable for PDL. Fractional lasers can target specific tissue depths within the skin. It is recommended that a device be selected whose depth matches, but does not exceed, the scar thickness. Lasers furthermore show promise for the prevention of scars through the preemptive treatment of surgical sites, although the question of when to initiate therapy is still debated.
Conclusion: Advances in laser technology have transformed the clinical management of surgical and traumatic scars. It is our hope this review will help dermatologists select the appropriate laser and treatment schedule in the management of surgical and traumatic scars.

#159

MULTIMODAL THERAPY FOR POST-SURGICAL SCARRING

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Background: To illustrate the benefit of combination therapy for a post-thyroidectomy scar.
Study: A 60-year-old female presented for evaluation of scarring along the neck 4 months after thyroidectomy. She developed thickened scars shortly after surgery and had little to no improvement after the use of silicone patches, flurandrenolide tape, fluticasone cream, or acupuncture. The lesions were painful and continued to thicken. On exam, there were ropy, interwoven, hypertrophic pink plaques on the anterior neck. Injection with intralesional steroid alone helped with symptomatic relief, but not the appearance of the scars. After careful discussion, combination therapy was initiated.
Results: After 7 treatments with intralesional steroids, 2 treatments with non-ablative fractional laser, and one treatment with pulsed dye laser, the patient had great improvement in the appearance and sensation of her scars.
Conclusion: This case reinforces the benefit of multiple treatment modalities for improved scar outcomes after surgery.

#160

NON-ABLATIVE FRACTIONATED RESURFACING IN THE TREATMENT OF SCAR CONTRACTURE

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Background: A 28 year old female presented with extensive scarring after a traumatic injury to her right lower extremity. The patient had been hit by a vehicle one year prior to presentation and had several open fractures with extensive overlying cutaneous damage, requiring multiple surgeries and skin grafts. She had limited range of motion of the affected limb secondary to scar contracture.
Study: She received 6 treatments with a non-ablative fractionated resurfacing (NAFR) device with 2 wavelengths (Fraxel DUAL, Solta Medical, Hayward, CA) with spaced 4–8 weeks apart. The

patient received 3 treatments with the 1927 nm NAFR thulium laser (10 mJ, 30% density, 8 passes) and 3 treatments with the 1550 nm NAFR laser (40 mJ, 17–26% density, 8 passes). Before and after treatment photographs were taken, as well as range of motion measurements with respect to ankle dorsiflexion.
Results: The patient had 50–75% improvement in the texture and discoloration. There was both subjective and objective improvement in the range of motion of the patient's right lower extremity. The patient experienced erythema, edema, which both resolved after 7–10 days.
Conclusion: Recent studies have shown great functional improvement in scar contractures with ablative fractional laser treatments; however, these treatments are accompanied by significant downtime, risk of further scarring and infection, and are not widely available. NAFR a very accessible treatment with an extremely low side effect profile, but until now has not been reported as efficacious in the treatment of scar contracture. This case report is novel in its demonstration of the utility of a dual wavelength NAFR in the treatment of scar contracture and functional impairment.

#161

EXCELLENT AESTHETIC AND FUNCTIONAL OUTCOME AFTER FRACTIONATED CARBON DIOXIDE LASER SKIN GRAFT REVISION SURGERY: CASE REPORT AND REVIEW OF LASER SKIN GRAFT REVISION TECHNIQUES

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Background: Skin grafts are used to reconstruct a defect in the skin, such as for surgical removal of cutaneous malignancies, replacement of tissue after burns, and hair transplantation. Skin grafts may be aesthetically displeasing, functionally limiting, and negatively impact patient's quality-of-life. There is limited published literature on laser skin graft revision for improving aesthetics and function. We present a case of a 64-year-old patient with skin graft who achieved improvements aesthetically and functionally after two treatment of fractionated CO_2 laser, and review the medical literature on laser skin graft revision techniques.
Study: Our patient presented to us for skin graft revision due to unnatural cosmetic appearance and functional limitation from a neck skin graft surgery. The skin graft's appearance was described as "a band aid stuck to my neck," and severely limited the patient's neck range of motion.
Results: He underwent two treatment of fractionated CO_2 laser. After the first treatment, he was "thrilled" with the results. The laser-revised skin graft scar blended in well with surrounding skin and helped increase neck range of motion. The aesthetic and functional results were sustained at 6 months post-last treatment.
Conclusion: Skin grafts can significant impact daily life, restrict movement, and lead to psychological problems that is often not adequately addressed by clinicians. A review of the medical literature demonstrated limited studies on laser skin graft revision for aesthetic and functional outcome. Previous studies have used Q-switched frequency double Nd:YAG (532 nm) laser, 1540 nm Er:Glass laser, Pulsed Dye Laser (PDL), unfractionated and fractionated CO_2 laser to address either aesthetic or functional challenges of skin graft. We think that skin graft revision with fractionated CO_2 laser provides excellent efficacy and safety, and clinicians may consider utilizing this treatment method to help improve skin graft aesthetics and function limitations.

#162

TREATMENT OF FACIAL ACNE SCARS WITH 755 nm PICOSECOND LASER

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Background: The psychological impact of acne and the resultant scarring is well known. Many different laser devices have been tried to treat scars. Currently, fractional resurfacing is the workhorse laser system but is often painful and can require some downtime. The 755 nm picosecond alexandrite laser (Cynosure) has been FDA approved for the removal of unwanted tattoos and benign pigmented lesions, as well as acne scars. An innovative optical hand piece attachment for the picosecond laser is capable of distributing greater density per pulse and is thought to improve the appearance of acne scars. The objective of this study was to investigate the safety and efficacy of a 755 nm picosecond laser with special optical hand piece, a diffractive lens array, in treatment of facial acne scars.
Study: A total of 20 male and female patients with facial acne scars between the ages of 18 and 65 were enrolled at The Laser & Skin Surgery Center of Northern California to undergo treatment with Picosure 755 nm picosecond laser using a lens array hand piece. Five laser treatments were performed, with the treatments spaced 1 month apart. The patients were then asked to follow-up at 1-month and 3-months after completion of treatment. A validated quantitative global post-acne scarring grading system developed by Goodman and Baron was used to grade the severity of scar scars prior to treatment initiation and at 1-month and 3 month follow-up.
Results: A total of 20 patients (19 women and 1 man) between the ages of 28 and 58 (mean age 40.6 years) with facial acne scars were enrolled for the study. Fitzpatrick skin types ranged from II to IV with most identifying themselves as Caucasian. Two patients withdrew from the study prior to completion, one due to pregnancy and the other due to pain intolerance. One patient was lost to follow-up. Two patients missed their 1 month follow-up but made it to their 3 month follow-up. Using the quantitative global post-acne scarring grading, there was a mean 17.5% improvement at 1 month (16% on the right and 19.1% on the left) and a mean 15.5% improvement at 3 months (11.5% on the right and 19.4% on the left). One patient with Fitzpatrick type IV skin had moderate hyperpigmentation noted 1 month after final treatment. There were no other adverse events other than transient erythema. Most patients reported being satisfied with the results with most reporting improvement in skin texture and some with pigment as well.
Conclusion: The 755 nm picosecond laser using diffractive lens array hand piece is a safe and effective device in the treatment of facial acne scars with the additional benefit of improvement in skin texture noted by most patients.

#163

USE OF INTRAOPERATIVE HIGH-DEFINITION ULTRASOUND TO ACCURATELY GAUGE SCAR THICKNESS AND IDENTIFY INTRA-SCAR ANATOMY DURING MULTIMODAL REVISION OF A HYPERTROPHIC BURN SCAR

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Background: Treating hypertrophic burn scars can be challenging because scar remodeling may cause significant changes in tissue pliability and skin scar contractures that lead to distortion of local anatomy. The ability to accurately and consistently characterize scar thickness and aberrant intra-scar anatomy would be useful to both clinicians and scar surgeons alike.

Study: A 20-year-old male presented for evaluation of a chest scar that resulted from a scald injury at one year of age. This was associated with significant restriction of his chest wall and intermittent pruritus and pain. Exam revealed a large, tight, confluent scar sheet involving the majority of his anterior chest wall, estimated to be roughly 0.5–1.5 mm in thickness. Local anatomic landmarks were significantly displaced. No arterial pulse was appreciated within the scar. High-definition ultrasound was used intraoperatively to visualize intra-scar anatomy and identified a high-flow, large-bore vessel overlying the sternum, approximately 6 mm from the stratum corneum. The aberrant vessel was mapped so as to avoid treatment directly over it. The thickest portions of the scar were then safely treated using an ablative, microfractionated, 10,600 nm carbon dioxide laser (Ultrapulse Encore Scar FX; Lumenis, Ltd., Yokneam, Israel), with a single pulse, non-overlapping stamping technique at pulse energies from 90 mJ to 150 mJ and treatment density of 3%, corresponding to a treatment depth of approximately 2.5 to 3.6 mm respectively. A total of 5 ml of triamcinolone acetonide (40 mg/ml) was then applied to the entire treatment field via laser-assisted delivery.

Results: At follow-up, the patient endorsed improvement in scar texture and decreased pruritus and pain. Exam revealed thinning of the central portion of the scar.

Conclusion: High-definition ultrasound measures scar thickness and may help to identify aberrant intra-scar anatomy more accurately than clinical impression alone; this intraoperative technique may be a useful adjunct in the management of certain hypertrophic scars for clinicians and scar surgeons alike.

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Felten, Richard	No Disclosure
Feng, Xin	No Disclosure
Ferreira, Lydia	No Disclosure
Finlay, Jarod	Received Salary From University of Pennsylvania; Served on Advisory Board for Varian Medical Systems
Finney, Robert	No Disclosure
Fleming, Trudy	No Disclosure
Florendo, Edmond	Pending
Fornaini, Carlo	Pending
Fournier, Nathalie	Received equipment from Novoxel; Received Discount from Croma, Merz; Consulting fees received from Calor, Urgo; Travel Expenses Paid By Merz, Novoxel; Holds Ownership Interest with Novoxel; Served on Advisory Board for Calor, Novoxel, Urgo
Francischetti, Martiniano	No Disclosure
Franco, Walfre	Pending
Frank, Michael	No Disclosure
Freitas, Anderson	Pending
Fried, Daniel	No Disclosure
Friedman, Paul	Received financial grant from Sebacia (principal investigator); Consulting fees received from Valeant; Served on Advisory Board for Valeant
Frydrych, Wendy	Pending
Fujibayashi, Mariko	No Disclosure
Fujimoto, Takahiro	No Disclosure
Keiko Lima Fujita, Alessandra	No Disclosure
Galiano, Robert	Pending
Gallagher-Colombo, Shannon	No Disclosure
Gao, Lin	No Disclosure
Gan, Stephanie	Pending
Garcia-Guzman, Miguel	Pending

Name	Disclosure
Garden, Jerome	Pending
Geddes, Elizabeth	No Disclosure
Geronemus, Roy	Holds Ownership Interest with OnLight Sciences, Zeltiq; Served on Advisory Board for Cynosure, Syneron-Candela, Zeltiq; Allergan, Cutera, Cynosure, Cytrellis, DUSA, Kythera, Lithera, Medicis, Miramar, Myoscience, MoMelan, Pfizer, Syneron-Candela
Ghafarrokhi, Shams	Pending
Gill, Ruby	No Disclosure
Godine, Richard	No Disclosure
Golabgir Anbarani, Afarin	No Disclosure
Gold, Michael	No Disclosure
Goldberg, David	Received financial grant from Allergan, Cutera, Sebacia, Syneron, Unilever; Consulting fees received from Miramar; Received honoraria for educational services from Cutera, Syneron; Holds Ownership Interest with Aquavit
Goldberg, Gerald	Received equipment from Syneron-Candela; Received Discount from Syneron-Candela, Cutera, DEKA, Palomar; Consulting fees received from Syneron-Candela, Con-Bio; Travel Expenses Paid By Syneron-Candela; Received honoraria for educational services from Syneron-Candela; Served on Promotional Speakers Bureau Syneron-Candela
Goldman, Mitchel	Received financial grant from Cynosure, Lumenis, Sienna Labs; Received equipment from Lumenis, Syneron-Candela; Received Discount from Cynosure, Lumenis, Syneron-Candela; Consulting fees received from Lumenis; Travel Expenses Paid By Lumenis; Received royalties from Taylor & Francis Publishers, JP Medical Ltd.; Holds Ownership Interest with Lumenis stock options, Sienna Labs stock and options; Served on Advisory Board for Lumenis
Gollnick, Sandra	Pending
Gomes, Anderson	No Disclosure
Goncalves, Joyce L.S.	Pending
Gowani, Zain	Pending
Graves, Michael	No Disclosure
Green, Jeremy	Received financial grant from Research for Ulthera; Received honoraria for educational services from Cutera, Cynosure, Ulthera; Served on Advisory Board for Lutronic; Served on Promotional Speakers Bureau Cutera, Cynosure, Ulthera
Greenbaum, Joshua	No Disclosure
Griffin, Thomas	No Disclosure
Gross, Deborah	No Disclosure
Gu, Ying	No Disclosure
Guilherme, Arnaldo	No Disclosure
Gutierrez-Herrera, Enoch	No Disclosure
Haedersdal, Merete	Received financial grant from Almirall, Galderma, Leo Pharma, Lumenis, Lutronic, Procter & Gamble; Received equipment from Loan of equipment from Palomar/Cynosure, Pantec; Travel Expenses Paid By Galderma, Pantec
Haimovic, Adele	No Disclosure
Hale, Elizabeth	Consulting fees received from Lifeline SkinCare, Merck, Revlon, Guthy-Renker; Served on Promotional Speakers Bureau Allergan, Merz

Name	Disclosure
Hamilton Roarty, Tricia	Pending
Harris, Ronald	Pending
Harry, Rosemary	Received Salary From Device Foundations, Inc; Holds Ownership Interest with Device Foundations, Inc; Served as Officer or Director Device Foundations, Inc.
Hasan, Tayyaba	Pending
Helwig, Larry	Pending
Hibler, Brian	No Disclosure
Hirschberg, Ronald	Pending
Ho, Derek	No Disclosure
Ho, Jessica	No Disclosure
Hoffmann, Klaus	Pending
Holanda, Vanessa	Pending
Hollmig, S. Tyler	No Disclosure
Holt, Ginger	Pending
Hoopman, John	Received financial grant from Sciton; Consulting fees received from Cutera, Sciton; Received honoraria for educational services from Cutera, Sciton
Hruza, George	No Disclosure
Hsu, Jeffrey	No Disclosure
Ibrahimi, Omar	Received financial grant from Living Proof, Lumenis, Lutronic; Received equipment from Lumenis, Lutronic; Received Discount from Kythera, Procter & Gamble, Zeltiq; Consulting fees received from Lutronic; Travel Expenses Paid By Lutronic; Served on Advisory Board for Lutronic
Ito, Naoko	Pending
Ito, Shinobu	Pending
Itri, Rosangela	Pending
Jacob, Carolyn	Received Discount from Miramar; Consulting fees received from Abbvie, Allergan, Galderma, Medicis/Valeant; Received honoraria for educational services from Abbvie, Galderma, Medicis/Valeant; Holds Ownership Interest with Allergan, Medicis/Valeant; Served on Advisory Board for Miramar; Served on Promotional Speakers Bureau Abbvie, Galderma, Medicis/Valeant
Jagdeo, Jared	Pending
Jalian, H. Ray	No Disclosure
Jansen, E. Duco	Pending
Javed, Muhammad	No Disclosure
Jia, Wancun	Pending
Johnson, Jennifer	No Disclosure
Joo, Jayne	No Disclosure
Kabir, Yasmeen	Pending
Kacur, Arundeep	Pending

Name	Disclosure
Kalhori, Katayoun AM	No Disclosure
Kaminer, Michael	No Disclosure
Kanazawa, Hideko	Pending
Kanchanapoomi, Melissa	No Disclosure
Karmisholt, Katrine	Received financial grant from Lumenis
Katz, Bruce	Received financial grant from Cynosure; Received equipment from Allergan, Alma, Cynosure, Merz, Valeant; Consulting fees received from Allergan, Merz, Valeant; Received honoraria for educational services from Allergan, Cynosure, Merz, Valeant; Served on Advisory Board for Allergan, Merz, Valeant
Kaufman, Joely	Received financial grant from Merz; Consulting fees received from Elizabeth Arden; Received honoraria for educational services from Cynosure, Cutera; Served on Advisory Board for Allergan, Energizer, Lutronic, Merz, Suneva; Allergan, Revance, Teoxane
Kauvar, Arielle	Received financial grant from Cynosure/Palomar, Lumenis, Syneron-Candela
Keller, Emily	No Disclosure
Kelly, Kristen	Received financial grant from Nitto Denko; Received equipment from CoolTouch, Light Sciences Oncology, Syneron-Candela; Consulting fees received from Pierre Fabre
Ketz, Ann	No Disclosure
Keys, Kathleen	No Disclosure
Khan, Imran	No Disclosure
Khatri, Khalil	No Disclosure
Kiener, David	Pending
Kilmer, Suzanne	Received financial grant from Allergan, Syneron-Candela, Cynosure, Living Proof, Lumenis, Miramar, Ulthera, Zeltiq,; Consulting fees received from Allergan, Lumenis; Travel Expenses Paid By Allergan, Zeltiq; Received honoraria for educational services from Allergan; Holds Ownership Interest with Solta, Zeltiq; Served on Advisory Board for Allergan, Syneron-Candela, Living Proof, Lumenis, Miramar, Zeltiq
Kim, Theresa	Pending
Kingsley, Melanie	Pending
Kochevar, Irene	No Disclosure
Koenig, Karsten	Pending
Kono, Taro	Pending
Kosari, Payman	No Disclosure
Kositratna, Garuna	Pending
Kovács, Katalin	No Disclosure
Krakowski, Andrew	No Disclosure
Krasieva, Tatiana	No Disclosure
Kruter, Laura	No Disclosure
Kurachi, Cristina	No Disclosure
Lagorri, Giuseppe	Pending
Lamba, Arundeep	No Disclosure

Name	Disclosure
Lanzafame, Raymond	Received financial grant from Apira Science TopHat 655 Study, J&J (CPUS) contract research project; Received equipment from Apira Science, J&J (CPUS); Consulting fees received from Apira Science, J&J (CPUS), GLG Councils, Leerink Swan, Coleman Research Group; Travel Expenses Paid By ASLMS for Annual meeting as per Bylaws and Regulations, Society of Laparoendoscopic Surgeons; Holds Ownership Interest with Stocks in Jamar, Lucid, (total aggregate value <$1000); partner in Biomedical Gateway LLC; Have intellectual property rights with Provisional patent Conversion Energy Enterprises; Served on Advisory Board for I am appointed as consultant (SGE) to the General and Plastic Surgery Devices Panel of the Medical Devices Advisory Committee of the FDA CDRH; Served as Officer or Director ASLMS, Society of Laparoendoscopic Surgeons, Monroe County Medical Society (see below)
Lask, Gary	Received financial grant from Invasix/Inmode; Received equipment from Invasix/Inmode, Syneron-Candela; Received Discount from Invasix/Inmode; Consulting fees received from Invasix/Inmode; Travel Expenses Paid By Invasix/Inmode; Received Salary From Invasix/Inmode, Novoxel; Holds Ownership Interest with Invasix/Inmode, Novoxel; Served on Advisory Board for Invasix/Inmode, Novoxel, Syneron-Candela; Served on Promotional Speakers Bureau Invasix/Inmode; no
Latrive, Anne	No Disclosure
Le, Monica	Pending
Lee, Jangwoen	Pending
Levin, David	Pending
Levin, Yakir	Pending
Li, Fang-Hui	No Disclosure
Liang, Ron	Pending
Liang, Ya	No Disclosure
Lima, Cássio	No Disclosure
Lindeburg, Katrine	Pending
Lippi, Paolo	Pending
Liu, Gangjun	Pending
Liu, Timon Cheng-Yi	No Disclosure
Lloyd, Amanda	No Disclosure
Longo, Diego	Pending
Longo, Leonardo	Pending
Lorden, Fran	Pending
Lorenc, Z. Paul	Pending
Low, Philip	Pending
Lv, Kang-Tao	Pending
Ma, Chuan	Pending
MacGregor, Jennifer	No Disclosure
Mahadevan-Jansen, Anita	Pending
Mahalingham, Sakkarapalayam	Pending
Mahon, Sari	No Disclosure

Name	Disclosure
Mahoney, Leysin	Pending
Majaron, Boris	No Disclosure
Mang, Thomas	Pending
Manstein, Dieter	Received financial grant from Lumenis; Consulting fees received from Neutrogena, Syneron, Zeltiq; Received royalties from Massachusetts General Hospital (licensing contracts with Cynosure, Palomar, Solta, Zeltiq); Holds Ownership Interest with GME German Medical Engineering; Served on Advisory Board for Zeltiq; Served as Officer or Director ASLMS (Laser Medicine Board Representative)
Marcus, Stewart	Pending
Mardaryev, Andrei	No Disclosure
Maris, Michael	No Disclosure
Martorano Fazio, Danielle	Pending
Massa, Mary	No Disclosure
Masson, Igor	No Disclosure
Matsunaga, Kayoko	Pending
Maytin, Edward	Pending
McClaren, Marla	No Disclosure
McDaniel, David	Received financial grant from BTL Aesthetics, Cynosure, Palomar, Ulthera; Received equipment from BTL Aesthetics, Cynosure, Palomar; Received Discount from Cutera, Cynosure, Palomar; Consulting fees received from BTL Aesthetics, Cynosure; Travel Expenses Paid By BTL Aesthetics; Received honoraria for educational services from Allergan, SkinCeuticals; Holds Ownership Interest with LifeSpan Extension; Have intellectual property rights with LifeSpan Extension, Palomar,; Served on Advisory Board for Allergan, BTL Aesthetics, Cynosure; Served as Officer or Director Institute of Anti-Aging Research
McDermott, Laura	Travel Expenses Paid By DermaSweep; Received Salary From DermaSweep; Holds Ownership Interest with DermaSweep
Meesters, Arne	No Disclosure
Mekas, Maria	No Disclosure
Meleti, Marco	Pending
Menezes, Honorio	No Disclosure
Fernanda Campos de Menezes, Priscila	Pending
Merigo, Elisabetta	Pending
Mervak, Julie	Pending
Mignon, Charles-Antoine	Received financial grant from European Funding; Received equipment from Philips; Travel Expenses Paid By Philips; Received Salary From Philips
Mihm, Martin	Pending
Mikulski, Lynn	Pending
Milanic, Matija	No Disclosure
Milner, Thomas	Pending
Milster, Tom	Pending

Name	Disclosure
Poorsattar Bejeh Mir, Arash	Pending
Mishra, Vineet	No Disclosure
Mogensen, Mette	Pending
Moradi, Ahmed	Pending
Moradi, Mahsa	Pending
Moradi, Mahshid	Pending
Mordon, Serge	No Disclosure
Moraes, Marcia	Pending
Morita, Yusuke	Pending
Morrison, Andrea	Received Salary From BTL Industries; Served as Officer or Director BTL Industries
Mortezai, Omid	Pending
Morton, Laurel	No Disclosure
Moy, Ronald	Pending
Mraz Robinson, Deanne	Received financial grant from Cynosure, ThermiAesthetics; Received equipment from Cynosure, ThermiAesthetics; Received Discount from ThermiAesthetics; Consulting fees received from Paradigm Medical, Ulthera/Merz; Travel Expenses Paid By Paradigm Medical; Served on Advisory Board for ThermiAesthetics; Served on Promotional Speakers Bureau Paradigm Medical
Munavalli, Girish	No Disclosure
Murison, Max	Pending
Nadora, Dawnica	No Disclosure
Nagarajan, Vivek Krishna	No Disclosure
Naheety, John	Pending
Barboza de Nardi, Andrigo	Pending
Narurkar, Victor	Received financial grant from Allergan, Alphaeon, Merz, Polyremedy, Revance, Solta/Valeant, Syneron-Candela; Served on Advisory Board for Allergan, Clarisonic, Galderma, SkinCeuticals, Skinmedica, Valeant
Nash, J.F.	Pending
Dehgha Nazhvani, Ali	Pending
Neel, Victor	No Disclosure
Negishi, Kei	Received financial grant from Cutera, Shiseido; Received equipment from Altek, Asclepion, Cutera, Cynosure, Sciton; Received Discount from Lumenis; Received honoraria for educational services from Cutera, Cynosure, Sciton
Nehal, Kishwer	Pending
Nelson, J. Stuart	Received financial grant from National Institutes of Health, Pfizer/Wyeth, Syneron-Candela; Received equipment from Syneron-Candela; Travel Expenses Paid By Syneron-Candela; Received royalties from University of California; Received honoraria for educational services from Syneron-Candela; Have intellectual property rights with Cool Touch (New Star), Syneron-Candela
Nemergut, Michael	No Disclosure
Ng, Elise	Pending

Name	Disclosure
Ngo, William	No Disclosure
Nguyen, John	Pending
Nguyen, Tuyet Ann	Pending
Nicholson, Andrew	Pending
Nishimura, Nozoni	Pending
Nour, Sherif	Pending
Nuijs, Tom	Pending
O'Connor, Maggie	Pending
O'Hagan, Marian	Pending
Ojea, Alecsander Rodrigues	No Disclosure
Olson, Susan	No Disclosure
Orbuch, David	No Disclosure
Ordaz, Josue	Pending
Ortega-Martinez, Antonio	No Disclosure
Ortiz, Arisa	Received equipment from BTL, Cutera, Invasix; Received honoraria for educational services from Sciton
Osley, Katie	Pending
Ostrowski, Rafael	Tria Beauty, Inc.
Owens, Patricia	Received honoraria for educational services from Cosmetic Bootcamp LLC for meeting design
Ozog, David	Pending
Paasch, Uwe	No Disclosure
Palm, Melanie	Received Discount from Lutronic; Received honoraria for educational services from BTL, Lumenis; Served on Advisory Board for Lutronic; Served on Promotional Speakers Bureau BTL, Lumenis, Lutronic, Syneron
Panchal, Ripul	Received financial grant from Globus - Research support to the University; Consulting fees received from Precision Spine
Panchaprateep, Ratchathorn	No Disclosure
Patel, Tapan	Pending
Paul, Akshay	Pending
Pedram, Mir Sepeher	Pending
Peng, Hao	No Disclosure
Pereira Goulart, Viviane	No Disclosure
Pereira, Max	No Disclosure
Perussi, Janice	Pending
Petersen, Marta	No Disclosure
Petro, Jane	Received financial grant from Cutera; Received equipment from loaned from Cutera, Cynosure, Sciton; Received honoraria for educational services from Cynosure, Sciton
Phan, Sydney	No Disclosure

Name	Disclosure
Philipsen, Peter	No Disclosure
Pinto, Nathali	No Disclosure
Polder, Kristel	Received equipment from Valeant; Received Discount from Valeant; Travel Expenses Paid By Valeant
Pollard, Leslie	No Disclosure
Polonelli, Luciano	Pending
Powell, Tracy	No Disclosure
Pozner, Jason	Received equipment from Alma, Apollo, Bella Contour, Canfield, Cutera, Cynosure, Deka, Exilis, Lutronic, Oculoplastic, Sciton, Serene, Syneron, Thermi, Zimmer; Received Discount from Alma, Cynosure, Ellman, Invasix, RA Medical, Syneron, Ulthera, Zeltiq; Received honoraria for educational services from Cynosure, Sciton, Syneron, Thermi, Zeltiq; Holds Ownership Interest with Sciton, Thermi; Served on Advisory Board for Syneron, Valeant, Zeltiq; Served on Promotional Speakers Bureau Cynosure, Sciton, Syneron, Ulthera
Pratavieira, Sebastião	No Disclosure
Prather, Heidi	No Disclosure
Preciado, Salena	Pending
Pryor, Brian	Pending
Purschke, Martin	No Disclosure
Quinn, Annette	No Disclosure
Raafs, Bianca	No Disclosure
Rahman, Zakia	Received equipment from Lexington, Sciton, Tria; Consulting fees received from Myoscience, Tria, Zeltiq; Travel Expenses Paid By Tria
Rai, Prakash	Pending
Rajadhyaksha, Milind	Ownership Interest with Caliber Imaging and Diagnostics (formerly Lucid)
Regan, Caitlin	No Disclosure
Reich, Hilary	No Disclosure
Barreto Requena, Michelle	Pending
Rhee, Katherine	No Disclosure
Rice, Tyler	Pending
Richardson, Martin	Pending
Riegel, Ronald	Holds Ownership Interest with American Institute of Medical Laser Applications; Served on Advisory Board for LiteCure
Riha, Margo	No Disclosure
Rivers, Jason	Received financial grant from Allergan, Leo, Merz, Regeneron; Received Discount from Allergan, Valeant; Consulting fees received from Allergan, Almirall, Galderma, Leo, Prollenium, Valeant; Travel Expenses Paid By Allergan, Leo, Prollenium, Valeant; Received honoraria for educational services from Allergan, Galderma, Leo, Prollenium, Valeant; Holds Ownership Interest with Riversol; Served on Advisory Board for Allergan, Galderma, Leo; Served on Promotional Speakers Bureau Allergan, Galderma, Prollenium; Served as Officer or Director Canadian Society for Dermatologic Surgery
Rohrer, Thomas	Received financial grant from Allergan, Merz; Received Discount from Syneron-Candela; Received honoraria for educational services from Syneron-Candela; Served on Advisory Board for Syneron-Candela

Name	Disclosure
Rosenthal, Aben	Pending
Ross, E. Victor	Received financial grant from Alma, Cutera, Cynosure, Lumenis, Syneron-Candela; Received equipment from Cynosure; Received Discount from Alma; Consulting fees received from Cynosure, Lumenis, Miramar Labs, Sebacia, Syneron-CandelaCynosure, Ulthera; Travel Expenses Paid By Alma, Cynosure, Cutera, Lumenis
Ross, Gerry	Received honoraria for educational services from Zolar
Ross, Nicholas	No Disclosure
Ross, Jr., Patrick	Pending
Rossi, Anthony	Received financial grant from American Academy of Dermatology, A. Ward Memorial Grant; Consulting fees received from Dynamed, Merz
Rubin, Iris	No Disclosure
Rylander, Chris	Holds Ownership Interest with Dermalucent LLC; Have intellectual property rights with Dermalucent LLC
Sadeghi, Mostafa	Pending
Sadick, Neil	No Disclosure
Saedi, Nazanin	Received financial grant and equipment from Cynosure/Palomar
Sahni, Karan	No Disclosure
Sahu, Joya	Pending
Sajjadi, Amir	Pending
Saikaly, Valery	No Disclosure
Sakamoto, Fernanda Hidemi	Consulting fees received from Living Proof
Saluja, Sandeep	No Disclosure
Santos, Priscila	Pending
Sasaki, Ryosuke	No Disclosure
Satava, Richard	Received financial grant from Institute of Surgical Excellence; Consulting fees received from CAMLS Simulation Center; Travel Expenses Paid By expenses incurred from approximately 75 lectures at various conferences, workshops, societies, and universities; Received honoraria for educational services from Bibb Medical Society, Mercer University; Holds Ownership Interest with InTouch Health, Inc.
Schaefer, Melaine	Pending
Segreto, Roberto	No Disclosure
Serrano, David	Pending
Shanks, Steven	Travel Expenses Paid By Erchonia; Received Salary From Erchonia; Holds Ownership Interest with Erchonia; Have intellectual property rights with Erchonia; Served as Officer or Director Erchonia
Mohammadi Shayan, Arman	Pending
Shek, Samantha YN	No Disclosure
Shen, Lingyue	Pending
Shin, Daniel	No Disclosure
Shumaker, Peter	No Disclosure
Shupp, Jeffrey	No Disclosure

Name	Disclosure
Shuter, David	Holds Ownership Interest with La Lumiere; Have intellectual property rights with La Lumiere; Served on Advisory Board for La Lumiere
Sierra, Heidy	No Disclosure
Sierra, Rafael	Pending
Silva, Gina	Pending
Singh, Selina	Pending
Sliney, David	No Disclosure
Smalley, Penny	No Disclosure
Smith, Brian	No Disclosure
Smith, Zachary	Pending
Smucler, Roman	No Disclosure
Sofen, Bryan	No Disclosure
Sprague, Rebecca	Served on Advisory Board for DUSA, Galderma
Stankiewicz, Kelly	No Disclosure
Starr, Jon	Consulting fees received from Tria
Stoll, Mary	Served as Officer or Director for Cynosure
Stout, Ashlyn	No Disclosure
Sujino, Toshio	Pending
Summers, Erika	No Disclosure
Sun, Victor	Pending
Sykes, Jonathan	Pending
Taghiyar, Leila	Pending
Tan, Wenbin	No Disclosure
Tandon, Shruti	No Disclosure
Tang, Elieza	No Disclosure
Tanghetti, Emil	Received financial grant from DUSA; Received Discount from Cynosure; Consulting fees received from Allergan, Galderma, DUSA, Obagi; Served on Advisory Board for Cynosure, DUSA, Galderma
Tanzi, Elizabeth	Received equipment from BTL, Cutera, Cynosure/Palomar, Lumenis, Valeant/Solta; Consulting fees received from Beirsdorf, Merz; Served on Advisory Board for Clarisonic, Miramar, Zalea, Zeltiq; Served on Promotional Speakers Bureau for SkinCeuticals
Tardivo, J.P.	Pending
Taub, Amy	Pending
Taudorf, Elisabeth	No Disclosure
Teixeira, D. F.	Pending
Temaat, Robbin	Pending
Thaysen-Petersen, Daniel	Pending
Thornton, Julie	No Disclosure

Name	Disclosure
Tkaczyk, Eric	No Disclosure
Tobin, Desmond	No Disclosure
Town, Godfrey	Received Salary From CyDen, GCG Healthcare; Holds Ownership Interest with GCG Healthcare; Served on Advisory Board for Reading Clinical Research; Served as Officer or Director for GCG Healthcare
Trageser, Mary	Pending
Tran, Thanh-Nga	Pending
Tremaine, Anne Marie	No Disclosure
Tretti Clementoni, Matteo	Received financial grant from Lumenis Ltd; Received equipment from Lutronic Ltd; Received Discount from Quanta System; Consulting fees received from Lumenis Ltd - Lutronic Ltd - Galderma; Travel Expenses Paid By Lumenis Ltd - Galderma; Received honoraria for educational services from Lumenis Ltd; Served on Advisory Board for Lumenis Ltd - Lutronic Ltd
Tromberg, Bruce	Pending
Tumilty, Steve	No Disclosure
Uitto, Jouni	Pending
Uusmaa, Petteri	Pending
Uzunbajakava, Natallia Eduarda	Received financial grant from EU comission funded Marie Curie Actions Grant; Travel Expenses Paid By PHILIPS Electronics Nederland B.V.; Received Salary From PHILIPS Electronics Nederland B.V.; Have intellectual property rights with PHILIPS Electronics Nederland B.V.
Valencia, Amy	No Disclosure
van Vlimmeren, Marijke	Pending
Varneon, Gilbert	Pending
Vasily, David B.	Received financial grant from Miramar; Received equipment from Cutera, Lutronic, Miramar, Viora; Received Discount from Cutera, Lutronic; Holds Ownership Interest in Cynosure; Served on Advisory Board for BioLumenX; Served on Promotional Speakers Bureau Cutera, Palomar; Paid study for hair removal from Miramar
Verma, Mahesh	Pending
Vescovi, Paolo	Pending
Vidimos, Allison	Received financial grant from Genentech
Vidovic, Luka	Pending
Viera, Martha	No Disclosure
Vigo, Anelise	Pending
Wachsmann-Hogiu, Sebastian	Pending
Waibel, Jill	Received financial grant from Funded clinical trials from ALMA, Cutera, Harvest Technologies, Loreal/Skinceuticals, Lumenis, Lutronics, Sebacia, Syneron-Candela; Received equipment from Harvest Technologies, Lutronics, Syneron-Candela; Have intellectual property rights with (co-inventor) University of Miami; Served on Advisory Board for Valeant; Served on Promotional Speakers Bureau for DUSA, Loreal/Skinceuticals, Zeltiq
Walker, Jeffrey	No Disclosure
Walkowiak Ventura, Kim	Pending
Wang, Frank	Pending

Name	Disclosure
Wang, Krystle	No Disclosure
Wang, Ruisheng	No Disclosure
Wang, Ying	No Disclosure
Wang, Yucheng	No Disclosure
Wanner, Molly	Consulting fees received from Nu Skin; Served on Advisory Board for Nu Skin
Weiss, Elliot	No Disclosure
Weiss, Margaret	Pending
Weiss, Robert	Received financial grant from Allergan, Cabochon, Cynosure/Palomar, Fibrocell, Galderma, Medicis, Merz, Revance, Sapheon; Received equipment from BTL Industries, CoolTouch, Cynosure/Palomar, Syneron-Candela; Consulting fees received from CoolTouch, Medicis; Travel Expenses Paid By Allergan, BTL Industries, CoolTouch, Cutera, Cynosure/Palomar, Fibrocell, Galderma, Merz, Skinceuticals; Served on Advisory Board for Skinceuticals; Served on Promotional Speakers Bureau for Cynosure/Palomar
Welge, Weston	No Disclosure
Westgate, Gill	Consulting fees received from Philips Electronics Ltd; Received Salary From Westgate Consultancy Ltd; Served as Officer or Director for Westgate Consultancy Ltd
White, Sean	Pending
Wilder-Smith, Petra	No Disclosure
Wind, Bas S	No Disclosure
Wink, Cherie	No Disclosure
Wolfsen, Hebert	Pending
Wolkerstorfer, Albert	No Disclosure
Woodward, Julie	Received financial grant from Elure/Syneron; Received equipment from Lutronic; Received Discount from Merz, Skinceuticals; Consulting fees received from Merz, Skinceuticals; Travel Expenses Paid By Lutronic, Merz, Skinceuticals; Received Salary From Merz, Skinceuticals; Served on Advisory Board for Merz, Skinceuticals
Wu, Defeng	No Disclosure
Wu, Douglas	Pending
Wu, Min	Pending
Wu, Thinh	Pending
Wu, Xingjia	Pending
Wulf, Hans C.	Received financial grant from Leo Pharma; Travel Expenses Paid By Galderma; Received honoraria for educational services from Galderma
Yadav, Neha	No Disclosure
Yaghmai, Dina	No Disclosure
Yang, Bruce	Pending
Yang, Owen	No Disclosure
Yaroslavsky, Anna	Pending
Yeung, C.K.	Pending
Yodh, Arjun	No Disclosure

Name	Disclosure
Yu, Bing	Pending
Zachary, Christopher	Received equipment from Cynosure, Lutronic, Solta, Zimmer; Consulting fees received from Cutera; Travel Expenses Paid By Amgen, Zeltiq; Served on Advisory Board for Amgen, Arbonne, Cutera, Zeltiq
Zebert, John	Pending
Zeitouny, Mounir	No Disclosure
Zelickson, Brian	Received financial grant from Miramar, Newton Medical, Siena Lab, Zeltiq; Received royalties from Alma, Candela, Syneron; Holds Ownership Interest with Newton Medical, Sienna Lab; Have intellectual property rights with Newton Medical; Served on Advisory Board for Candela, Lumenis, Ulthera, Zeltiq
Zezell, Denise	No Disclosure
Zhang, Quan-Guang	No Disclosure
Zhao, JianXin	No Disclosure
Zhou, Guoyu	Pending
Zhu, Hong	No Disclosure
Zhuang, Anne	No Disclosure
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